Pension schemes and pension projections in the EU-27 Member States — 2008-2060

Volume II—Annex

Economic Policy Committee (AWG) and Directorate-General for Economic and Financial Affairs
PENSION SCHEMES AND PENSION PROJECTIONS IN THE EU-27 MEMBER STATES — 2008-2060

Volume II — Annex
Belgium

Description of the pension projection model and its database

1.1. Institutional context

For Belgium, the MALTESE system of models, developed at the Federal Planning Bureau, produces projections of pension expenditure of the first pillar (national methodology\(^1\)). As part of other (non AWG) projection activities, this model also provides projections for other kinds of social expenditure as well as for the total Belgian government's budget.

In 1987, at the request of the government, the Federal Planning Bureau started developing the Maltese system of models in order to assess long-term social expenditure within the overall framework of public finance. This was done within the framework of the statutory mission of the FPB to support economic policy-making.

Since 1987, the Maltese system of models has been constantly developed and sophisticated.

Between 1987 and 2001, it was used several times, either on the initiative of the FPB or to support economic policy-making (especially for measuring the impact of various statutory public pension reforms in Belgium: 1990, 1996).

In 2001, the Law “guaranteeing a continuous reduction in public debt and the setting up of the Ageing Fund” was ratified. The goal of the Fund is to build up a demographic reserve to finance the supplementary expenses pertaining to the statutory pension schemes due to ageing during the period 2010-2030, as long as the public debt has been reduced to 60% of GDP. This Law also created the Study Committee for Ageing, which has to publish a yearly report about the budgetary and social implications of ageing (estimate of the budgetary cost of ageing and specific studies). The Federal Planning Bureau has been entrusted with the technical and administrative secretariat of the Study Committee for Ageing. So every year, the MALTESE system of models is applied to produce a long-term projection of all social expenditure for the yearly report of the Study Committee for Ageing. Then, the department « Borrowing requirements of the Public Sector » of the High Council of Finance provides his yearly Advice with recommendations for budgetary policy, based on the annual report of the Study Committee for Ageing. And finally, the Federal Government supplies a yearly « Memorandum on Ageing » which is based on the annual report of the Study Committee of Ageing and the annual Advice of the department « Borrowing requirements of the Public Sector » of the High Council of Finance.

1.2. General description of the whole model

1.2.1. Type and structure of the whole model

MALTESE is a system of meso-economic models with one central model and several specific peripheral models (computing the number of pensioners, average pensions, health care, etc.).

\(^1\) Pension expenditure is projected using the MALTESE model but based on the AWG assumptions.
The global accounting frame of the system relies on the national accounts. The central model as well as the peripheral models are accounting models adequate for translating demographic projections into budgetary developments like social security account and overall public finance account. Special attention is paid to modelling social expenses according to the calculation rules (legislation), often by scheme, gender, age and categories for the number of beneficiaries (new and other) and the corresponding average benefits (ceiling, minimum, indexation rules, etc.). A very detailed database is used for this purpose. The baseline assumes no change in legislation, rules or policy.

Below, the characteristics specifically relevant to the pension projection appear in bold.

The projection proceeds in five steps:

- The **first step** is the projection of the population by age and gender given the hypotheses about fertility rates, life expectancy and migration flows.

- Given the behavioural hypotheses, legal parameters of eligibility and the macroeconomic framework, the population is, in a second step, split into different **socio-economic groups**: school population, labour force (working and unemployed), elderly long-term unemployed, people on a full-time career break, disabled persons, pensioners, early retirement (pre-pension), and other non-participating population (see the appendix for the sources of data). This socio-economic projection results from transition probabilities from one status to another one. It is a generalisation of the AWG methodology which is used to produce the labour force projection. The participation and retirement behaviours of the different generations in the different age and gender classes are based on assumptions regarding participation rates and on present retirement behaviour, taking into account the effects of the multiple reforms. The socio-demographic projection leads to a coherent projection of the number of beneficiaries in the different social security schemes.

- In a third step, the benefits in the various schemes are projected on the basis of the number of beneficiaries and of the different institutional arrangements (wage ceilings, adjustment to living standards, etc.). Average benefits are calculated by branch, gender, age groups and categories, except for healthcare expenditure (which depends on private consumption of healthcare by age group and gender and on GDP growth).

- In a fourth step, the dynamics of the benefits obtained in the third step are applied to the corresponding aggregates of national accounts.

- Finally, the social security expenditures are included in a projection of the public budget. This consolidation of the social security sector with the rest of public finance is necessary because of several links between the social security budget and other aspects of the budget. Firstly, social expenditure is not only financed by contributions, but also by social security taxes and transfers from the federal budget. Secondly, the civil servants' pensions are financed by the federal budget. Finally, the Ageing Fund is supposed to be fed with funds that are obtained from a continuing reduction of the public debt. As for projections with “no change in policy” scenarios, average tax and contribution rates are assumed to be constant over time, as are the calculation rules of the social benefits. The evolution of all revenues and primary expenditure leads to the calculation of public debt and interest payments.

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2 As defined by the AWG.
1.2.2. Coverage of the whole model

Starting from a demographic projection, the whole model generates the evolution of expenditure in the different social security schemes (see box below), given socio-demographic and macroeconomic scenarios.

The pension model for those AWG pension projections specifically covers the pensions, the disability allowances after one year and the “prepension” benefits, all of which appear in bold in the box below.

<table>
<thead>
<tr>
<th>The various social expenditures in the MALTESE system of models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pensions:</strong></td>
</tr>
<tr>
<td>- wage earners</td>
</tr>
<tr>
<td>- self-employed</td>
</tr>
<tr>
<td>- civil servants</td>
</tr>
<tr>
<td>- assistance scheme</td>
</tr>
<tr>
<td><strong>Health care</strong></td>
</tr>
<tr>
<td>- acute care</td>
</tr>
<tr>
<td>- long-term care</td>
</tr>
<tr>
<td><strong>Disability allowances</strong> (wage earners and self-employed)</td>
</tr>
<tr>
<td>- primary disability allowances (first year)</td>
</tr>
<tr>
<td>- disability allowances (subsequent years)</td>
</tr>
<tr>
<td>- maternity</td>
</tr>
<tr>
<td><strong>Unemployment benefits</strong> (wage earner scheme)</td>
</tr>
<tr>
<td><strong>“Prepension”</strong> (wage earner scheme)</td>
</tr>
<tr>
<td><strong>Family allowances</strong> (wage earner scheme, scheme for the self-employed, civil servants’ scheme)</td>
</tr>
<tr>
<td><strong>Other social expenditures</strong> (mainly subsistence support, accidents at work, work-related illness)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
</tr>
</tbody>
</table>

1.2.3. Assumptions made in the AWG labour force projection

The projection of the labour force is given by the AWG (employment and unemployment) on the basis of the Eurostat Statistics. Importing this AWG projection in the MALTESE system raises two main issues. Firstly, the MALTESE system normally produces a consistent projection of the different socioeconomic groups (not only the labour force but also disabled persons, pensioners, “prepensioners”, etc.) which is an important feature for simulating the evolution of the number of pensioners. Secondly, this socioeconomic projection results in an exhaustive breakdown of the population by age and gender for each projection year, which ensures the consistency between the demographic and the socioeconomic projection. Both properties of the MALTESE system implied making use of the original data and definitions concerning the socioeconomic groups, in particular the administrative employment and unemployment data. Otherwise, the transition probabilities from the labour force and from employment to other socioeconomic statuses - retirement in particular – would have had to be reestimated, and the consistency of the demographic and the socioeconomic projections, on the other hand, would have been lost.
As far as employment is concerned, the projection takes up the AWG’s evolution of the employment rates broken down by 5-year age groups. This means that an increase of one percentage point of the employment rate according to the Eurostat concept is translated into an increase of one percentage point of the employment rate following the administrative concept. However, between 60 and 64 years, the original dynamic of the model is maintained, which is guided by the early retirement in old age pension.

As regards unemployment, for the age groups under 50 years, the approach is similar to that used for employment: the growth of the administrative unemployment rate follows the growth of the Eurostat unemployment rate given by the AWG (a decrease of one percent of the Eurostat unemployment rate is translated into a decrease of one percent of the administrative unemployment rate). However, for the older age groups (50-54 and 55-59 years), the Eurostat and the administrative unemployment rates are very different: the Eurostat unemployment rates are very low while the administrative rates are very high. So the administrative unemployment rates have been much more reduced in those age groups, but without any consequence on the number of pensioners. Between 60 and 64 years, the original dynamic of the model is maintained. Globally, both Eurostat and administrative unemployment rates decrease by about 20%.

1.3. Assumptions and methodologies applied: the pension model

1.3.1. Number of pensioners

The fundamental principle which is used to model the number of pensioners is to let the existing number of pensioners get old and to add new pensioners based on recent “entry behaviour” (transition probabilities from one status to another one).

The projection of the number of pensioners is carried out at a disaggregated level per scheme, gender and age or age group.

a. Entries in the old age pension scheme

Entries in old age pension mainly happen between 60 and 65 years. The legal retirement age is 65 years. As far as men are concerned, the overall pension rate at 65 years (number of pensioners in the first pillar to the population of 65 years) is kept constant (because of the practically universal character of the legal pension). For women, a “total coverage rate” at 65 years is defined and also supposed constant. This “total coverage rate” is the ratio of the number of women with their own pension (old age or survivor’s pension) or with their husband’s (at the family rate, which is a higher rate if the spouse has no income) to the overall number of women aged 65.

The distribution by scheme (wage earner, self-employed and civil servants) of the beneficiaries at 65 years is determined according to the historical evolution of activity by scheme of the corresponding generation. The entry profile in old age pension between 60 and 65 years depends on the socio-economic make-up of the population at 59 years. Depending on the socioeconomic status at 59 years (employment, unemployment, “prepension” or disability) and on the scheme, retiring is done at varying ages: for example, people in work retire younger than the beneficiaries of a disability allowance.
b. Entries in the survivor’s pension scheme

Before the age of 60, (female) entries in the survivor’s pension scheme are determined by scheme and 5-year age group, in function of the evolution of the female labour force, the widowed population and the distribution by scheme of the male labour force of the same age group.

From the age of 60 onwards, the number of new female pensioners in the survivor’s pension scheme is determined by the number of deceased (married) male pensioners in the scheme in question.

c. Entries in prepension

Entries in the prepension system are calculated on the basis of an entry probability by age and sex based on the number of wage earners.

d. Entries in disability

The methodology implies that the disability rates (the shares of disabled persons per sex and age category in the demographic population) are calculated using the principle of cohorts. Firstly, the entry probabilities in the primary disability benefit system (disabled for less than a year, not taken into account in the results of pension expenditure) are calculated from the potential active population\(^3\). Then the entry probabilities in the disability benefit system (disabled from one year) are calculated from the primary disabled category. The number of primary disabled and disabled persons by age category and sex are computed by applying these rates to the demographic projection. The distribution of the number of primary disabled and disabled persons over the wage earner scheme and the self-employed scheme is carried out proportionally to the number of workers in the respective schemes.

1.3.2. Average pension

The average pension amount in the different pension schemes is estimated by modelling as accurately as possible the main legislative parameters for the successive cohorts of persons entitled to a pension. For each pension scheme (wage earner, self-employed, civil servants), an average pension is estimated for each career profile (full career or not, retirement age), each category and according to the legal replacement rate (in the wage earner and self-employed schemes).

The evolution of these shares depends on the socioeconomic and macroeconomic projections: for instance, the increase in the female participation rate results in a growing number of women building up full pension rights. As a consequence, a growing number of pensioners, both in the wage earner and self-employed schemes, claim a pension for ‘singles’, which is calculated at a lower legal replacement rate, instead of a pension at family rate.

Furthermore, the projection of the unemployment rate, of the early retirement rate, etc. affects the development of a full-time career. The hypothesis concerning productivity growth has also an impact on the evolution of the average pension amounts through the wages. This effect occurs faster in the case of public pensioners, because their reference wage is calculated on the basis of the incomes over the last five working years. As far as employees and self-employed people are concerned, this wage evolution only appears in the long term as their

\(^3\) Working and unemployed people, people in pre-pension and full-time career break.
pension is calculated on the basis of the average income over their whole career, which, at the start of the projection period, is almost completely situated in the past.

The income distribution is supposed to remain constant in the projection. It is used, among other things, to compute the percentages of recipients with incomes above the wage ceiling and below the minimum pension.

In the wage earner scheme, the number of the beneficiaries of a minimum claim per working year rises, unlike the number of people entitled to a guaranteed minimum pension, because the adaptation to living standards of the minimum claim per working year is higher than this applied to the guaranteed minimum pension.

In the wage earner scheme, the average prepension (only the part paid by the National Employment Office) and disability benefits are calculated per gender and age group, taking into account the respective ceilings. Disability allowances in the self-employed scheme are lump-sum benefits.

### 1.3.3. Social policy hypotheses

The social policy hypotheses used in the model concern the growth of wage ceilings, the adaptation to living standards of the non lump-sum benefits, the real growth of lump-sum benefits and the indexation to wages of public sector pensions.

The Generation Pact introduces the principle of an adaptation to living standards of the replacement benefits (not only pensions). This (biennial) mechanism works in two steps. First, the disposable budget by scheme (wage earners and self-employed) is calculated, it is equivalent to the increase of:
- wage ceilings (and minimum claim wage-earner pensions) by 1.25% per year;
- earning-related benefits by 0.5% per year;
- lump-sum benefits (including minimum benefits) by 1% per year.

In a second step, concrete measures of adaptation to living standards are proposed by social partners. These measures have to respect, in each scheme, the global financial constraint that is mentioned above. However, they can be aimed in each scheme at specific sectors, categories of beneficiaries or types of allowances. For the years 2007 and 2008, the projection takes into account all the measures decided by the social partners and the government. From 2009 onwards, social allowances are adapted according to the general principle of disposable budget’s calculation (+1.25% for wage ceilings...).

The indexation to wages of public sector pensions implies that the wage increases for active civil servants are mirrored in the pensions of the retired civil servants. Historically, average pension increases have been 0.5% lower than the corresponding growth in wages. Additionally, there is a tendency for wage increases to take forms which bypass, at least partially, the indexation to wages of civil servants pension scheme.

### 1.3.4. Data used

From a general point of view, the model is fully consistent with the Belgian national accounts and covers all expenses of the global public finance account.
The next table presents the data sources used in MALTESE for the number of beneficiaries, the pension expenditures and the tax on pension.

Administrative sources are used for the number of beneficiaries and the detailed benefits (gender, age, minimum or not...). But finally, the pension expenditure results match the national accounts.

### Table 1 Sources of pensions data (beneficiaries and expenses)

<table>
<thead>
<tr>
<th>Administrative data concerning beneficiaries and benefits</th>
<th>National Office for Pensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepension (wage earner scheme)</td>
<td>National Employment Office</td>
</tr>
<tr>
<td>Disabled population (wage earner and self-employed schemes)</td>
<td>National Institute for Disability and Sickness Insurance</td>
</tr>
<tr>
<td>Pension:</td>
<td></td>
</tr>
<tr>
<td>- wage earner scheme by category</td>
<td>National Office for Pensions</td>
</tr>
<tr>
<td>- self-employed scheme by category</td>
<td>National Office for Pensions</td>
</tr>
<tr>
<td>- civil servants scheme by category</td>
<td>National Institute for the Social Security of the Self-Employed</td>
</tr>
<tr>
<td>Guaranteed income for elderly people</td>
<td>Pension Administration Office</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>National accounts: expenditure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pensions (wage earner, self-employed, civil servants, GIEP)</td>
<td>National Accounts</td>
</tr>
<tr>
<td>Prepension</td>
<td></td>
</tr>
<tr>
<td>Disability</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tax on pension</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributions paid by pensioners</td>
<td>National accounts</td>
</tr>
<tr>
<td>Personal income tax</td>
<td>Estimation for the year 2005 from the Research and Documentation Department of the Federal Public Service Finance</td>
</tr>
</tbody>
</table>

### 1.3.5. Reforms incorporated in the model

All the reforms mentioned under point 1.2. of the Belgian country fiche⁴ are integrated in the projection.

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⁴ See the Report.
Appendix: Data sources of the socioeconomic projection of the MALTESE model

The basic idea is to perform an exhaustive and consistent breakdown of the projected population into different socioeconomic groups which are important for the projections. The projection of the labour force - which is at the basis of the projection of the economic growth - is thus consistent with the projection of the socioeconomic groups receiving social benefits.

The four major socioeconomic groups that are identified in the MALTESE model are the following: the school population, the potentially active population (further subdivided into employment by professional status, unemployment, prepension and full-time career break), the disabled population (subdivided in primary disability and disability) and the pensioners.

Data for the different relevant socioeconomic groups come from administrative records issued by the various competent social security bodies (see next table). In contrast to this approach, groups may be based on a single source (like the Eurostat Labour Force Survey, LFS in short). However, not all types of social security beneficiaries and socioeconomic categories are readily discernible by means of the LFS.

All the data are collected by gender and age groups of 5 years, sometimes even per age year.

<table>
<thead>
<tr>
<th>Socioeconomic groups</th>
<th>Sources of data</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>School population</td>
<td>Labour Force Survey, NIS of Belgium</td>
<td></td>
</tr>
<tr>
<td>Potentially active population</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- full-time career breaks</td>
<td>National Employment Office</td>
<td></td>
</tr>
<tr>
<td>- prepension</td>
<td>National Employment Office</td>
<td></td>
</tr>
<tr>
<td>- older unemployed exempt from job search requirements</td>
<td>National Employment Office</td>
<td></td>
</tr>
<tr>
<td>- unemployed people job-seekers</td>
<td>National Employment Office</td>
<td></td>
</tr>
<tr>
<td>- employment: wage earners</td>
<td>National Accounts and Crossroads Bank for Social Security for the breakdown by sex and age groups</td>
<td>Beware: the definitions differ from those used in the LFS and by the AWG</td>
</tr>
<tr>
<td>- employment: self-employed persons</td>
<td>National Accounts and Crossroads Bank for Social Security for the breakdown by sex and age groups</td>
<td>Beware: the definitions differ from those used in the LFS and by the AWG</td>
</tr>
<tr>
<td>- civil servants (with a distinction between statutory and non statutory)</td>
<td>National Accounts and Crossroads Bank for Social Security for the breakdown by sex and age groups</td>
<td></td>
</tr>
<tr>
<td>Disabled population (primary disability and disability):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- wage earner scheme</td>
<td>National Institute for Disability and Health Insurance</td>
<td></td>
</tr>
<tr>
<td>- self-employed scheme</td>
<td>National Institute for Disability and Health Insurance</td>
<td></td>
</tr>
<tr>
<td>Pension beneficiaries:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- wage earner scheme by category</td>
<td>National Office for Pensions</td>
<td></td>
</tr>
<tr>
<td>details about the career</td>
<td>sample from the National Office for Pensions</td>
<td></td>
</tr>
<tr>
<td>- self-employed scheme by category</td>
<td>National Office for Pensions</td>
<td></td>
</tr>
<tr>
<td>Details about the career</td>
<td>National Institute for the Social Security of the Self-Employed</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>- Civil servants scheme by category</td>
<td>Pension Administration Office</td>
<td></td>
</tr>
<tr>
<td>Details about the career</td>
<td>Pension Administration Office</td>
<td></td>
</tr>
<tr>
<td>Guaranteed income for elder people</td>
<td>National Office for Pensions</td>
<td></td>
</tr>
</tbody>
</table>
Bulgaria

Description of the pension projection model and its input data

The Bulgarian pension model was elaborated by the NSSI, which maintains, updates and uses the model. The model is deterministic, written and run under the Visual Basic Excel application. The model is based on historical demographic and pension data. It enables the NSSI to make long-term projections and simulate the impact of changes in all the relevant parameters of the current pension system. Outputs of the model were used in the Convergence Programmes of the Republic of Bulgaria and the National Strategies for Adequate and Sustainable Pensions of the Social Protection Committee.

These projections were not submitted for peer reviews.

– Assumptions and methodologies applied

The projections included in this pension fiche are based on EUROPOP 2008 population, prepared by EUROSTAT and the Commission’s Baseline macroeconomic assumptions.

– Demographic assumptions

As input data the model uses the latest available statistical data for 2007 for population by sex and single age groups, fertility and mortality rates, type of social insurance and insurance income. These data are provided by the National Statistical Institute (NSI) and the NSSI’s Personal Register of Insured Persons. The model was used for making a demographic projection. The assumptions for fertility and mortality rates and net migration are consistent with EUROSTAT EUROPOP 2008 population projections.

Table 11: Demographic Assumptions

<table>
<thead>
<tr>
<th>Indicators</th>
<th>2008</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population /at the beginning of the year/</td>
<td>7 642 185</td>
<td>7 173 577</td>
<td>6 726 804</td>
<td>6 273 155</td>
<td>5 815 432</td>
<td>5 283 081</td>
</tr>
<tr>
<td>Life expectancy at birth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- male</td>
<td>69.71</td>
<td>72.83</td>
<td>75.49</td>
<td>77.51</td>
<td>79.62</td>
<td>81.56</td>
</tr>
<tr>
<td>- female</td>
<td>76.69</td>
<td>79.28</td>
<td>81.27</td>
<td>83.13</td>
<td>84.86</td>
<td>86.47</td>
</tr>
<tr>
<td>- male</td>
<td>69.45</td>
<td>71.76</td>
<td>73.86</td>
<td>75.94</td>
<td>78.14</td>
<td>80.32</td>
</tr>
<tr>
<td>- female</td>
<td>76.53</td>
<td>78.42</td>
<td>80.14</td>
<td>81.85</td>
<td>83.65</td>
<td>85.46</td>
</tr>
<tr>
<td>Total fertility rate</td>
<td>1.38</td>
<td>1.42</td>
<td>1.46</td>
<td>1.49</td>
<td>1.52</td>
<td>1.55</td>
</tr>
<tr>
<td>Net migration</td>
<td>-1 377</td>
<td>242</td>
<td>-477</td>
<td>2 483</td>
<td>1 605</td>
<td>-1 178</td>
</tr>
</tbody>
</table>

Source: EUROSTAT

The development of the old-age dependency ratio for Bulgaria shows that the demographic changes in the structure of the population will deepen and the process of ageing will raise the challenges posed by the population ageing.
– Macroeconomic assumptions

The projections of the pension expenditures are based on the macroeconomic scenario prepared by the Commission’s Services according to the standard methodology applied to all EU Member States. Among the main indicators included in the projection are GDP, unemployment rate, participation rate (15+), etc. Productivity is modelled as a ratio between GDP growth and Labour Force growth. This indicator is used to determine the real growth of insurance income.

Table 12: Macroeconomic assumptions

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP (EUR bln.)</td>
<td>28.9</td>
<td>45.6</td>
<td>55.5</td>
<td>64.5</td>
<td>69.3</td>
<td>73.9</td>
</tr>
<tr>
<td>Labour Force Participation Rate (15-64) Baseline</td>
<td>66.8%</td>
<td>70.3%</td>
<td>69.0%</td>
<td>68.0%</td>
<td>67.9%</td>
<td>69.3%</td>
</tr>
<tr>
<td>Employment - Baseline</td>
<td>3 307</td>
<td>3 147</td>
<td>2 847</td>
<td>2 513</td>
<td>2 159</td>
<td>1 948</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>6.9%</td>
<td>4.7%</td>
<td>4.7%</td>
<td>4.7%</td>
<td>4.7%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Inflation</td>
<td>8.4%</td>
<td>2.0%</td>
<td>2.0%</td>
<td>2.0%</td>
<td>2.0%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Real GDP growth</td>
<td>6.3</td>
<td>2.4</td>
<td>1.7</td>
<td>1.4</td>
<td>0.3</td>
<td>0.8</td>
</tr>
<tr>
<td>TFP growth</td>
<td>1.2</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Capital deepening (contribution to labour productivity growth)</td>
<td>2.7</td>
<td>1.6</td>
<td>1.0</td>
<td>1.0</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Source: DG ECFIN

The unemployment rate is a result of the changes in the labour supply and in the employment rate - it will drop to 4.7% in 2010 and it will remain stable until the end of projection period.

GDP growth will exceed 5% annually in 2007-2010, afterwards it will gradually decelerate. Lower dynamic of the labour productivity will cause GDP growth to slow down to 2.4% in 2020. The decreasing number of employed people in the following years will lead to even lower GDP growth, which will reach 0.8% in 2060.

– Assumptions concerning pension insurance
Pensions are indexed according to Art. 100 of the SIC on the basis of 50% of nominal growth of insurance income and 50% of the allowable for the projections „technical” inflation which is 2%.

The social pensions for old age, minimum pension for periods of insurance and old-age and maximum amount of pensions are projected on the basis of current legislation. Social pension for old age is determined by the Council of Ministers. Up to 1.07.2007 the minimum pension for periods of insurance and old age was set to 115% of the social pension for old age, while currently the amount of minimum pension for periods of insurance and old-age is defined on annual basis in the Law on the PSI Budget. The amount of maximum pension is 35% of maximum insurance income in the country for the previous year. The model does not project the minimum pension for periods of insurance and old age, as it is exogenously defined in the annual Law on the PSI Budget. Therefore, the results of the model are not based on the ‘minimum’ public pensions projections.

The social insurance contributions for the mandatory second pillar (for the whole projection period for all persons born after 31 December 1959) are projected to account for 5% of the social insurance contribution for the Pension Fund. As of 1 January 2009 the distribution of social insurance contributions between Pension Fund and UPF for the abovementioned people will be 25 to 5% of the insurance income.

As of 1 January 2009 until the end of projection period the retirement age for women will be 60, and for men – 63 years of age.

As of 1 January 2009 the pension rights for the PSI are attained when men gather 100 points (63 years of age and periods of insurance - 37 years) and women 94 points (60 years of age and periods of insurance of 34 years). However, many workers will not be able to retire until they reach 65 unless they have at least 15 years as periods of insurance, 12 of them real. The right to life pension from the UPF persons is attained after the accomplishment of all conditions applied to the PSI. It is expected that pension benefits from second pillar will be paid for the first time in 2021. Under certain conditions persons may receive pension from the UPF 5 years earlier than statutory retirement age.

The model does not examine early retirement schemes under the 1st pillar because after 2011 they will be incorporated in the 2nd pillar PPF (PPF schemes are outside the model, and with limited scope).

Data used to run the model

Most data come from the Personal register of NSSI, which is in charge of disbursing pension and social insurance benefits, after the collected revenues was transferred from the National Revenue Agency (NRA) to the PSI budget. The model use data for:

- GDP; Average monthly wage;
- Unemployment rate;
- Employment growth rate;
- Productivity growth;
- Annual average inflation;
- Real interest rate;
- Employment rate;
- Participation rate;
- The number of pensions disaggregated by age and gender;
- The number of new pensions (by age and sex);
- Average pension (by age and sex);
- Insurance income by gender, age, type of insurance.

Apart from the above mentioned indicators, the model requires a population projection (disaggregated by single age and sex), assumptions on the growth rate of the average wage, inflation, working population, employment and unemployment rates, real interest rate, productivity, etc.

The data for insured persons are reported by the NSSI Personal Register of Insured Persons, because in the National Accounts’ data may lead to overestimation of the insured/working persons.

The data for working population are reported under the Labour Force Survey compiled by the National Statistical Institute. These data is preferred instead of the National Accounts data due to the fact that the latter are totally incomparable with the LFS data, which might result in big disparities between historical and projected data.

As historical data the model uses last year’s available data for the abovementioned indicators.

- Incorporation of recent reforms

All reforms described in part one of this fiche are included in pension projections.

All pension reforms embedded in the national legislation are taken into account.

--General description of the NSSI model for forecasting the long-term status of the public social insurance funds

In relation to the new amendments to the social insurance legislation and the elaboration of the Mandatory Social Insurance Code in 2000, a Long-term Forecasting Model of the PSI Funds was devised. The model was elaborated by John Wilkin, an actuary engaged by the World Bank, and the “Statistics, Actuarial Analysis and Forecasting” Department staff at the NSSI. In 2002 the model was fundamentally updated (with respect to the launch of universal pension funds for supplementary mandatory insurance) and currently reflects the present PSI status. It is deterministic and is elaborated in Visual Basic for Applications (VBA) for Microsoft Excel. The model forecasts are based on many parameters – data and selected legal provisions according to the Social Insurance Code. It can make forecasts for an 80-year period, and forecasts on the status of PSI funds, it can also make demographic forecasts and forecasts on supplementary mandatory pension funds.

The main macroeconomic assumptions in this model, serving as input to short-term forecasts, are consistent with the Ministry of Finance and AEAF macroeconomic forecasts on: labour productivity growth, GDP growth, CPI changes, real wage changes, interest rate, unemployment rate, etc.

The input data for the model comprises the reported information on the PSI in the NSSI information system – number of PSI Funds, insured persons and beneficiaries (consumers); PSI Funds revenues and expenditures, etc; NSI statistical data (GDP in nominal and real terms; population and its demographic characteristics; annual average wage by sex and occupation; number of unemployed etc. for the year preceding the first year of the forecast).

The main model input parameters and results are presented in Microsoft Excel tables:

1. The Assumptions Table containing the main economic assumptions; parameters of the current legislation and the amendments in the SIC, forming the basis for the calculations.
2. The PSI Funds Operations Forecast Table, as main table, displays the cash flows (revenues and expenditures) of the Funds for each year of the period under review. It contains more specifically:

- GDP in nominal terms; Social insurance base, being the sum of social insurance wages for insured persons of all categories;
- Insurable income, equal to the sum of social insurance wages for insured persons of all categories adjusted with the amount of compliance;
- Revenues, equal to the sum of social insurance contributions and other fund revenues;
- Expenditures, equal to the sum of pensions and short-term benefits expenditures and administrative expenditures;
- Annual funds balance change equal to the difference between funds revenues and expenditures;
- End-of-year funds balance equal to the difference between funds revenues and expenditures on an accrual basis;
- Funds ratio, equal to the end-of-year funds balance to annual funds expenditures ratio;
- Required funds ratio, equal to the funds reserve required to ensure servicing pensions expenditures for the adopted minimum period;
- Actuarial balance, being the difference between annual rate of revenue and the annual rate of expenditure related to social insurance contributions;
- Expenditures as a percentage of GDP, equal to the annual funds expenditures to annual GDP ratio.

3. The Main indicators influencing the PSI Funds Table, containing the main demographic and economic indicators, which influence the trends in the annual fund actuarial balance during the period under review. It contains more specifically:

- Population; number of insured persons; number of pensioners;
- Dependency ratio; pensioners ratio, being the number of fund pensioners to the number of insured persons;
- Average insurance income for insured persons; average pension;
- Replacement ratio, being the average pension to the average social insurance income ratio;
- Social insurance compliance rate;
- Calculated required contribution rate, being equal to the replacement ratio, multiplied by the dependency ratio and divided by the social insurance contributions collection rate.

4. The Active Population Table, containing population, aged above 15; labour force dynamics (participation rate; number of unemployed and employed) and insured persons by type of social insurance for each year of the period under review.

5. Second Pillar Assumptions Table, containing the main assumptions, linked to Supplementary Mandatory Social Insurance (the second pillar) with a direct impact on PSI. For the second pillar pensions a specified size of the contributions is defined; the
contributions are collected in individual accounts every year. The accounts are modified annually with underlying interest rate and administrative costs rate. On retiring, the monthly pension is calculated on the basis of the accumulated amount in the individual account of the insured person, interest rate and average life expectancy. When the second pillar was launched, a portion of the first pillar social contribution was transferred to that in the second pillar. The Fund's operating costs are calculated as 5% of every social contribution and 1% annually of the Fund's net assets. Every year an interest rate for the contributions accumulating period and for the contributions reimbursing period is introduced. The model uses social insurance contributions by year, by labour category and by contribution type (whether transferred from the first pillar or being supplementary for the second pillar only). Some of the assumptions are fixed, i.e. registered only in the base year, while others change every year of the period under review.

6. Second Pillar Fund Operations Table, showing the status of the Supplementary Mandatory Social Insurance Funds every year of the period under review. It contains more specifically:

- Second pillar revenues, including revenues from social insurance contributions and interest revenues;
- Second pillar expenditures, including pensions (old age and inheritable) and administrative expenditures;
- Funds growth, being the difference between the funds’ annual revenues and expenditures;
- Funds balance, being the difference between the funds’ annual revenues and expenditures on an accrual basis.

- Additional model characteristics relevant to understand the projection results

   Number of different persons modelled per generation – the model makes the projection for each year for:

   1. Population of Bulgaria by gender and age;
   2. Insured persons by type of insurance, gender and age;
   3. Pensioners by type of benefits, gender and age.

   The model contains the data for new pensioners as of 31 December, for the calendar year preceding the starting year of the projections, for the following parameters:

   1. Income distribution in 15 groups;
   2. The divisions of pensioners by gender, age, labour category and periods of insurance.

   This data are updated every year and are used as a base for computing the number of new pensioners and the amount of their pensions for each year of the projections.

   The periods of insurance is computed for each year of projections on the basis of the statutory retirement age for different labour categories and on the basis of gender. Replacement rate of new retirees is computed as a ratio between new average pension and average insurable income.
The survivors’ pensions are computed on the base of registered deaths every year and the current status of the survivors pensions from the year preceding the starting year of the projection.

The statutory retirement age by gender and labour category is the starting parameter of each year of the forecast. The model contains data on the number of existing old age pensions by category of worker, age, and sex. These data are used to determine prevalence rates by category of worker for old age pensions. The model determines prevalence rates (as a percent of the population) for each type of pension and pension component by age and sex. The model uses these prevalence rate to project the number of pensioners.

ζ Summing up and conclusions
To sum up, this pension fiche has to provide an overview of the model and methodology used by Bulgaria for the purpose of pension spending projections, contributions, pensioners and the number of contributors as requested by the Ageing Working Group. In addition, a description of the Bulgarian pension system is also included.

National pension projections indicate that public pension spending in Bulgaria will rise as a share of GDP from 8.3% in 2007 to 11.3% in 2060. This development is mainly due to the increase of Old age and Early pensions that are projected to contribute 3.1p.p. to this 3-percentage point change (the contribution of other pensions for the period 2008-2060 is negative -0.2 p.p.). Unfavourable demographic development in the country over the longer run is the main reason for these increases of spending as a percentage of GDP.

Bulgaria is faced with the adverse effects of population ageing in terms of its ability to meet the resulting budgetary challenges. For the whole projections period public pension system is on deficit that has to be financed by the central government budget. In order to improve the financial position of the pension system amendments in the legislation aiming at the establishment of the Silver Demographic Reserve Fund are expected.

The need for appropriate and timely policy responses is urgent. These measures may include the rise of statutory retirement age; encouraging longer stay on the labour market for older persons; increase of insurance base through increase of insured persons and insurance income for easing of age-related spending pressures in the future. Furthermore, the Bulgarian government expects to maintain the existing low levels of debt and unemployment, improving labour force participation rates and supporting the economy’s long-term growth potential by means of strategic public investments.

ζ References
Bulgarian Convergence Programme 2006-2009;
EUROSTAT EUROPOP 2008;
DG ECFIN Macroeconomic Scenarios for Bulgaria;
Draft Law on the Silver Demographic Reserve Fund
European Commission (2008), Economic Policy Committee, *Suggested structure for the country fiche on pension*,


Law on the Public Social Insurance Budget 2007;

Law on the State Budget for 2007

Social Insurance Code.
Annex: Detailed description of the NSSI Model

The model is very sensitive to the date of the input data and the dates that proposed changes to current law begin. It is very important to check these dates.

The ControlPanel is not only a device for running and navigating through the Model. It is also an input Worksheet. There are five spinners on the ControlPanel. They appear below the User Selection list box. The first spinner sets the projection period of the fund operation model. (The population model always projects to the year 2075, so that the population projection is available for all possible projection years for the fund operation model.) The user can choose to run the model for one projection year (i.e., through 1998) or all the way to the year 2075.

The second spinner allows the user to set the last year of the government subsidy to the fund. The government subsidy is generally equal to the negative balance of the fund in a given year. In other words, any deficit in the social insurance fund would be subsidized by the general fund of the Bulgarian Republican Budget, artificially keeping the fund in balance.

– Population Projection Input Files

The population projection relies on five input worksheets. They are: IN_Population, IN_Fertility, IN_Mortality, IN_Migration, and IN_DemographicAssumptions.

IN_Population currently contains 2007 data for the population of Bulgaria by age (0 through 100+) and sex. This information is used by the population projection model as the starting population in its projection of the Bulgarian population by age and sex. Although not necessary, the starting population should be updated every year. All individuals age 100 or over have been included in the value for age 100.

The IN_Population worksheet also contains 2001 population data by marital status. It is divided into four categories: single, married, divorced and widowed. These data are used to determine benefits that depend on marital status, such as proposals to pay additional pensions to widows and widowers. More recent data should be used if available.

IN_Fertility contains fertility rates for females aged 15 to 49. The Bulgarian National Statistical Institute supplies these data. The birth rates by individual age are calculated by dividing the births of mothers grouped into five-year age groups by the female population in the corresponding age group. The “tfrbase” value refers to the base total fertility rate and is the sum of the fertility rates at each age. The data in the worksheet are for 2007. Although not necessary, ideally, fertility rates should be updated every year. The model uses the same age distribution in every year of the projection period, prorating each age-specific fertility rate by a constant factor so that the total fertility rate specified by the user in the IN_DemographicAssumptions worksheet is matched.

IN_Mortality provides mortality rates by sex for ages 0 to 90. This information has been taken from a Bulgarian life table that was based on deaths in the years 2005 to 2007. The mortality rates in this table represent the probability of death from exact age “x” to exact age “x+1,” which are shown in the “qx” column of a life table. Although not necessary, ideally, the data in this worksheet should be updated every year. The model uses these mortality rates to generate a life table every year in the projection period. Values from the life table are used to project the number of deaths.
**IN_Migration** currently uses 2006 migration data from the United Nations\(^5\). This table includes annual rates and numbers of net migrants by age (0 to 100) and sex. The annual rates are calculated by dividing the number of migrants by the population. The data in this worksheet should be updated as soon as new data are available.

**IN_DemographicAssumptions** allows the user to specify future trends in the Total Fertility Rate, Net Migration (in thousands) and the annual rate of improvement in Mortality Rates (%). Historical values for the years 1998 through 2008 appear in the worksheet, but are not used in the model’s calculations. The model uses the values from 2008 through 2080.

**– Fund Operation Projection Input Sheets**

The Fund Operation Projection Model (or, the “Main” Model) projects the income and the outgo of the Social Insurance Fund. This model relies on the population projection and 12 input worksheets. The worksheet that will be changed most often is **IN_Assumptions**. This worksheet is the primary user interface through which changes to current law is modelled and is initially set to replicate current law. This sheet also contains the projected assumptions for various economic parameters, which can be changed to make projections under various scenarios.

**– Reclassification**

The next set of parameters is contained in a table entitled “Reclassification”. The year that reclassification takes place, the percentage of Category 1 workers moved to Category 2, the percentage of Category 2 workers moved to Category 3, and the relevant cut-off ages are determined by the user. The cut-off age is dimensioned by age and sex and refers to the minimum age at which workers in a particular category will not be reclassified. In other words, every worker who is the cut off age or older will not be reclassified.

**– Proposed Law Benefit Formula**

The block of parameters labelled “Parameters for Proposed Law Benefit Formula” allows modelling of the effect of introducing a new benefit formula, which will determine the benefits due to new old age pensioners. These parameters specify the accrual rate for earning new pension credits in and after the “year of change”. Basic Percent accruals prior to the year of change remain as under current law. The parameters specify the “replacement rate” factor used in the pension formula. The replacement rate is of the form:

\[
\text{replacement rate} = (\text{basic percent}) + (\text{incremental percent}) \times (\text{years of service} - \text{required years}),
\]

The replacement rate can not be greater than the maximum percentage. The pension is equal to:

\[
\text{pension} = (\text{flat benefit %}) \times (\text{average wage in economy}) + (\text{replacement rate}) \times (\text{workers average wage})
\]

However, the pension cannot be less than 85% of the minimal pension for old age and periods of insurance nor more than the maximum amount of pension. Minimal pension for old age and periods of insurance is determined on annual basis in Law of Public Social Insurance Budget. The user must specify the replacement rate parameters separately for males and

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females and for each category of worker. The following table summarizes the pension formula parameters and gives the VBA name for each parameter as used in the model:

Table 13: Pension Formula Parameters

<table>
<thead>
<tr>
<th>Name in IN_Assumptions (variable name in VBA)</th>
<th>Description of Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of Change</td>
<td>Year that pension formula is changed.</td>
</tr>
<tr>
<td>pl_year</td>
<td></td>
</tr>
<tr>
<td>% of Ave Wage</td>
<td>Percent of average national wage for pension calculation (the same leva amount for each worker).</td>
</tr>
<tr>
<td>pl_flat</td>
<td></td>
</tr>
<tr>
<td>Required Years</td>
<td>Number of years of service required to receive a full pension (i.e., the basic percent).</td>
</tr>
<tr>
<td>pl_rqlos</td>
<td></td>
</tr>
<tr>
<td>Basic Percent</td>
<td>The base replacement rate.</td>
</tr>
<tr>
<td>pl_baserr</td>
<td></td>
</tr>
<tr>
<td>Increment Percent</td>
<td>Percentage increase in replacement rate for each year of service after the required years.</td>
</tr>
<tr>
<td>pl_addrr</td>
<td></td>
</tr>
<tr>
<td>Maximum Percent</td>
<td>Maximum replacement rate that can be achieved by years of service accrual.</td>
</tr>
<tr>
<td>pl_maxrr</td>
<td></td>
</tr>
<tr>
<td>Minimum Pension (pl_minben)</td>
<td>The minimum pension as defined in Law of Public Social Insurance Budget</td>
</tr>
<tr>
<td>Maximum Pension (pl_maxben)</td>
<td>The maximum pension as defined in Law of Public Social Insurance Budget</td>
</tr>
</tbody>
</table>

Note: pl refers to “proposed law.”

– Retirement Age Based on Points

The block of parameters labelled “Retirement Age Based on Points” allows modelling of the effect of determining the retirement age based on points, where one point is earned for every year of the worker’s age and for each year of service. The earliest age of retirement regardless of points, the number of points required to retire before the normal retirement age, and the age at which points are no longer needed are specified by the user for both sexes. The normal retirement age is the age at which points are no longer needed to retire.

– GDP

The GDP data in millions of leva and the year for which it applies have to be entered into the model.

– Yearly Assumption Parameters

The model starts with historical data from year 2007 and going through year 2080 for which the future assumptions for several economic parameters, including the year-over-year increase in productivity (i.e., GDP per worker), inflation, and average real wages must be incorporated. The year-over-year increase is the 12-month average for one calendar year divided by the 12-month average for the previous year minus 1 and then multiplied by 100. The increase in average real wages is calculated by determining the rate of increase in nominal wages and then adjusting for inflation.

The Base Wage increase is the percentage increase in the Base Wage (or reference wage) used in the calculation of pensions each July. The value for 2007 is placed in IN_Index. “Ad Hoc Benefit Difference from Wages” is used for the indexing of benefits under the “type of index” or “ad hoc benefit increases”.
In the worksheet **IN_Index**, allows a specification of the type of indexing (or toi in VBA) method for projecting each type of pension and each component of pensions. The choices are none (0), by the same increase as the average wage (1), by inflation (2), by the increase in the minimum wage (3), by use of the individual coefficient (which means by the increase in the Base Wage) (4), by the increase in the social pension (5), by the increase in the family allowance (6), by ad hoc increases (7), and by formula (9).

“SSI Fund Interest Rate” is the rate of return to the Social Insurance Fund on all of the Funds assets. The actual rate of return to the fund has been close to zero in the past, but a more internationally accepted practice is to manage the fund’s assets by investing as much of the funds as possible, and to deposit all of the interest earned back into the fund.

The “labour force participation rate” is the labour force ages 15 through 74 divided by the population ages 15 through 74. The labour force is the number of persons either working or looking for work (i.e., employed plus unemployed). The “unemployment rate” is the number of persons unemployed divided by the labour force. The total labour force participation rates determined from the age-specific rate in **IN Labour** are displayed on the RunTime worksheets when the model is run.

The “compliance rate” is determined by the following equation:

\[
\text{Compliance rate} = \frac{\text{(actual contributions)}}{\text{(contributors} \times \text{average wage} \times \text{contribution rate)}}
\]

The compliance rate for the last data year is determined from data and displayed on the RunTime worksheet while the model is running, but the user assumes the future years.

The retirement ages and contribution rates are also chosen by the user to model the effect of proposed changes in the pension law. The required fund ratio is chosen by the user to specify the minimum amount in the fund that should be considered actuarially sound (i.e., the amount that the user believes can assure that all pensions will be paid when due). The following table summarizes the yearly parameters that must be entered in the **IN_Assumptions** worksheet, along with the VBA name used in the model.

<table>
<thead>
<tr>
<th>Variable (VBA name)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year year</td>
<td>Year of projection</td>
</tr>
<tr>
<td>Productivity Increase</td>
<td>Increase in economic productivity</td>
</tr>
<tr>
<td>ProductivityIncrease</td>
<td></td>
</tr>
<tr>
<td>Inflation inflation</td>
<td>Inflation</td>
</tr>
<tr>
<td>Real Wage RealWage</td>
<td>Real Wage</td>
</tr>
<tr>
<td>Base Wage Increase BaseWageIncrease</td>
<td>Increase in Base Wage from previous year</td>
</tr>
<tr>
<td>Adhoc Benefit Difference from Wages adhoc_ben_incr</td>
<td>Difference between benefits and wages as determined arbitrarily by NSSI.</td>
</tr>
<tr>
<td>SSI Fund Interest Rate</td>
<td>Interest rate for money in the social insurance fund</td>
</tr>
<tr>
<td>Parameter</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td><code>int(year)</code></td>
<td>Labour Force Participation Rate (by sex)</td>
</tr>
<tr>
<td><code>tlfpr(sex)</code></td>
<td>Total labour force participation rate (ages 15 through 74) by sex</td>
</tr>
<tr>
<td><code>tur(year)</code></td>
<td>Unemployment Rate</td>
</tr>
<tr>
<td><code>cmplyrt</code></td>
<td>Compliance rate for covered workers</td>
</tr>
<tr>
<td><code>RetirementAge(sex,cat)</code></td>
<td>Retirement age by sex and category of worker</td>
</tr>
<tr>
<td><code>cl_txrt_er(cat)</code></td>
<td>Social insurance tax rate paid by employers by category</td>
</tr>
<tr>
<td><code>cl_txrt_ee</code></td>
<td>Social insurance tax rate paid by insurance persons</td>
</tr>
<tr>
<td><code>cl_txrt_ii</code></td>
<td>2nd Job Industrial Injury Tax Rate</td>
</tr>
<tr>
<td><code>cl_txrt_se</code></td>
<td>Tax rates applicable to relevant categories of self-employment.</td>
</tr>
<tr>
<td><code>cl_txrt_pres</code></td>
<td>Tax rate applicable to special services.</td>
</tr>
<tr>
<td><code>RequiredFundRatio(year)</code></td>
<td>Fund amount required to assure the timely payment of pensions.</td>
</tr>
<tr>
<td><code>widows_pension_percent</code></td>
<td>Percent of deceased workers’ pension paid to widows and widowers in addition to their personal old age pension.</td>
</tr>
<tr>
<td><code>GenDisTrend</code></td>
<td>Factor multiplied by base year disability prevalence rates to adjust the amount of disabilities up or down during the projection period.</td>
</tr>
<tr>
<td><code>adjindcoe</code></td>
<td>Factor multiplied by the individual coefficient distribution from the base year in order to adjust the amount of the average individual coefficient up or down during the projection period.</td>
</tr>
</tbody>
</table>

**IN Index** includes parameters for Indexing Benefits in the first year of the projection period. This worksheet specifies the pension benefit increases by month for the first year in the projection period for First and Second Pillar Pensions by type of pension. This is because the model takes the starting amount of pensions as the amount for IN Benefits, which is for December of the year before the projection period. **IN Index** also includes monthly pension supplement amounts by component. All of the months should be filled in. Months that are not yet known must be estimated. During the year, as more information becomes available, the estimates should be replaced by the actual data.

In the model it is possible to specify the indexing method that will be used for future increases. There are nine choices provided. If the user chooses 0 then there will be no indexing. The other options use the average wage, inflation, the minimum wage, the individual coefficient method of recalculation (which increases each year with the Base Wage), the social pension, the family allowance, or an ad hoc amount read from **IN Assumptions** for indexing. The percentage of an indexation that will be applied towards pension increases must also be chosen.

**IN 2ndPillar** allows the user to model the effect of implementing a second pillar pension. Second pillar pensions are based on “defined contribution” formulas. Under this type of formula, contributions are collected each year and deposited into a individual account, interest rate and average life expectancy. The account is credited interest each year, and also is charged for administrative expenses. At retirement, a monthly pension is calculated based on
the value of the individual account. When a 2nd pillar program starts, it is often done by transferring some of the 1st pillar contribution to the 2nd pillar, while at the same time reducing 1st pillar pensions.

The model can use either the matrix of percentages for voluntary participation or the cut-off ages for mandatory participation for the projection. Under the mandatory option, the model assumes that 100% of workers under the cut-off age will participate in the 2nd pillar option, and that 0% of workers at or above the cut-off age will not participate. The selection between a voluntary program or a mandatory program (or no second pillar program) is completed. The user can choose to deactivate the 2nd Pillar entirely, allow workers to participate in the 2nd Pillar voluntarily, or mandate worker participation. If the voluntary option is chosen, then the user should input 2nd Pillar participation rates by age and sex. If the mandatory option is chosen, then these values will not be used in the projection.

Cut-off ages arranged by category and sex are determined. The cut-off age is the lowest age that does not participate in the 2nd pillar (thus, retaining both the current 1st pillar contribution rates and the current 1st pillar pension). Operating costs are calculated as a one-time percentage of each contribution and as an annual percentage of the assets (or balance) in the individual accounts. The expense factors are also entered.

For each year, the user needs to specify interest rates during accumulation and payout. The interest rate during the accumulation period (i.e., the period before retirement) is applied to the balance in the individual accounts to calculate the interest credited each year, while the interest rate during the payout period (i.e., the period of retirement) is used in calculating the annuity factor that determines the monthly pension that can be paid from the individual account at retirement. It is also necessary to input the 2nd Pillar pension index (which is used to calculate the annuity factor) and the 2nd pillar contribution (both the transfers from the 1st pillar and additional amounts). Contribution rates can vary by category of worker.

The IN_Budget worksheet uses whole historical data. The data are subdivided into the following categories: Income by Source of Fund, Outgo for Pensions and Supplements, Outgo for Short Term Benefits, Outgo for Population Growth Benefits, Administrative Expenses and Outgo During December for Pensions and Supplements. The historical data contained in this worksheet are for information purposes only; the program does not use them. Space is available to fill-in data for the current year, but the model also does not use these data.

The IN_Wage worksheet contains information on social pension amounts, minimum wage amounts, average wages (aggregate, male and female), inflation and unemployment by month for 2008. The data on this worksheet should be expanded every year. The user should fill all of the months in. Months that are not yet known must be estimated. During the year, as more information becomes available, the estimates should be replaced by the actual data.

IN_Labor contains detailed data by age (for ages 15 to 74) and sex for the labour force participation rate, unemployment rate, and the relative wage (i.e., the average wage for each age as a percent of the average wage at all ages). The participation rate and unemployment rates were initially taken from “Employment and Unemployment” published by the Bulgarian National Statistical Institute. The relative wage scale was obtained from data on contributors provided by the actuarial department. The data in this worksheet should be updated to a more recent year.

IN_Contributors is provided by the actuarial department of NSSI. It holds data showing the insured person and employer contribution rates, the number of contributors, and the amount of contributions by sex for each type of contributor for ages 16 through 70. There are 7 different types of contributors. The data in this worksheet are used to calculate coverage rates (i.e., the
ratio of contributors to workers) by age, sex, and type of contributor. Each year, this worksheet should be updated with data for December.

The data in IN_Benefits is provided by the actuarial department of NSSI. This worksheet contains data on the number of pensioners and the average pension for 12 types of pension by age and sex. Average pensions are given for 6 different pension components. The information contained in IN_Benefits is used to tabulate the starting number of pensioners and the starting average pension. The model determines prevalence rates (as a percent of the population) for each type of pension and pension component by age and sex. The model uses these prevalence rates to project the number of pensioners. It uses the calculation of average new pensions and the indexing of existing pensions to project the average amount of pensions. Each year, this worksheet should be updated with data for December.

The data in this worksheet are arranged as follows:

Column 1 = age, Columns 2 to 15 for men, columns 16 to 29 for women

<table>
<thead>
<tr>
<th>Column</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age of pensioner</td>
</tr>
<tr>
<td>2 &amp; 16</td>
<td>Number of Beneficiaries receiving 1st or 2nd pensions</td>
</tr>
<tr>
<td>3 &amp; 17</td>
<td>Average Total levra from 1st and 2nd pensions</td>
</tr>
<tr>
<td>4 &amp; 18</td>
<td>Number of 1st pensions</td>
</tr>
<tr>
<td>5 &amp; 19</td>
<td>Average Amount of 1st pensions</td>
</tr>
<tr>
<td>6 &amp; 20</td>
<td>Number of 2nd pensions</td>
</tr>
<tr>
<td>7 &amp; 21</td>
<td>Average Amount of 2nd pensions</td>
</tr>
<tr>
<td>8 &amp; 22</td>
<td>Number of pensioners with compensation for inflation</td>
</tr>
<tr>
<td>9 &amp; 23</td>
<td>Average Amount of compensation for inflation</td>
</tr>
<tr>
<td>10 &amp; 24</td>
<td>Number receiving assistance for invalidity (companion helper or caretaker)</td>
</tr>
<tr>
<td>11 &amp; 25</td>
<td>Average Amount of supplement for companion</td>
</tr>
<tr>
<td>12 &amp; 26</td>
<td>Number of pensioners receiving child allowance</td>
</tr>
<tr>
<td>13 &amp; 27</td>
<td>Average Amount of supplement for child allowance</td>
</tr>
<tr>
<td>14 &amp; 28</td>
<td>Number of pensioners receiving veteran's allowance</td>
</tr>
<tr>
<td>15 &amp; 29</td>
<td>Average Amount of supplement for veteran’s allowance</td>
</tr>
</tbody>
</table>

IN_PensionLaw contains parameters for the retirement ages and the pension formula for current law. The model uses the retirement ages only for historical years, and then updates them each year during the projection period with data from IN_Assumptions. The parameters for the pension formula, however, are used for every year unless a new pension formula is specified to start in a future year in IN_Actuals.

IN_IncomeDistribution contains data on the number of new old-age pensioners in December 2007 by amount of individual coefficients. The pensioners are grouped into 15 amounts (from less than 0.50 to over 10.00). These data are used by the model to determine average new pensions through the use of 615 cases. The model determines the pension for 615 cases for each age at retirement, each sex, and each category of worker. The 615 cases consist of 41 periods of insurance (10 through 50) crossed with 15 amounts of individual coefficients. Each year, this worksheet has to be updated with data for December.

IN_NewPenLosCat contains data for the number of new pensioners in 2007 by sex, category of worker, and periods of insurance. These data are used by the model in constructing the 615 cases used in the determination of the average new old age pension. The data in this worksheet should be updated each year.
IN_OldAgePenCat contains data on the number of existing old age pensions by category of worker, age, and sex. These data are used in conjunction with the data from IN_Benefits to determine prevalence rates by category of worker for old age pensions.

Running the Model

– Population Projection

In order to begin the Population program, the user needs to click on “Project Population” under the Select User Selection box and then click on Execute User Selection. The RunTime worksheet will appear. After the year 2080 has been completed the message “Calculation Finished” will appear on the RunTime worksheet. The population model uses fertility, mortality, migration and the starting population data to calculate the population of Bulgaria over the duration of the projection. The number of males and females by age from 0 to 100 years old, total births, total deaths and total migrants are calculated and printed into an ASCII output file “projpop.out.” Only after the “projpop.out” file has been created can the model make projections for the Fund Operations. The program also writes male and female life tables used in the population projection model (OUT_LifeTables) and writes a summary of the population projection to OUT_Population.

The OUT_Population file includes demographic statistics for the first year of the projection period, the year 2008 and every fifth year until 2080. The total population of Bulgaria is projected and divided into the age-groups of young, middle, and old. The old-age dependency ratio is also calculated. Changes in the population (i.e. births, deaths, and net migration) appear below the dependency ratio. The worksheet then shows the population grouped into age clusters and separated into males and females.

– Fund Operation Projection

The second part of the model projects the operations of the Social Insurance Fund over time. This is referred to as the “Main” model. However, once the population is determined, it is not necessary to recalculate it unless changes are being made to the demographic assumptions. Therefore, it saves time to run only the “Main” model if the population assumptions remain the same. Alternatively, both programs can be run.

Output

The names of the output files generated by the program begin with the extension "OUT_.". The user can print any of these files after running the program to obtain information on the projection. Every output table will include a description of the scenario being tested as well as the date and time that the model was run. In addition, there is a button on the ControlPanel that allows the user to choose the correct paper size.

The output sheets are summarized below:

The OUT_Fund table traces the year-by-year cash flow (income and outgo) of the fund. It also shows the fund balance and the fund ratio (a measure used to test the short-range actuarial soundness of the social insurance system). It is detailed in table form below.
### Table 15: Summary of OUT_Fund

<table>
<thead>
<tr>
<th>Name</th>
<th>Variable *</th>
<th>Description / Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>year</td>
<td>Calendar year</td>
</tr>
<tr>
<td>GDP</td>
<td>GDP</td>
<td>GDP</td>
</tr>
<tr>
<td>Full Taxbase</td>
<td>fulltaxbase(0, year)</td>
<td>Sum of all wages for category 1, 2, and 3 workers in the nation</td>
</tr>
<tr>
<td>Compliant Taxbase</td>
<td>taxbase(0, year)</td>
<td>Sum of all wages on which contributions have been paid for category 1, 2, and 3 workers in the nation</td>
</tr>
<tr>
<td>Payroll Tax</td>
<td>taxincome(year)</td>
<td>Contributions collected from category 1, 2, and 3 workers (including the employer and insured persons contributions)</td>
</tr>
<tr>
<td>Other Income</td>
<td>otherincome(year)</td>
<td>All income to the fund other than contributions from category 1, 2, and 3 workers or from interest or government subsidies. This is mostly contributions from self-employed, amounts recovered from audits, and transfer from the Republican Budget to cover the contributions of pensions for the military, police, and civil servants.</td>
</tr>
<tr>
<td>Government Subsidy</td>
<td>govtsub(year)</td>
<td>Transfers from the Republican Budget to cover any shortfall of income over outgo.</td>
</tr>
<tr>
<td>Interest</td>
<td>interest(year)</td>
<td>Amounts earned from invested fund assets. Currently this close to zero because there is a policy to keep the fund close to zero.</td>
</tr>
<tr>
<td>Total Income</td>
<td>pen_tot(year)</td>
<td>Sum of all pension payment (including all components) for the 12 types of pensioners during the calendar year.</td>
</tr>
<tr>
<td>Pensions</td>
<td>shortben_tot(year)</td>
<td>Sum of all short term benefit payments during the calendar year.</td>
</tr>
<tr>
<td>Administration</td>
<td>admin(0, year)</td>
<td>Sum of all administrative expenses during the calendar year.</td>
</tr>
<tr>
<td>Total Outgo</td>
<td>outgo(year)</td>
<td>Sum of pension payments, short term benefits, population growth benefits, and administrative expenses during the calendar year.</td>
</tr>
<tr>
<td>Change in Fund Balance</td>
<td>fund(year) - fund(year-1)</td>
<td>Total fund income minus total fund outgo.</td>
</tr>
<tr>
<td>Fund Balance (EOY)</td>
<td>fund(year)</td>
<td>Fund balance at end of year</td>
</tr>
<tr>
<td>Fund Ratio (EOY)</td>
<td>fund(year) / outgo(year)</td>
<td>FundRatio</td>
</tr>
<tr>
<td>Required Fund Ratio (EOY)</td>
<td>RequiredFundRatio (year +1)</td>
<td>Required fund ratio from IN Assumptions</td>
</tr>
</tbody>
</table>

* All of the amounts with the exception of the year have been multiplied by a factor of $10^{-9}$.  

OUT_Budget projects the same values as appear in IN_Budget for the first few years of the projection in order to provide a gauge with which to check with NSSI’s short term projections.

The OUT_Cost table displays projected income rates, cost rates, and the actuarial balance. The “cost rate” for a given year is the total outgo of the fund plus the amount needed to attain and/or maintain the required fund ratio expressed as a percent of the tax base. The “income rate” for a given year is the total income to the fund (excluding interest) expressed as a percent of the tax base. The actuarial balance for a given year is the income rate minus the cost rate. The cost rates, income rates, and actuarial balances over a given time period can be summarized into one number by means of present values. For example, the cost rate over the 25-year period 2008 through 2032 is the present value of all outgo during that period divided...
by the present value of the tax base during the period. The actuarial balance over the period is equivalent to the change in the tax rate that would put the fund in exact actuarial balance. For example, an actuarial deficit of -5% over the period 2008 through 2032 could be exactly eliminated by a tax increase of 5 percentage points at the beginning of 2008.

**OUT_CostRatios** is a projection of the estimated required tax rate for each year in the projection period. The estimated required tax rate is equal to the replacement ratio (the average benefit divided by the average wage) times the dependency ratio (the number of beneficiaries divided by the number of taxpayers) divided by the compliance rate. This table gives information of the cause of any trend in the actuarial balance of the fund, i.e., demographic, economic, or compliance related.

**OUT_Benefits** displays the amount of benefit payments, number of beneficiaries, and average benefits by type of benefit and year. This table provides detail on the pension projections.

**OUT_NewPensionNumber** displays the number of new pensioners by sex and category. It also shows the percentage of pensioners who receive the minimum and maximum pension amounts. This worksheet provides detail on the models use of prevalence rates to project new pensioners.

**OUT_NewPensionAverage** presents summary information from the projection of the new pension amounts. Information includes the average wage, base wage, average pension, the average individual coefficient, average periods of insurance factor, the average replacement rate and minimum and maximum pensions by year.

**OUT_OldAgePensions** includes information pertaining to the prevalence rates by age for male and female old age pensioners currently receiving benefits. This table provides detail by age on how the model projects the number of pensioners and the average pension.

**OUT_ExampleWorkers** shows the replacement rates for 1st and 2nd pillars for three example workers: low income earners, average income earners, and high-income earners.

**OUT_2ndPillarFund** shows the projection of the aggregate income and outgo of all individual accounts in the 2nd pillar program.

**OUT_Workers** displays the projection of the labour force, the number of unemployed, and the number of workers (taxpayers). The number of contributors is divided into type of contributor.
Czech Republic

Pension projection model

The pension model

The pension model has been built in the Ministry of Finance, which maintains, updates and uses the model. The model is a semi-aggregated simulation model written and run under the GAMS application. It enables to make long-term projections and simulate the impact of changes in all the relevant parameters of the current system.

Simple projections of non-mandatory private pensions are treated outside this model.6

Sources of data

Most data come from the Czech Social Security Administration, which is in charge of collecting social security contributions and disbursing all pension benefits. The model makes use of the information on:

- the number of pensions disaggregated by type of pension, age and gender
- the number of new pensions (by type of pension, age and sex),
- average pension (by type of pension, age and sex),
- average newly granted pension (by type of pension, age and sex),
- matrix of the number of new pensions (by type of pension) for a given combination of assessment basis (average earnings during the assessment period) and contribution period.

Apart from the above mentioned data running the model requires a population projection (disaggregated by single age and sex), assumption on the growth rate of an average wage, evolution of the parameters of the pension formulae and indexation rule. All assumptions about macroeconomic framework and population projection are those of AWG.

The structure of the model

The model makes distinction among various pension benefits (old-age, disability and survivors’), sexes (males, females) and generations (the year of birth).

In accordance with the Czech legislation the model explicitly differentiates several types of pensions:

- Old-age pensions (including early retirement old-age pensions that can be granted up to three years prior to statutory retirement age);
- Disability pensions
  - full disability (3rd degree when working capacity is reduced by at least 70%)

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6 The information about projections of 3rd pillar is in Chapter 0.
- partial disability pension (2nd and 1st degree, with working capacity reduced by 50 - 69% and 35 - 49% respectively);
- Widow’s/widower’s pensions solo;
- Widow’s/widower’s pensions in concurrence with other pensions (disability, old-age);
- Orphan’s pensions.

The distinction between males and females is important since males and females differ in their earnings profiles, length of their career and contribution periods. These differences result in different level of pension benefits. It is also important to apply cohort approach since the cohorts (generations) are not homogenous. Generations (identified by the year of birth) differ in some important characteristics, e.g. mortality rates (impacts for instance the number of survivors’ pensions or the average lengths of receiving an old-age pension), disability rates (impacts the number of disability pensions) and affiliation with a generation is also decisive for determination of the statutory retirement age.

The model primarily works with the number of pensions, not with the number of pensioners. The number of pensioners is somewhat lower than the number of pensions since some pensioners may be entitled to receive more (two) pension benefits. According to the Czech pension legislation recipients of disability or old-age pensions may under given conditions receive widow’s /widower’s pension at the same time. Thus, the number of pensioners can be obtained by subtracting the number of widow’s /widower’s pensions in concurrence with other pensions from the total number of pensions.

The model consists of three main building blocks. The first block calculates the number of pensions and flow of new pensions. The second one computes the level of new pension benefits. The third block combines the information on the stock and flow of pensions with the projection of new pension benefits, which gives the evolution of an average pension benefit and spending on all pension benefits in the projection horizon.

Figure 1: Simplified structure of the model
Block 1 – number of pensions

The number of pensions is calculated on the basis of the cohort methodology. The computation rests on the idea, that there is a certain probability that an individual of given age and sex and from given cohort retires, becomes disabled or becomes orphan/widow/widower.

Disability and old age pensions

The approach can be illustrated on the example of (full – 3\textsuperscript{rd} degree) disability pensions.

The conditional probability ($P$) of becoming disabled for a person of age $a$ and sex $s$ can be expressed on the basis of disability rates ($DR$) as:\footnote{Assuming an upper limit on disability rate equal to 1.0.}

\[ P_{t}^{a,s} = \frac{DR_{t+1}^{a,s} - DR_{t}^{a,s}}{1 - DR_{t}^{a,s}} \] \hspace{1cm} (1)

Denoting a particular generation by a superscript $g$ (where $g = t - a$), the equation (1) can be rewritten as:

\[ P_{t}^{g,s} = \frac{DR_{t+1}^{g,s} - DR_{t}^{g,s}}{1 - DR_{t}^{g,s}} \] \hspace{1cm} (1a)

The disability pensioner can change its status since he/she can stop receiving disability pension due to renewed working capacity or becoming entitled to old-age pension. After the statutory retirement age the recipient of disability pension can ask the Czech Social Security Administration to calculate his/her old-age pension and he/she will get the higher pension. As a result disability pensions almost disappear behind the statutory retirement age.\footnote{Moreover, from the year 2010 onwards, all “fully” disabled people aged 65 and more are automatically concerned as old age pensioners.} The conditional probability that a person ceased to be disabled can be expressed as follows:

\[ P_{t}^{a,s} = 1 - \frac{DR_{t+1}^{a,s}}{DR_{t}^{a,s}} \] \hspace{1cm} (2)

or

\[ P_{t}^{g,s} = 1 - \frac{DR_{t+1}^{g,s}}{DR_{t}^{g,s}} \] \hspace{1cm} (2a)

The probabilities were calculated for all types of disability pensions and old-age pensions in the years 2005-2007. Disability rate can then be projected on the basis of a three-year average exit/entry probability as:

\[ DR_{t+1}^{g,s} = DR_{t}^{g,s} \cdot \left(1 - P_{t}^{g,s}\right) + P_{t}^{g,s} \] \hspace{1cm} (3)

Or in accordance with (2a):

\[ DR_{t+1}^{g,s} = DR_{t}^{g,s} \cdot \left(1 - P_{t}^{g,s}\right) \] \hspace{1cm} (4)

The number of disability pensions ($DPen$) in year $t$ is determined as a product of the cohort size ($Pop$) and the sex and cohort specific disability rate ($DR$):
\[ DPen_t = \sum_{g,s} DR^{g,s}_t \cdot Pop^{g,s}_t \]  

(5)

The same approach has been applied to determine the number of 2\textsuperscript{nd} and 3\textsuperscript{rd} degree of disability pensions and old-age pensions.

Under the current legislation the statutory retirement age is gradually increased from the present 61 years for men and 58 for women with two children to 65 for men and 64 for the women with two children. Thus the model must take account of the rise in retirement age. It is done by splitting the probability profile for the given generation \((g)\) in a convenient point (depending on the type of pension) and shifting it outwards by the difference between the statutory retirement age \((RA)\) valid for the given generation \(g\) and the statutory retirement age for the generation reaching the statutory age in the base year (in 2007 generation of men born in 1946 has retirement age equal to 61 years, i.e. \(2007 = 1946 + 61\), whereas the generation of women born in 1949 reached the statutory retirement age, \(2007 = 1949 + 58\)).

\[ P_{g,m} = P_{1946+m}^{1946+a} \]  

(6a)

\[ P_{g,f} = P_{1949+f}^{1949+a} \]  

(6b)

**Survivors’ pensions**

Somewhat different approach from the one outlined in equations 1 to 5 has been used to calculate the number of survivors’ pensions. The probability of receiving widow’s/widower’s pension \((P)\) depends on the marital status, probability of spouse to die in a given year and compound probability of the couple to die within the same year. This can be formally expressed as:

\[ P^{g,f}_t = \left( \varepsilon^{e,m}_t - \varepsilon^{e,m}_{t-f} \cdot \varepsilon^{e,f}_t \right) \frac{MPop^{g,f}_t}{Pop^{g,f}_t} \]  

(7)

Superscript \(f\) and \(m\) denotes female and male population respectively, \(\varepsilon\) stands for mortality rate and \(MPop\) is the number of married population. The same relation holds for male. Since married couples are not necessarily of the same age, \(\varepsilon\) of the other sex should be viewed as an average mortality rate of the other sex around the given age \(a (= t - g)\).

The number of widow’s pensions \((WPen)\) can be derived from equation (7) and the assumption on the ratio of married population in a given starting age \((a_0 = t_0 - g)\). Before the age \(a_0\) an assumption was made (on the basis of fairly stable mortality rates) that the profile of widow’s/widower’s pension is the same as in the base year. The ratio of widow’s pensions after age \(a_0\) is calculated as follows:

\[ \frac{WPen^{g,f}_t}{Pop^{g,f}_t} = \frac{WPen^{g,f}_{t-1}}{Pop^{g,f}_{t-1}} + \left( \frac{MPop^{g,f}_{t_0}}{Pop^{g,f}_{t_0}} - \frac{WPen^{g,f}_{t-1}}{Pop^{g,f}_{t-1}} \right) \varepsilon^{e,m}_t \]  

(8)

The equation 8 is used to calculate the total number of widow’s/widower’s pension. It is further split into the solo pensions \((WsPen)\) and pensions in concurrence \((WcPen)\) with other

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\(^9\) After this age the entitlement for widow’s/widower’s pension is permanent (i.e. till the end of one’s life) as opposed to the age before when the entitlement is only temporary (it lasts a year). The age is set in the legislation 4 years before the statutory retirement age and as such it will rise with the postponement of this benchmark.
pensions (old-age and disability) according to the probability that the person is a recipient of old-age or disability pensions, which is given by the fraction of population that receives old-age (Open) or disability pensions (DPen).

\[
WsPen_{t,s}^{g,m} = WPen_{t,s}^{g,m} \cdot \left(1 - \frac{OPen_{t,s}^{g,m} + DPen_{t,s}^{g,m}}{Pop_{t,s}^{g,m}}\right) \tag{9}
\]

\[
WcPen_{t,s}^{g,m} = WPen_{t,s}^{g,m} - WsPen_{t,s}^{g,m} \tag{10}
\]

The number of orphan’s pensions is projected simply on the basis of the existing profile (age and sex specific ratio of orphan’s pensions to population) since mortality rates for those aged less than 26 are not subject to any major changes. With respect to their limited importance this seems to be a good approximation.

**What is behind final results…**

Figures 2 to 9 show the cross-sectional profiles of old-age pensions, full disability pensions, partial disability pensions and widow’s/widower’s pensions. Figures portray not only the result of cohort methodology but also the method used to model the gradual rise in the statutory retirement age. The rise in retirement age leads to the postponement of the retirement but at the same time the number of substitute pensions (disability pensions) increases since disability is related to age. Shift in the curve for the widow’s/widower’s pensions is driven by the falling mortality rates.

However, the rise in the number of disability pensions due to increase in retirement age means that the fraction of population retiring (due to old age) will shrink. The model assumes that the share of old-age pensioners in the residual population (population less the number of full 3rd degree disability pensions, Pop - DPen) is kept in line with the profile for the generation reaching the statutory retirement age in the base year, for men that is:

\[
\frac{OPen_{i+1,(g-1946)}^{g,m}}{Pop_{i+1,(g-1946)}^{g,m} - DPen_{i+1,(g-1946)}^{g,m}} = \frac{OPen_{1946}^{1946,m}}{Pop_{1946}^{1946,m} - DPen_{1946}^{1946,m}} \tag{11}
\]

The profile of old-age pensions is then adjusted by the shift in the disability profile:

\[
\left(\frac{OPen_{i+1,(g-1946)}^{g,m}}{Pop_{i+1,(g-1946)}^{g,m}}\right)^{\text{adjusted}} = \frac{OPen_{i+1,(g-1946)}^{g,m}}{Pop_{i+1,(g-1946)}^{g,m}} \cdot \frac{1 - DPen_{i+1,(g-1946)}^{g,m}}{Pop_{i+1,(g-1946)}^{g,m}} \cdot \frac{1 - DPen_{i+1,1946}^{g,m}}{Pop_{i+1,1946}^{g,m}} \tag{12}
\]

The following figures show cross sectional profiles for years 2007, 2009, 2016, 2023, and 2030 for men and 2007, 2011, 2015, 2019, 2023, 2027, and 2033 for women. The years were not chosen randomly but they reflect the calendar year, in which the statutory retirement age increases by one additional year. It is apparent that the process takes longer for women despite the faster speed (rise by 2 months a year for men compared to 4 months for women). It is a result of the much higher increase in statutory age for women. Beyond 2030 and 2033 respectively the profile should be more or less stable. However, minor changes might result due to the applied cohort component approach.
Figure 2: Cross sectional profile of old-age pensions - male

Figure 3: Cross sectional profile of old-age pensions - female

Figure 4: Cross sectional profile of full disability pensions - male

Figure 5: Cross sectional profile of full disability pensions - female

Note: Profiles for people aged 65 and more are not used from 2010 onwards since they are automatically considered as old age pensioners.

Figure 6: Cross sectional profile of partial disability pensions - male

Figure 7: Cross sectional profile of partial disability pensions - female
The most important output of the block 1 is the numbers of all the different pension types. They are shown in the Figures 11 to 14.

One reform measure, however rather administrative, is visible in the numbers of old age and full disability pensions. The transfer of disabled people aged 65+ (from 2010 onwards) to old age pensioners cause the jump in both relevant time series. Due to the scale of the Figure 10 and Figure 12 the effect is more apparent in the case of disability pensions (leaving pensions).
than in the old age pensions (incoming pensions). Further trends depends solely on demographic development.

The number of new pensions \((NPen)\) in generation \(g\) and sex \(s\) is consistent with the stock of pensions \((Pen)\), from which it is computed with the use of the probability of survivorship derived from sex and generation specific mortality rate \((ε)\):

\[
NPen_{t}^{g,s} = Pen_{t}^{g,s} - Pen_{t-1}^{g,s} \cdot (1 - ε_{t}^{g,s}). \tag{13}
\]

There is no such straightforward relationship in the case of disability pensions since a disability benefit is withdrawn when the working capacity is restored. Thus the number of new pensions computed according to (13) would be underestimated and spending on disability benefits and an average benefit would be lower (under the assumption of indexation lower than the wage growth). The model assumes a fixed relationship between the number of new pensions and the stock of pensions in a given age \((a)\) and the ratio was calibrated on the basis of 2007 data\(^{10}\).

\[
NPen_{t}^{a,s} = k_{g+a}^{g,s} \cdot Pen_{t}^{g,s} \tag{14}
\]

\[
k_{g+a}^{g,s} = NPen_{2007}^{a,s} / Pen_{2007} \tag{15}
\]

**Block 2 – determination of newly granted pension benefit**

This block enables to (i) assess the impact of the government decisions (pertaining to the indexation of the main parameters of the pension formulae) on the level of newly granted pensions in the short run and (ii) simulate the impact of changes in the pension formulae in the long run.

The changes in pension formulae are simulated in a matrix with two dimensions – assessment basis and contribution period. It is a matrix \((281 \times 40)\), which gives the number of pensions for a given combination of assessment basis (average earnings during the assessment period) and contribution period. It is possible to compute a pension benefit for each cell of the matrix on the basis of the pension formulae (equations 16, 17, 18 and 19). Weighing the pension benefits by the number of recipients gives the average newly granted pension. The structure of the matrix is held constant in all years of the projection horizon.

\[
NBen = FRC + ERC \tag{16}
\]

\[
ERC = \left\{ae \cdot rc_{1} - \max(0,ae - rb_{1}) \cdot (rc_{1} - rc_{2}) - \max(0,ae - rb_{2}) \cdot (rc_{2} - rc_{3}) \right\} \cdot (cp_{1} + cp_{2} \cdot 0.8) / 365 \cdot ar \tag{17}
\]

\[
ae = \frac{\sum_{Y=1}^{Y-1} ye_{Y} \cdot \prod_{i=1}^{Y-1} i_{t}}{\min(30,Y - 1 - 1986) - ncp / 365} \tag{18}
\]

\[
i_{t} = w_{t+1} / w_{t} \tag{19}
\]

\(NBen\) stands for newly granted pension benefit, \(FRC\) for flat rate component (currently in 2007 amounts to 2,170 CZK \(\approx 78\) EUR), \(ERC\) earnings related component, \(ae\) assessment

\(^{10}\) That is, the model assumes a constant probability of restoring the working capacity.
basis (average earnings during the assessment period), rb reduction brackets (currently 9,600 CZK $≈ 346$ EUR and 23,300 CZK $≈ 839$ EUR), rc reduction coefficient (currently 100% up to 9,600 CZK, 30% up to 23,300 and 10% over 23,300), cp contribution period up to the statutory retirement age in days (including non-contributory periods assessed as if contributory but only up to 80%), ar accrual rate (1.5%), Y year of retirement, ye yearly assessment basis in the last 30 years (but not before 1986) in present value calculated on the basis of index $i$ derived from the growth rate of average wage in the economy ($w$) and ncp is for excluded non-contributory periods.

In fact, the equation (17) is more complex since earnings related component furthermore reflects the early or late retirement (before and after the statutory retirement age). In case of early retirement the ERC is reduced by 0.9% of the assessment basis for each 90 days before the statutory retirement age up to 2 years and by 1.5% of the assessment basis for more than 2 years earlier retirement. In case of later retirement the ERC is increased by 1.5% of the assessment basis for each completed 90 days after the statutory retirement age.

The above given description concerns old-age pensions. The same procedure is used for other pension benefits. Although the procedure is the same, there are however minor changes in the pension formulae (see description of calculation of pension benefits above).

It should be apparent from the equations above that the Czech pension system is very flexible and there are many parameters that can be used to steer the system. The government can easily adjust the level of new pensions by changing the parameters of the pension formulae. On the other hand, absence of any government decision would lead to gradual decrease in the level of newly granted pensions since the flat rate component and the reduction brackets would remain constant in nominal terms. In the projection exercise we assume that the monetary parameters of the pension formulae (flat rate component, reduction brackets) are indexed to average wage growth. All other parameters (reduction coefficients, accrual rate) remain unchanged. Under these assumptions the replacement rate remains in principle constant with respect to these parameters. However other factors play role (such as indexation, retirement age postponement and wage development).

**Block 3 – average pension and total pension spending**

In the base year the average pension benefit (for all types of pensions) is reported for each age and sex by the Czech Social Security Administration. It then enters the equation computing total pension expenditure. Total spending on a given type of pension (equation 20) is a function of the average pension benefit ($Ben$) from the previous year indexed in accordance with the pension legislation ($ind$), the newly granted pension benefit ($NBen$) calculated in the block 2 of the model, and the number of pensions ($Pen$) and newly granted pensions ($NPen$) from the block 1.

$$E_i = \sum_{g,s} \left( Pen_{i,s}^{g,s} - NPen_{i,s}^{g,s} \right) \cdot Ben_{i-1}^{g,s} \cdot \left(1 + ind_i \right) + NPen_{i,s}^{g,s} \cdot NBen_{i,s}^{g,s} \tag{20}$$

Total pension expenditure is simply a sum of the pension spending on all the pension types.

In the projection horizon the average pension benefit ($Ben$) for a given generation $g$ and sex $s$ is calculated on the basis of the pension spending ($E$) and the number of pensions ($Pen$). The average pension is a weighted average of average pension from the previous period and the newly granted pension benefits:

$$Ben_{i}^{g,s} = \frac{E_{i}^{g,s}}{Pen_{i}^{g,s}} = \frac{\left( Pen_{i}^{g,s} - NPen_{i}^{g,s} \right)}{Pen_{i}^{g,s}} \cdot Ben_{i-1}^{g,s} \cdot \left(1 + ind_i \right) + NPen_{i}^{g,s} \cdot NBen_{i}^{g,s} \tag{21}$$
In the projection exercise the pension benefits are indexed as per legal minimum only, that is by CPI inflation and 1/3 of the average real wage growth. However, the indexation used to be more generous before 2007.11

11 Past development of this rule has been quite erratic. In years after 2000 the indexation was higher than the minimum of CPI+1/3 of real wage growth. However, with further increase of social security spending also the indexation is less generous. Last year it amounts, in fact, to minimum level. Thus the assumption of minimum indexation seems reliable.
Figure 18: Ratio of average pension to average wage – widow’s/widower’s pensions solo

Figure 19: Ratio of average pension to average wage – widow’s pensions in concurrence
Figures 16 to 20 show the evolution of average pension to average wage ratio. The fall in the ratio is caused by the assumed indexation rate. Indexation was set equal to the minimum legal requirement (CPI inflation plus 1/3 of the real wage growth). It corresponds to the obligation adopted by the government but is significantly lower than the indexation applied in the past. The discrepancy between the current and the past indexation practice leads to the fall in the ratio.

Moreover, there are other factors at play in case of the old-age pensions. The fall in the ratio of average old-age pension to average wage is more apparent because of a gradual increase in the number of early retirement permanently reduced pensions (this scheme was introduced in the mid-1990’s and it will amend the structure of benefits in the next two or three decades) and because of the gradual increase in the retirement age\(^{12}\) that slows down the inflow of higher (compared to average pension) newly granted pensions.

Non mandatory pensions

The voluntary, fully funded and state-subsidized pension scheme based on defined contribution (DC) is already more than 10 years in existence in the Czech Republic. However, this third pillar is rather considered to be advantageous way of saving due to state contribution and very often due to employer’s contribution. That is why the people who enter this scheme finally choose mostly lump sum rather than lifetime annuity.

Projections of non-mandatory pensions are very simple, using the available data of Association of Pension Funds (APF). Unfortunately they are available only for the revenue side. Thus we were not able to provide projections of expenditures, benefits, assets and reserves.

The numbers of contributors are expected to rise with declining intensity: its growth in 2008 amounts to an average from the past (i.e. 7.5%) and then the increase is by 1.5 p.p. lower each following year up to 2012. From 2013 onwards the numbers develop with the population growth. Under this condition the structure of contributors by age and sex remains the same like in 2007 (last known data) over the whole range of projection.

Contributions are simply a product of the number of contributors multiplied by an average contribution, while the latter is projected to develop in line with the labour productivity growth.

Following table provides a picture of assumed development of personal contributions and the state subsidy over years of projection.

<table>
<thead>
<tr>
<th>Table 3: 3rd pillar contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Number of contributors</td>
</tr>
<tr>
<td>1000 persons</td>
</tr>
<tr>
<td>Total Contributions</td>
</tr>
<tr>
<td>% of GDP</td>
</tr>
<tr>
<td>- of which: contributions</td>
</tr>
<tr>
<td>% of GDP</td>
</tr>
</tbody>
</table>

\(^{12}\) However, in the long run it will contribute to rise in the ratio since the period, in which the pension is disbursed, will be shorter. Thus the relative gap between the average pension and the average wage will become narrower.
<table>
<thead>
<tr>
<th>- of which: state subsidies</th>
<th>mil EUR 2007</th>
<th>88</th>
<th>177</th>
<th>233</th>
<th>285</th>
<th>336</th>
<th>384</th>
<th>428</th>
<th>478</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of GDP</td>
<td></td>
<td>0.09</td>
<td>0.14</td>
<td>0.16</td>
<td>0.14</td>
<td>0.14</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
</tbody>
</table>
Denmark

Description of the pension projection model and its base data
The projection of public and private pensions is done with different models. Therefore the description is split in two parts, one describing the modelling of public pensions and one describing the modelling of the private pensions.

Public pension schemes

General Description of the model
In the projection of the number of recipients of public pensions, the shares of the population in the various schemes (broken down by age, gender and ethnic origin) are assumed constant after 2015. In the years up to 2015 the number of recipients and the pension per recipients comes from a medium-term projection which takes account of the business cycles and recent economic reforms (including pension reforms). The average pension benefit (per pensioner) in real terms is assumed constant at the 2007 level. In the projection period, the pension rate is indexed to the wage growth according to the Rate Adjustment Percentage Act.

Data
The number of pensioners in each scheme broken down by age, gender and ethnic origin is from the Register based labour force statistics (RAS) provided by Statistics Denmark. The levels from RAS are adjusted to measure full-year recipients in the “Cohesive social statistics” also published by Statistics Denmark.

Assumptions and methodologies applied
In the national model for the long-term projections of public expenditures, the population is distributed by age, gender and origin of birth (immigrants, descendants and natives) and the share of the population in different pension schemes are also distributed by age, gender and origin. Since the AWG population projection is only distributed by age and gender it is assumed that the distribution by origin is the same as in the national projection.

The pension supplement in the public old-age pension system is reduced if the pensioner has income beside the public old-age pension (for example pension from the private pension schemes). The projected increase in payouts from the occupational and private schemes implies that the number of public old-age pensioners with a significant private pension income is higher. The expenditures on the pension supplement per pensioner will hence decrease over time. This feature has not been included in the model, which leads to an overstatement of the expenditures on public pensions.

The share of the population receiving civil servant pension is gradually reduced so that less than 20.000 persons receive civil servant pension in 2060 compared to around 130.000 persons in 2007. The reduction stems from the changes in employment form where public employees are increasingly covered by contribution-financed and contribution-defined pension schemes.
The pensions are indexed to the wage growth according to the Rate Adjustment Percentage Act. The wage growth in the AWG projection is equal to the inflation rate plus the country specific labour productivity growth rate.

**Incorporation of recent reforms**

The Welfare Reform from 2006 has been incorporated in the model. The main features of the reform are an increase in the retirement age with 2 years (from 2019-2022 for the VERP and from 2024-2027 for the old age pension) and an indexation of the retirement age to the life expectancy for 60 year olds from 2025. The expected effect of the reform is an increase in the retirement age from 65 years in 2007 to 72 years in 2060 with the AWG assumptions of life expectancy.

**Private and occupational pension schemes**

**Institutional context**

The AWG calculations relating to private pensions have been done with a model developed by the Ministry of Finance, building on the DREAM\(^\text{13}\) model. The model is also used in relation to the Convergence Programme with respect to pensions. In relation to the AWG calculations, only data and assumptions (about interest rate, GDP growth etc.) have been changed, not the model. DREAM is a dynamic computable general equilibrium (CGE) model with overlapping generations of households that plan their behaviour consistent with rational expectations.

The calculations have not been submitted to a peer review.

**Assumptions and methodologies applied**

All relevant macro numbers are implemented in line with the AWG assumptions. Annual hours worked by age and gender is used as input in the model and have been calculated using the information on total hours worked on the aggregate age cohorts supplied by AWG (15-24, 25-54, 55-71). For each aggregate, the annual hours worked for each age cohort (15, 16, …) have been calculated using the annual hours worked from the Convergence Programme and the number of employed persons from AWG. The number of hours has hereafter been calibrated to make sure the numbers match the AWG projection.

**Data used to run the model**

In addition to the AWG data, data from DREAM (originally from the tax authorities) is used to construct contributions to occupational and private pensions.

**Reforms incorporated in the model**

As described under public pensions.

---

\(^{13}\) Danish Rational Economic Agents Model.
**General description of the model**

The projection of occupational and individual private pensions schemes are based upon a cohort approach. Meaning that each generation accumulates pension wealth \( (PW) \) upon an individual account, according to

\[
PW_t = C_t - B_t + (1 + i)PW_{t-1}
\]

Where \( C \) is the annual contribution, \( B \) is the annual benefit/out-payment from pension’s schemes as retiree and \( i \) the rate of return to the accumulated pension wealth. The generational pension wealth evolves with net contribution and rate of return on accumulated assets.

Occupational and private pensions can be paid out either as a one time payment (capital pension) or over several years (either as an annuity for 10 years or as a life long payment). In the model it is assumed that the 3 pension types are paid out over a number of years:

- Capital pension: Paid out over 11 years starting from the retirement age for VERP
- Annuity pension: Paid out over 17 years starting from the retirement age for VERP
- Life-long pension: Paid out from the retirement age for old age pension until death

The future pension payments are calculated on an individual basis based on information about contributions, interest rate and mortality rates. The aggregate contributions and benefits are calculated as the sum of the individual numbers.

The tax payments have been calculated outside the model. Payments from pensions are taxed as personal income. The progressivity of the tax system has not been modelled; instead an average tax rate (calculated from the level in 2007) is applied to payments from pensions.
Germany

Model description

The pension model for the statutory pension scheme is operated jointly by the federal Ministry of Labour and Social Affaires and the German Pension Insurance (Deutsche Rentenversicherung). Based upon this model both the contribution rate and the annual pension adjustment are set. A working group on pension projections consisting of experts from the Ministry and the German Pension Insurance is responsible for the projection of the financial development of the statutory pension scheme.

The pension model basically consists of two sub models, a cohort model for the projection of the demographic impact on pension expenditures and a model for the calculation of the dynamic financial development regarding the pension adjustment and the contribution rate. Additionally, there are two major sub modules which capture the evolvement of future working careers and the quite complex interactions between different pension types, the effects of early retirement and the rising statutory retirement age.

The model distinguishes between Western Germany and the Eastern part of Germany due to different pension point values.

As is the case in all long term calculations, it should be born in mind that the inherent uncertainty of projections increases exponentially with the time horizon. Projections over a time period covering a quarter to half a century span the entire work career of an entire generation. They should be interpreted with care and not seen as forecasts with any degree of certainty.

1 Source of data

The models incorporate data from numerous sources. Most data relating to pensions is provided by the official statistics of the Deutsche Rentenversicherung (DRV). Population data is provided by the Federal Statistical Office (Statistisches Bundesamt). The set of long-term demographic and macroeconomic assumptions is set by the governmental Commission on "Achieving financial sustainability for the social security system" and supplemented by short and medium term economic forecasts of the government. For this projection exercise however, the commonly agreed (AWG) assumptions were used. The following data sets are included:

- number of pensions (DRV)
- average pension benefit of the persons already retired (DRV)
- new pensions (DRV)
- average pension benefit of new pensions (DRV)
- population projection and mortality rates (AWG scenario)
- labour market (AWG scenario)
- wages (AWG scenario)
1.1 The demographic pension model

The demographic pension model is based upon a cohort approach. In general, the number of pensions in t+1 (the model works with the number of pensions, not with the number of pensioners as it is possible to receive an old age pension and a survivor's pension at the same time) equals the number of pensions in t plus new pensions less pensions expiring due to death. The average pension in t+1 is calculated as a weighted average of the new entrants pension and the average pension in t corrected for expiring pensions.

The following figure illustrates the main dependencies of this model for Western Germany:

Figure 1: The demographic pension model

The number of expired pensions in each projection year is equal to the number of pensions in t multiplied by the mortality rates given in the AWG population scenario. Conditional on age and gender specific marriage probabilities, spouses of the deceased retirees will be granted new survivor pensions. Newly granted old-age and disability pensions are calculated with the probabilities of pension entry estimated on behalf past trends, while also taking into account the legislated increase of the statutory retirement age.

The projection of the average pension benefits is similar to the calculation of the number of pensions. In addition, the impact of changes in the labour market regarding unemployment and activity rates is taken into account projecting the pension entitlement. Also, the deduction on pensions in the case of early retirement is considered.

Multiplying the number of pensions by the average pension benefit yields non-dynamic pension expenditures. At this stage no indexation of pension benefits is taken into account yet.
Hence, these non-dynamic expenditures capture only demographic and labour market trends and reforms that are projected to alter the retirement decision of future generation pensioners.

This model is slightly modified for the projection of pension expenditures in the Eastern part of Germany to account for differences in per capita income, probabilities of pension entry and pension benefits. However, it is assumed that the share of insured persons in the statutory pension scheme and average income levels in both parts of Germany will converge. Therefore, probabilities of pension entry and pension benefits are also assumed to converge to Western German levels over time (by 2015, respectively 2050).

1.2 The financial pension model

The financial pension model has the purpose to project dynamically evolving pension expenditures based on the non-dynamic pension expenditures and macro-economic assumptions. The major driving force between non-dynamic and dynamic pension expenditures is the indexation of pension benefits or, more precisely, the calculation of the pension point value. Furthermore, the contribution rate for the statutory pension scheme is calculated by means of the financial pension model. This happens under the constraint, as stipulated by law, that revenues and expenditures have to be balanced every year.

Starting from the non-dynamic pension expenditures, multiplied by the change in the pension point value, the model then shows the evolution of dynamic pension expenditure under consideration of other expenditure items (as rehabilitation or administrative costs). The indexation of the pension point value depends on the increase of gross wages (in this case given by the AWG), changes in the contribution rate and the sustainability factor, which evolves with the change in the contributors/pensioner ratio as explained above.

The revenues of the pension system stem from pension contributions and governmental subsidies. Flows from the budget are adjusted for wage growth and the change of the contribution rate. The corresponding mechanism follows rules encoded into law. Contributions depend upon the number of employees, the number of unemployed as the Federal Employment Office (Bundesanstalt für Arbeit) is transferring contributions for the unemployed to grant them pension claims, the evolution of wages (AWG scenario) and the contribution rate. The contribution rate is set annually under the constraint that revenues meet expenditures.
1.3 Assumptions for the AWG projection

The assumptions agreed by the AWG are applied in the present exercise. All legislated pension reforms are taken into account. In particular the increase in statutory retirement age is considered.
Annex – The Adjustment Formula

Pensions are adjusted every year on 1st of July. The adjustment formula is stipulated as follows:

\[
ppv_t = ppv_{t-1} \cdot \frac{ae_{t-1} \cdot 100 - rf_{t-1} - cr_{t-1} \cdot \left(1 - \frac{pc_{t-1}}{pc_{t-2}}\right) \cdot \alpha}{ae_{t-2} \cdot 100 - rf_{t-2} - cr_{t-2} \cdot \left(1 - \frac{pc_{t-1}}{pc_{t-2}}\right) \cdot \alpha + 1}
\]

- \(ppv\) = pension point value
- \(ae\) = average income based on National Accounts
- \(ae^*\) = adjusted average income
- \(rf\) = contribution rate to subsidised private pension scheme (2008: 2.0%, 2009: 2.5%, … ,2012 ff: 4.0%)
- \(cr\) = contribution rate to statutory pension scheme
- \(pc\) = equivalent pensioners/contributors ratio
- \(\alpha\) = allocation factor = 0.25

In general, the pension point value is adjusted in line with the growth of average earnings, but this increase is reduced by the so-called Riester-factor and the sustainability factor. However, the adjustment of the pension point value may not be lower than zero.

Regarding the calculation of the increase of average earnings, National Accounts figures are used as a basis. To take into account differences in the increase of average earnings based on National Accounts and average earnings of contributors to the statutory pension scheme, a correction factor is integrated into the formula: The time lag of this correction factor is t-3 due to statistical reasons. A lower increase of contributors' average earnings compared to National Accounts' average earnings leads to a decrease of the adjustment and vice versa.

\[
ae_{t-2}^* = \frac{ae_{t-2} \cdot ae_{t-3}^{ps}}{ae_{t-2}^{ps} \cdot ae_{t-3}^{ps}}
\]

- \(ae^*\) = adjusted average income
- \(ae\) = average income based on National Accounts
- \(ae^{ps}\) = average income of contributors to the statutory pension scheme

The so-called Riester-factor leads to a reduction of the adjustment if the contribution rate e.g. to the statutory pension scheme has increased in the previous year. Up to 2013 a reduction of adjustment will also take place due to the implied increase of the contribution rate to the subsidised private pension scheme. For example, if the contribution rate to the statutory pension scheme increases from 19.5 % to 19.6 %, the adjustment is reduced by 0.13 percentage points.
In order to maintain the long term financial sustainability of the statutory pension scheme, the sustainability factor is included in the adjustment formula. This factor causes a reduction of the adjustment if the number of those financing the system (contributors) decreases and/or if the number of pensioners increases. Therefore, the sustainability factor is calculated on the basis of the change of the pensioner/contributor ratio. As changes in part-time/full-time work should be eliminated, the number of pensioners and contributors are calculated on the basis of equivalents, which are defined differently for Western and Eastern Germany.

\[
\text{(4) } pc = \frac{ePen_w + ePen_E}{eCon_w + eCon_E}
\]

\[
\text{pc} = \text{pensioner/contributor ratio} \\
\text{ePen} = \text{equivalent pensioners} \\
\text{eCon} = \text{equivalent contributors} \\
W, E = \text{Western, Eastern Germany}
\]

The number of equivalent pensioners is calculated as follows:

\[
\text{(5) } ePen = \frac{PE}{sp}
\]

\[
\text{PE} = \text{pension expenditure} \\
\text{sp} = \text{standard pension},
\]

The standard pension is a pension based on 45 pension points multiplied by the current pension point value (e.g. 26.56 € / month in Western Germany in 2008). By dividing the pension expenditures by a "standard pension" the number of "standard" or equivalent pensioners is obtained.

A similar approach is used for calculating the equivalent contributors: Total contributions are divided by a "standard" contribution, which has to be paid for earning one pension point, to receive the number of equivalent contributors.

\[
\text{(6) } eCon = \frac{CR}{sc}
\]

\[
\text{CR} = \text{contribution paid by employees and the unemployed} \\
\text{sc} = \text{standard contribution}
\]
Summing up, the effect of the sustainability factor is as follows: For example an increase of life expectancy of 10% would lead to an increase of the number of pensioners of also 10% and therefore - at a first view - to the same increase of expenditures. But due to the sustainability factor the annual pension adjustment would be lowered, so that the increase of pension expenditures in this case would be below 10%. Therefore the increase of the financial burden on contributors is limited. Regarding the number of contributors, the same mechanism operates. Hence, the impact of the sustainability factors depends on the demographic and economic development and therefore differs in respect to the underlying assumptions.
**Estonia**

**Description of the pension projection model and its base data**

The pension projections model is managed by the Insurance Policy Department of the Ministry of Finance of Estonia.

The models structure is in following graph:

- **Population projection model:**
  The model applies initial fertility, mortality and migration rates age specifically to a statistically observed initial population. The model can accommodate alternative assumptions regarding the future development of fertility and mortality rates.

- **To carry out projections the following data is used:**
  - Initial population: \( \{L (x, 0, s); \text{for all } x, s\} \)
  - Mortality rates: \( \{q (x, t, s); \text{for all } x, t, s\} \)
  - Fertility rates: \( \{F (x, t); \text{for } x=15, 49, \text{for all } t\} \)
  - Sex ratio of the newborn: \( \text{SR} \)
  - Net migration: \( \{N (x, t, s); \text{for all } x, t, s\} \)

  There \( x \) - age, \( t \) - time, \( s \) – gender.

- **Assumptions for economic indicators:**
  The model contains basic macro-economic assumptions as inputs (on GDP, labour productivity and wage growth, future inflation etc). These assumptions have automatic links and also feedback in the model.
Future productivity increases and average unemployment rates (for men and women) are exogenous inputs (assumptions). These two assumptions allow seeing the impacts of less or more to GDP development. Future inflation rates (GDP deflator and CPI) are also exogenous. GDP growth rate for each year results from the change of employees and change of labour productivity.

$$\text{Real GDP growth} = (1 + \text{labour productivity growth}) \times (1 + \text{change of employees}) - 1$$

**Labour market projection:**

Labour force by age and sex is calculated by multiplying population by labour force participation rates for single ages up to the age of 100. In projections it is possible to change the level and the structure of participation rates. Unemployment is calculated by using general trend of unemployment rates and change in unemployment age structure. Employed persons are the difference between the labour force and the unemployment.

**Pension projection:**

In general the model calculates the number of insured who are actually contributing (for the I and II pillar) by applying compliance rates to the employed, by individual age and sex and also their actual wage, from which they pay taxes (this differs from national average wages). Numbers of pensioners for I and II pillar old age pensioners are calculated by applying retirement rate to the population. Difference between the number of pensioners of age x in year t and the surviving pensioners of age x-1 of year t-1 is taken as the number of new pensioners. Other pensioners (disability, survivor) are calculated by initial data and change vector as follows:

Disability pensioners = population * disability structure base year * disability change

Average pension amounts for all ages for old age pensioners are calculated on the basis of actual pension formula:

$$P = B + V \cdot s + V \cdot \sum A$$, see description above.

Base and V values are indexed, which results from macroeconomic and labour force projections. S value is real data and this has remained unchanged from 1999. The values are taken from wage statistics. Averages for all age cohorts are used.

To calculate mandatory funded pillar pensions, contribution rate is applied to the wage and these contributions will be accumulated with return rate. Finally it will be turned into annuities, using annuity return rate and unisex life expectancy.

**Output:**
Outputs of the projections are the overall expenditure and revenue of the public pension budget, II pillar assets, transfers from I pillar to II pillar, average pensions and replacement rates, different system indicators etc. For this projections are imported from other parts of the model and then consolidated to overall level.
Ireland

1. Pension Projections Methodology

1.1. Institutional Context

The projections presented as part of this exercise were undertaken by the Department of Finance.

1.2. Underlying Assumptions

Tables 8 and 9 present the demographic and macroeconomic assumptions that underlie the pension projection results for Ireland. These correspond to those agreed by the Economic Policy Committee’s Ageing Working Group\textsuperscript{14}.

### Table 8: Demographic Assumptions

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertility rate</td>
<td>1.90</td>
<td>1.90</td>
<td>1.89</td>
<td>1.89</td>
<td>1.88</td>
<td>1.88</td>
<td>-0.02</td>
</tr>
<tr>
<td>Life expectancy: Male</td>
<td>77.4</td>
<td>79.2</td>
<td>80.7</td>
<td>82.2</td>
<td>83.5</td>
<td>84.7</td>
<td>7.4</td>
</tr>
<tr>
<td>Female</td>
<td>81.7</td>
<td>83.5</td>
<td>85.0</td>
<td>86.3</td>
<td>87.6</td>
<td>88.8</td>
<td>7.0</td>
</tr>
<tr>
<td>Net migration flows (000s)</td>
<td>63</td>
<td>22</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 9: Macroeconomic Assumptions

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP growth (y-on-y %)</td>
<td>5.1</td>
<td>2.9</td>
<td>2.3</td>
<td>1.8</td>
<td>1.6</td>
<td>2.0</td>
</tr>
<tr>
<td>Labour input growth (y-on-y %)</td>
<td>2.9</td>
<td>1.0</td>
<td>0.7</td>
<td>0.1</td>
<td>-0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Labour productivity growth (y-on-y %)</td>
<td>2.2</td>
<td>1.8</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Population growth of 15-64 year olds (y-on-y %)</td>
<td>2.7</td>
<td>1.0</td>
<td>0.6</td>
<td>0.0</td>
<td>-0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Employment growth of 15-64 year olds (y-on-y %)</td>
<td>3.4</td>
<td>1.0</td>
<td>0.6</td>
<td>0.0</td>
<td>-0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Participation rate of 15-64 year olds (%)</td>
<td>72.5</td>
<td>75.7</td>
<td>75.7</td>
<td>76.0</td>
<td>76.3</td>
<td>76.3</td>
</tr>
<tr>
<td>Employment rate of 15-64 year olds (%)</td>
<td>69.1</td>
<td>71.8</td>
<td>71.9</td>
<td>72.1</td>
<td>72.5</td>
<td>72.4</td>
</tr>
<tr>
<td>Unemployment rate of 15-64 year olds (%)</td>
<td>4.7</td>
<td>5.1</td>
<td>5.1</td>
<td>5.1</td>
<td>5.1</td>
<td>5.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Real interest rate (%)</th>
<th>3.0</th>
<th>3.0</th>
<th>3.0</th>
<th>3.0</th>
<th>3.0</th>
<th>3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation rate (%)</td>
<td>-2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**1.3. Projection Methodology**

Ireland’s projection methodology is reasonably straightforward. It may be described as a partial equilibrium approach which produces pension projections based on a set of demographic and macroeconomic assumptions. An overview of the approach is presented below.

**1.3.1. Social Security Pensions**

*Number of Pensioners:* In projecting forward the number of Social Security pensioners, the starting point is the proportion of the population aged 65/66 and over in receipt of pension payments of the types covered by the ‘Old-Age and Early pensions’ category, and the proportion of those aged 65 and under covered by the ‘Other pensions’ category. On the basis of assumptions as to how these proportions will change between 2007 and 2050 (reflecting the ongoing move towards a more contributory based Social Welfare system and increased labour force participation), the number of recipients of the various pension payments in a given year is calculated via a gradual move between the start and end points. The move between the two points takes into account demographic developments and also changes in the employment rate where relevant.

With respect to disaggregating pensioners by age, the pensioner numbers reported in the ‘Old-Age and Early pensions’ and ‘Other pensions’ categories relate to pensioners who are for the most part aged 65/66 and over in the case of the former, and 65 and under for the latter. Thus, an age breakdown broadly in line with those above and below pension age (65/66) is provided.

*Pension Expenditure:* Gross pension expenditure projections adopt a bottom-up approach. The projection methodology takes the 2007 rates of payment applicable to the various pension payments plus appropriate extra allowances as the starting point. Thereafter, the State Pension (Contributory) rate is indexed to nominal earnings with all other rates rising at the same flat rate. An estimate of overall spending is provided by multiplying the projected payment rates for each year by the number of pensioners claiming each type of payment.

Net pension expenditure projections are not provided.

*Contributions:* Social Security pensions in Ireland are financed through a combination of PRSI contributions (Social Insurance pensions) and general tax revenues (Social Assistance schemes; Social Insurance schemes in the event of a shortfall in contributions). The projected value of Pay Related Social Insurance contributions (employer, employee and self-employed) is held constant over the entire timeframe at the 2007 rate of 4.2% of GDP.

---

15 The figures for pensioners in receipt of the State Pension (Contributory), State Pension (Transition) and State Pension (Non-Contributory) also include adult dependents some of whom may be below 65/66 years in age (Data source: Department of Social and Family Affairs).

16 However, increases for means tested pensions are adjusted downwards in line with the current means adjustment mechanism in place for the State Pension (Non-Contributory) and Widow / Widower’s Non-Contributory schemes. As such, the difference between contributory and non-contributory payment rates that applies in 2007 is maintained throughout the projection period.
It should be noted that PRSI revenue is used to fund a wide range of social insurance benefits, not just pensions. While pension expenditure absorbed approximately 65% of contribution income in 2007, this is projected to rise to almost 180% by 2060.

An estimate of the taxation revenues used to finance Social Assistance pension payments is not reported here.

**Number of Contributors:** The number of individuals paying PRSI in 2006 (the most recent year for which this data is available) is taken as the base figure when projecting forward contributors\(^\text{17}\). Over time, the number of contributors is assumed to grow in line with the employment growth rate of those aged 15-65.

### 1.3.2. Public Service Pensions

**Pension Expenditure:** The Public Service pension expenditure projections set out in Table 2 represent an update of the detailed analysis carried out by the Commission on Public Service Pensions (2000), and are based on the large number of assumptions made at that time in relation to withdrawals, age, illness and retirement patterns\(^\text{18}\). Actual spending on Public Service pensions in 2007 is taken as the starting point and the number of public servants is assumed to remain constant over the projection period. Reforms implemented in 2004, including the raising of the minimum pension age and the removal of a compulsory retirement age for most new public servants, are accounted for in the projected spending figures.

As in the case of the Social Security projections, net pension expenditure estimates are not reported as it is impossible to distinguish Public Service pension income from non-pension income on the basis of tax records.

**Number of Pensioners:** Projections in relation to the number of Public Service pensioners allow for an increase over time in line with the general age and gender profile of the sector.

**Contributions:** The contribution projections reflect the different contribution rates in place for many pre-1995 and post-1995 public servants. This situation follows from the Government’s decision that new entrants to the Public Service after 6 April 1995 should be in the full PRSI class. The number of public servants is assumed to remain constant over the projection period. The results show a fall in Public Service contributions as a percentage of GDP from 0.4% in 2007 to 0.3% in 2060\(^\text{19}\).

### 1.3.3. National Pensions Reserve Fund (NPRF)

In projecting the assets of the National Pensions Reserve Fund out to 2060, the market value of the NPRF at end-2007 ($21 billion) is taken as the starting point. The fund is rolled forward on the basis of a real interest rate assumption of 3% and an annual contribution by the Exchequer of 1% of GNP until 2055. While withdrawals are permitted to begin in 2025, there are no set legislative rules as of yet governing the manner of draw-down. Thus, for the purpose of this exercise, a technical assumption is made that post 2025 draw-downs increase from an initial level in line with the rise in the population aged 65 and over from the base

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\(^{17}\) Data source: Department of Social and Family Affairs.

\(^{18}\) Current data on these patterns is not available for many of the numerous Public Service groups.

\(^{19}\) Note that the increase in average pension contributions applicable across the Public Service with effect from March 1 2009 is not taken account of here.
2025 figure. The draw-down level as a percentage of GNP is assumed to peak in 2055 before being scaled back so as to lead to the exhaustion of the Fund by 2070.
## Annex 1: Main Eligibility Requirements for First Pillar Pensions

<table>
<thead>
<tr>
<th>Pension Scheme</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State Pension (Contributory)</strong></td>
<td>Claimant must</td>
</tr>
<tr>
<td></td>
<td>▪ be 66 years or over</td>
</tr>
<tr>
<td></td>
<td>▪ have commenced paying PRSI contributions before age 56</td>
</tr>
<tr>
<td></td>
<td>▪ have at least 260 full rate contributions paid</td>
</tr>
<tr>
<td></td>
<td>▪ from 2012 have at least 520 full rate contributions paid</td>
</tr>
<tr>
<td></td>
<td>▪ a yearly average of 48 paid / credited since 1979 to the end of the relevant tax year or a yearly average of 10 paid / credited since 1953 (or since commencement of insurable employment if later) to the end of the relevant tax year</td>
</tr>
</tbody>
</table>

| **State Pension (Non-Contributory)** | Claimant must                                                                                 |
|                                      | ▪ be 66 years or over                                                                          |
|                                      | ▪ satisfy a means test                                                                          |
|                                      | ▪ satisfy the Habitual Residence Condition                                                     |

| **State Pension (Transition)**       | Claimant must                                                                                 |
|                                      | ▪ be 65 years                                                                                 |
|                                      | ▪ have commenced paying PRSI contributions before age 55                                        |
|                                      | ▪ have at least 260 full rate contributions paid                                               |
|                                      | ▪ from 2012 have at least 520 full rate contributions paid                                     |
|                                      | ▪ a yearly average of 48 paid / credited since 1979 to the end of the relevant tax year or a yearly average of 24 paid / credited since 1953 (or since commencement of insurable employment if later) to the end of the relevant tax year |

| **Widow(er)’s Contributory Pension** | Claimant must                                                                                 |
|                                      | ▪ be widowed or divorced from late spouse and not remarried / cohabiting                        |
|                                      | ▪ have 156 weeks PRSI paid before pension age / death of spouse                                |
|                                      | ▪ an average of 39 weeks PRSI paid / credited over 3 or 5 tax years (whichever is most beneficial) before pension age / death of spouse or an annual average of 24 PRSI contributions for a minimum pension, or an average of 48 for a maximum pension |

| **Widow(er)’s Non Contributory Pension** | Claimant must                                                                                 |
|                                        | ▪ be widowed or divorced from late spouse and not remarried / cohabiting                        |
|                                        | ▪ satisfy a means test                                                                          |

| **Invalidity Pension**                | Claimant must                                                                                 |
|                                      | ▪ be deemed incapable of work due to illness                                                   |
|                                      | ▪ have 260 PRSI contributions paid                                                            |
|                                      | ▪ have 48 PRSI contributions paid / credited in the relevant tax year                         |
### Illness Benefit

**Claimant must**
- be unable to work due to illness
- be under 66 years
- have at least 52 weeks PRSI contributions paid (104 weeks from January 2009) and 39 weeks PRSI contributions paid / credited in the relevant tax year (13 of which must be paid contributions) or 26 weeks PRSI contributions paid in the relevant tax year and 26 weeks PRSI contributions paid in the tax year immediately before the relevant tax year

### Disability Allowance

**Claimant must**
- satisfy the Habitual Residence Condition
- have a disability that has continued or is expected to continue for at least one year and causes an inability to do work that would otherwise be suitable
- be between 16 and 65 years
- satisfy a means test

### Carers Allowance

**Claimant must**
- be 18 years or over
- satisfy a means test
- be in close proximity to the person they are caring for
- care for the person on a full-time basis
- not be employed outside the home for more than 15 hours a week
- be resident in the State
- not live in a hospital or similar institution

**Person claimant cares for must**
- be so disabled as to need full-time care and attention
- not normally live in a hospital or similar institution
- be 16 years or over or under age 16 if a Domiciliary Care Allowance is being paid

### Carers Benefit

**Claimant must**
- be 16 or over but under 66
- have been in employment for at least eight weeks in the previous 26 weeks before becoming a carer (have worked for a minimum of 16 hours per week or 32 hours per fortnight)
- be in close proximity to the person they are caring for
- care for the person on a full-time basis
- not be employed outside the home for more than 15 hours a week
- be resident in the State
- not live in a hospital or similar institution
- have 156 weeks PRSI contributions paid between entry into insurance and the time the claim is made and 39 weeks PRSI contributions paid in the relevant tax year or 39 weeks PRSI contributions paid in the 12 month period before the commencement of the Benefit or 26 weeks PRSI contributions paid in the relevant tax year and 26 contributions paid in the relevant tax year prior to that

**Person claimant cares for must**
- be so disabled as to need full-time care and attention
- not normally live in a hospital or similar institution
<table>
<thead>
<tr>
<th>Scheme Name</th>
<th>Claimant must</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blind Persons Pension</strong></td>
<td>• be 18 years or over</td>
</tr>
<tr>
<td></td>
<td>• be blind or have serious vision impairment</td>
</tr>
<tr>
<td></td>
<td>• be resident in the State</td>
</tr>
<tr>
<td></td>
<td>• satisfy a means test</td>
</tr>
<tr>
<td><strong>One Parent Family Payment</strong></td>
<td>• be the main carer of at least one child</td>
</tr>
<tr>
<td></td>
<td>• be living with the child</td>
</tr>
<tr>
<td></td>
<td>• not be cohabiting</td>
</tr>
<tr>
<td></td>
<td>• have earnings of €425.00 or less per week (from May 2008)</td>
</tr>
<tr>
<td></td>
<td>• satisfy a means test</td>
</tr>
<tr>
<td></td>
<td>• satisfy the Habitual Residence Condition</td>
</tr>
<tr>
<td><strong>Pre-Retirement Allowance</strong></td>
<td>• be between 55 and 65 years of age</td>
</tr>
<tr>
<td></td>
<td>• be retired from the workforce</td>
</tr>
<tr>
<td></td>
<td>• satisfy a means test</td>
</tr>
<tr>
<td></td>
<td>• have received Job Seekers Benefit or Job Seekers Allowance for 15 months or</td>
</tr>
<tr>
<td></td>
<td>is no longer entitled to the One Parent Family Payment</td>
</tr>
<tr>
<td></td>
<td>• or to the Carer’s Allowance or is separated from his / her spouse</td>
</tr>
<tr>
<td></td>
<td>• and has not been working for the preceding 15 months</td>
</tr>
</tbody>
</table>
Annex 2: Main Features of Second Pillar Public Service Pension Schemes

Terms Applicable to all Pensionable Staff

Pensions
- 1/80th of net pensionable pay per year of service
- Net pensionable pay is pensionable pay less twice the State Pension (Contributory) for staff subject to integration and is full pensionable pay for others

Lump Sums
- 3/80ths of pensionable pay per year of service on retirement or earlier death

Spouse’s Pensions
- 1/160th of spouses net pensionable pay per year of service
- For spouses pension purposes, net pay is either full pensionable pay or pay less twice the rate of the State Pension (Contributory) or full pay less once the rate of the State Pension (Contributory) depending on the scheme
- Some public service staff and pensioners are not members of a Spouse and Children’s scheme

Maximum Benefits
- Based on 40 years of service

Public Servants with Standard Terms

Retirement Age
- For staff recruited prior to 2004 retirement is optional from age 60 with a maximum retirement age of 65
- For staff recruited since 2004 the minimum pension age is 65 and there is no maximum retirement age
- No integration applies for staff recruited prior to 6/4/95
- For staff recruited since 6/4/95, integration applies to main scheme and spouses pensions (where integration applies, a supplementary pension may be paid under certain conditions)

Public Servants with Special Terms

Retirement Age
- Gardaí and prison officers can retire from age 50, subject to 30 years service. Each year after 20 counts as double
- Retirement terms vary for members of the army
- Certain staff (mainly professional grades) may receive notional added years i.e. benefits are based on actual service plus extra years
- For some Public Service groups, many staff members recruited prior to 1995 were subject to integration either in part or in full
- Un-established civil servants have a minimum and maximum retirement age of 65
- Teachers (recruited prior to 2004) may retire from age 55 on, subject to having 30 years service
- Psychiatric nurses may retire from age 55. Service in excess of 20 years is doubled
Greece

Description of the pension projection model and its base data.

- Institutional context in which those projections are made.

The National Actuarial Authority, under its institutional Law, is the organisation which should perform yearly viability studies of the social security system. The International Labor Office (ILO) in collaboration with the National Actuarial Authority has made a projection for IKA-ETAM, OAEE, OGA and Public Sector with 2005 base year. The pension model was transmitted and exists in the NAA’s infrastructures. A group of the NAA’s personnel was trained during the last two years by the ILO; so as to be able to run current models, change them according to the assumptions and policy scenarios and also to elaborate further analysis of the pension system by analysing actuarially the rest of the Hellenic pension schemes.

For the current, 2008, study the ILO performed a peer review for the four modelled schemes to check whether new assumptions and policy regulations where properly incorporated in the model. A document reporting the result of the peer review is attached in Part E of the Annex.

The rest of the schemes where estimated using a non actuarial technique developed by an external actuarial partner of ILO, Mr George Langi and was applied by Mrs Marianna Papamichail, member of the NAA. Those results have not been examined by a peer review.

So we will refer for the four schemes as “Group1”, for the rest as “Group2” and for the loadings as “Group3”.

- Assumptions and methodologies applied

For the funds of the Group1:
The assumptions used are those given by the AWG at 2007. Other assumptions concern pension indexation, wage growth and members of the schemes projections, which are described in pages 4-6. Further assumptions concern:
  i. The salary and income distribution: They follow a normal distribution in each estimated sub group of men or women of a certain age.
  ii. Entry, exit and pension rates were extracted from the data base of the schemes for the years they were available, more or less three years 2003, 2004 and 2005.
  iii. Past service was also calculated from the historic figures of the members of the funds. Projected past service follows again a distribution fitted to historical data.

- General description of the ILO model(s)

The model estimates the revenues and expenses of the future which are based on the method of cohort decomposition by projecting year by year the figures that relate to insurants and pensioners, such as salaries and pensions. Special characteristic of this model is that it uses distributions and not average prices for insurants’ longevity and salaries.

The platform of this model is the Microsoft Office Excel and its core is written in Visual Basic for Application. The program’s structure being in a modularized form provides a great
degree of automatization. This fact ensures the best potential control of processes and its function.

The model also covers the highest security funds IKA -ETAM, OAEE, OGA and Public Sector. Each of the above has developed a separate system of files and archives such as the code VBA. However, these four funds are totally fed by certain common archives like mortality, population, workers, financial figures etc.

In general, for each scheme is applied the following:

The number of active population of IKA-ETAM and OAEE is estimated by applying the coverage rate to projected population by age and sex.

\[ \text{Active}(x, t) = \text{Coverage Rate}(x, t) \times \text{Population}(x, t) \]

The transition from active to pensioners is simply led by using transition probabilities:

\[ \text{New Invalidity Pensioners}(x + 1, t + 1) = \text{Active}(x, t) \times \text{Invalidity Rate}(x, t) \]

\[ \text{New Old-age Pensioners}(x + 1, t + 1) = \text{Active}(x, t) \times \text{Retirement Rate}(x, t) \]

\[ \text{New Survivors Pensioners}(x + 1, t + 1) \text{ are calculated by a subroutine of the model according to the eligibility provisions of each scheme and mortality.} \]

The financial part of the above transition is calculated by using the assumed acquired credit and past salary. The active population is classified by their acquired past credits and income level. The newly awarded pensions are estimated by applying the eligibility conditions for pensions and the pension formula to all groups of population by credit and salary. Nevertheless, if an active worker stays active for one year, the credit will increase by the contributed period.

The transition from pensioner to pensioner is simulated as follows:

\[ \text{Number of Pensioners}(x + 1, t + 1) = \]

\[ \text{Number of Pensioners}(x, t) \times (1 - \text{mortality}(x, t)) + \text{New Pensioners}(x + 1, t + 1) \]

\[ \text{Amount of Pensions}(x + 1, t + 1) = \]

\[ \text{Amount of Pensions}(x, t) \times (1 - \text{mortality}(x, t)) \times (1 + \text{indexation}(t)) + \text{Amount of New Pensions}(x + 1, t + 1) \]

The model is structured in groups of insurants (group files) with different characteristics. These groups, the economic-demographic file and mortality file constitute the input files.

For IKA-ETAM: twelve groups are established according to the first year of insurance (pre – post 1993) and the field of employment (general, arduous and constructions).

For OGA: there are eight groups according to the category of pension (main, basic, additional, and uninsured old-age) and the gender.

For OAEE: There are eight group files, which stem from the consolidation of TAE, TEBE and TSA, according to the gender and each of the above funds.
For the Public Sector employees: six files where established, according to the first year of insurance (pre 1993, between 1983 and 1992, post 1993) and the gender. There are also two files for the militaries and other two files for the pensioners, so as totally are ten files.

The ILO replacement ratio for the new pensioners is calculated by the average awarded pension, which is distributed and the average salaries of the activated insurants. The one presented in the results was especially calculated for the AWG and it only concern the groups of new pensioners (awards).

The model, calculates the correspondingly rates for each category of pension (old-age, disability and survivor), for the normal or minimum pension (old-age and disability) and for the type of survivor pension, depending where it stems from, (actives, old age pensioners, disability pensioners), as well. In general, the same philosophy is followed in every archive of results.

The active insurants’ careers are modeled according to the distributions and not the average of figures. Every age has distributions of the service years, which is based on real incidents and the distinction of salaries to low, medium and high. Moreover, there is a density factor for every age, which implies the rate of contributions that is paid, small to younger and high to older. The distribution of the service years changes yearly, according to the absence or not of the active fund and density factor. Salaries are also changed as a consequence from the evolution in financial figures.

It is obvious that there is no particular age of pension. According to the above distributions and eligibility conditions, pensions are awarded at any age. The pension’s rates are estimated by the pension formulas being integrated in VBA Code, as are the distributions and eligibility conditions of each scheme. Survivor pensions are given and calculated in the same manner, in relation to the enacted law of each fund.

- **Data used** to run the model.

Preparative to compiling the survey, a great number of statistic data were used. These data resulted from the statistic process of elements about insureds and pensioners individual by individual. The aggregate tables, having resulted from those elements, were used for the preparation of input files separately for each insurance scheme, either by themselves or after smoothing and adjustments.

As follows, the processed elements, which were used for each insurance scheme, are concisely projected:

- **IKA-ETAM** (12 groups in 2001-2005)
  - Number of contributors by number of days credited in the year.
  - Average wage by number of days credited in the year.
  - Number of contributors by level of monthly salary.
  - Number of insureds by number of days credited since registered.
  - Number of pensions and total amount paid in the year, according to the kind of pension (full, old-age, reduced old-age, disability, survivors).
  - Number of pensions by level of pension amount and the kind of pension.
  - Number of pension by insurance class and the kind of pension.
- Number of pensions at the beginning and the end of the year, new pensioners, exits by death, other exits, by the kind of pensions (cohort tables).
- Monthly average pension at the beginning and the end of the year, for new pensioners, for exits by death, for other exits, by the kind of pensions (cohort tables).
- Annual average old age pension (full, reduced).
- Number of disability pension by the ratio of disability (100%, 75%, and 50%).

### OGA (4 groups)
- Number of insureds by number of the registered months in the year and for each insurance class (2005, 2006).
- Number of insureds by number of the paid months in the year and for each insurance class (2005, 2006).
- Number of insureds by number of the registered months since register and for each insurance class (2005, 2006).
- Number of insureds by number of the paid months since register and for each insurance class (2005, 2006).
- Number of contributors by insurance class (2004, 2005).
- Average contribution by insurance class (2004, 2005).
- Average service by insurance class (2004, 2005).
- Number of contributors by status (continually, active, new entrants etc.).
- Number of contributors by marital status (2004, 2005).
- Number of pensions and amount of the pension (with increments) for old-age and disability pension (2004, 2003 and 2001).
- Number of awards average service and average amount of the pension (with increments) for old-age and disability pension (2003, 2004 and 2005).
- Number of pensions by level of pension for old-age and disability pension.
- Number of pensioners for each category (only Basic, Basic and Additional, only Additional, Basic and Main, only Main) (2004,2005)
- Number of main pensioners by service, including Additional Service.
- Number of main pension awards by service, including Additional Service (2004, 2005).
- Number of Additional (not main) pensioners by service (2004, 2005).
- Number of uninsured old-age pensioners (2004, 2005).
- Number of basic pensions (discrete values) by level of pension.

### Public Scheme (10 groups)
- Number of insureds by years of service (2004, 2005).
- Number of insureds of municipalities by years of service (2005, 2006).
- Number of insureds by salary scale and education level (2005, 2006).
- Number of insureds of municipalities by salary scale and education level (2005, 2006).
- Number of insureds by hiring age (2005,2006)
- Number of new entrants for municipalities (2005, 2006)
- Data for air force insureds, meaning the hiring duty, marital status, salary scale, years at the service, contributors, new entrants and new erases.
- Number of pensioners and annual amounts of the pension (with allowances) both for each kind of pension (old-age, disability and survivors) and for each category of pension (Civil, Military and War), (2002, 2003, 2004, 2005).
- Number of awards and average amounts of the pension for each kind of pension (old-age, disability and survivors) and for each category of pension (Civil, Military and War), (2002, 2003, 2004, 2005).

**OAEE**

The three former sub-funds’, TEBE, TAE and TSA plus the new fund’s data were required for the valuation. All four funds work on the basis on presumptive earnings.

- Sex
- Date of birth
- Number of protected members
- Insurance Class
- Number of contributions in each class
- Amount of money paid within the year
- Date of first pension
- Date of last pension

These data were used in a way different than the rest of the funds, since presumptive earnings and insurance classes allow for an easy tracking of each insured or pensioners throughout the years. Aggregate tables were also made, having always in mind that the insured switch from one class to another every three years, and the sums for contributions and pension percentages earned each year are fixed.

Besides the above data, concerning distributions by age and gender, we have also used aggregate statistic data, which were given by Statistic Departments of the schemes as well as figures of revenues and expenses by Account Departments. In addition, macroeconomic data and other that refer to the provisions of each scheme such as amounts of salaries, allowances, insurance classes etc.

**For the funds of the Group2:**

The assumptions used are those given by the AWG at 2007. Other assumptions concern pension indexation, wage growth and members of the schemes projections, which are described in pages 4-6. Further assumptions concern the:

i. Age distribution of contributors =
   IKA-ETAM age distribution of contributors, moved to fit average age.

ii. Contribution’s valuation = number of contributors * contribution.
   Number of contributors (x, t) =
   Contributors(x,t-1)* [1+IKA-ETAM evolution of contributors(x, t-1, t)]

iii. Contribution (t) =
    Average contribution (t-1) * [1+ Change of the average salary (t-1, t)]

iv. Age distribution of pensioners = IKA-ETAM age distribution of pensioners, moved to fit average age.

v. Benefits valuation = pensioners * amount of pension
   Pensioners(x, t) =
   Pensioners (x, t-1) * [1 + IKA-ETAM evolution of pensioners(x, t-1, t)]

vi. Amount of pension (t) = average pension (t-1)* (1+ %pension indexation)

**For the funds of the Group3:**
There has been a loading on the amount of total contributions of 10.8% and another on the amount of total benefits of 11.0%.

- **Reforms incorporated in the model.**

IKA –ETAM was the scheme that was mainly affected by the reform. Detailed analysis of the past and the reformed legal provisions of IKA-ETAM on eligibility conditions exist in the Part A of the Appendix.

However, due to methodological and time constraints, this study does not incorporate a number of potentially important aspects of the recent reform (Law 3655/2008), including:

- The reduced fragmentation of the system, by limiting the number of funds from 133 to 13, significantly reducing administrative costs and improving monitoring and supervision.
- Financial incentives for extending working lives by up to 3 years past the statutory retirement age and increased disincentives for early retirement.
- The strengthened provisions regarding maternity leave, aimed at facilitating female participation in the labor market.
- The establishment of the Insurance Fund for Inter-generational Solidarity (AKAGE), which will accumulate reserves in order to finance pension payments of social security funds for the years beyond 01.01.2019. Starting 01.01.2009, AKAGE will be funded by:
  - 10% of annual total privatization revenue,
  - 4% of the annual VAT revenue,
  - 10% of total annual receipts from special social resources of Social Insurance Funds, branches or accounts, as described in article 150 in Law 3655/2008.
- The introduction of the Individual Social Security Number, effective from 01.06.2009, allowing, inter alia, for improved expenditure control. The introduction of the Individual Social Security Number, which is expected to lead to increased expenditure control and to assist employment inspection, thus contributing in reducing contribution evasion.

Some of these provisions may be incorporated indirectly within the existing modeling framework and there are plans to proceed in this direction in the future.

**Additional information, References**

Spain

PROJECTION METHODOLOGY AND ASSUMPTIONS

1. Description of the public pension projection model and its base data

- Institutional context in which those projections are made:
  - The model is made by the University of Barcelona, in the framework of collaboration with the Ministry of Economy and Finance.
  - The model has been submitted to academic review as several academic publications have been based on it. Also, assumptions and results have been compared with the Social Security (Ministry of Labour and Immigration) own projections.

- General description of the model(s)
  The projections of public pensions are composed by 4 independent and deterministic models:
  - Model 1. A model for projecting old age and early retirement public pension expenditure administered by the Social Security, for private sector employees, the self-employed and the public sector employees of the regional and local administrations.
  - Model 2. A model for projecting disability public pension expenditure administered by the Social Security, for private sector employees, the self-employed, and the public sector employees of the regional and local administrations.
  - Model 3. A model for projecting survivors’ public pension expenditure administered by Social Security, for private sector employees, the self-employed, and the public sector employees of the regional and local administrations.
  - Model 4. A model for projecting public pension expenditure for public sector employees of the central administration, administered by the State (CPE), including old age and early retirement pensions, disability pensions, survivors’ pensions and war pensions.

- Data used to run the models
  The macroeconomic and demographic variables used in the projections are exogenous, the common ones agreed by the Ageing Working Group (AWG).
  The basic data used to run the pension model for SS were supplied by the Social Security (Ministry of Labour and Immigration) and refer to the base year 2007 and to historical data. All data by type of pensions (old-age and early retirement, disability and survivors), by sex and age: Number of new registrations and average pension; number of withdrawals (existing pensions that were no longer received at some point during the year) and average pension; number of existing pensions (that were already granted on January the 1st and have caused no withdrawal during the current year) and average pension.
  The projection method of the main variables, i.e. new registrations for each period and their corresponding pension benefit, varies according to pension type and the relevant historical data are also taken from a new micro data set published by the Social Security, the MCVL\(^{20}\). Finally, the projection of people leaving the system is obtained taking into account the possible causes of withdrawal from the system. Given that the main cause is mortality, the general projection applies age and gender specific mortality rates given by the demographic scenario.

\(^{20}\) Muestra Continua de Vidas Laborales (MTIN, 2006).
**Methodology:**

The models simulate the net number of pensions of each category every year, their average pension benefit, and the total pension expenditure per year. The basic model works through the following steps:

**Projection of demographic variables:**
- Projections of the number of pensions
- Projections of new entrants into the pension system (registrations)
- Projections of people leaving the system
- Projections of common pensioners (pensioners staying that year in the system)

**Projection of quantitative variables:**
- Average contribution bases
- Average pension benefit of new registrations
- Average pension benefit of people leaving the system
- Average pension benefit of common pensioners

Given that the models disaggregate expenditure projection according to the categories of age, sex and pension type, the representative agent is a pensioner –beneficiary of retirement, disability or survival benefits– belonging to a particular age and sex cohort. Nevertheless, this basic representative agent is further extended to consider other characteristics in some cases.

The model is built on three different modules related in the following manner. An exogenous demographic module is taken as starting point. This, through labour market variables, affects the second one, the economic module. The economic module, together with the institutional factors, produces then the final output.

In order to compute the number of pensions, we need to take into account three types of beneficiaries: a) common pensions ($C_t^e$), who receive benefits throughout the year; b) new registrations ($R_t$), who enter the system at some point during year $t$; and c) withdrawals ($W_t$), who leave the system before the end of year $t$. To deal with discontinuities we need to make two main assumptions. On the one hand new entries and withdrawals are assumed to be present half a year. On the other hand, it is assumed that all pensioners are born on December 31st.

This way, the number of pensions aged $e$ during a year ($NPA_t^e$) and the number of pensions aged $e$ at the end of the year ($NP_t^e$), evolve according to:

$$NPA_t^e = C_t^e + 0.5R_t^e + 0.5W_t^e$$  \[4\]

$$NP_{t+1}^e = NP_t^e + R_t^e - W_{t+1}^e$$  \[5\]

Their corresponding average pensions are ruled by:

$$pm_t^e = c_t^e + pmc_t^e + r_t^e + pmr_t^e + w_t^e + pmw_t^e$$  \[6\]

$$pm - np_{t+1}^e = \frac{R_t^e pmr_t^e + C_t^e pmc_t^e}{R_t^e + C_t^e}$$  \[7\]

---

21 For example, new entry pensions are further classified by the number of working years –for retirement pension–, or by the degree of disability and cause -for disability benefits.

22 In the following equations we omit the sex superscript for simplicity, while it is considered in the computations.
Where $pm$ is the average pension of NPA, and $pm_{np}$, $pmc$, $pmr$ and $pmw$ are the corresponding to NP, C, R and W respectively.

Finally, once new entries and their corresponding average pensions are computed, the number of withdrawals and common pensioners and their average pensions are derived as:

$$C^e_t = NP^e_t - W^e_{t+1}$$  \[8]\n
$$pmc^e_t = pm_{np}^e \frac{I_t}{I_{t-1}}$$  \[9]\n
$$W^e_{t+1} = NP^e_t \cdot m^e_t + R^e_t \cdot 0.5m^e_t$$  \[10]\n
$$pmw^e_{t+1} = pm_{np}^e \frac{NP^e_t}{NP^e_t + R^e_t} \frac{I_{t+1}}{I_t} + \frac{R^e_{t+1}}{NP^e_t + R^e_{t+1}} pmr^e_{t+1}$$  \[11]\n
Being $I$ the Price index and $m$ the mortality rate.

The average pension benefit for a given period $(pmt)$ is to be computed from the corresponding weighted average of the pension benefits of the different groups (common, new registrations, and withdrawals)\(^{23}\). On the one hand, the future initial pensions are derived from the expected evolution of the elements entering the pension formula, while the average common pensions evolve along the life cycle of each particular cohort, being adjusted only by inflation.

- **Old-age retirement pensions**

  In the following, we outline the special features of the projection model for this pension category in what relates to entry pensions and average pension.

  - **Projection of new old-age retirement entrants**

    The projection of the number of new entries not only depends on population projections but it also depends crucially on the projected trends of participation rate. For retirement and disability pensions exit rates are obtained from the participation rates given by the labour market scenarios\(^{24}\). In particular, a probability of exiting the labour market is obtained for each cohort at each age and sex from their participation rates. This way, new entries are increased according to the forecasted evolution of the labour force participation rates by age and gender, delivered by the European Commission scenarios. This operation allowed us to calculate a matrix containing the numbers of new entrants by age, gender and Social Security schemes.

    The consideration of recent reform measures is introduced. We also consider the gradual extinction of the SOVI regime, as cohorts who were potentially eligible –those registered as contributors before 1967– will be completely retired in the next years. Both a reduction in the number of entry pensions and an increase in average pension –given that those pensioners receive lower pensions– are gradually considered.

  - **Projecting the average pension benefit of new entrants**

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\(^{23}\) In parallel the number of pensions at the end of the year needs to be derived.

\(^{24}\) In case of old-age retirement pensions, new pensions are consistent with exit rates derived from the cohort simulation model of the Commission (labour market scenario). As it is based in the labour market scenario, it incorporates the impact of recent reforms on activity. Disability pensions are derived from disability rates applied to participants. For the survival pensions another strategy is derived as explained later.
The pension formula for new registrations of old-age pensions combines the reducing coefficient for early retirement pensions \(-\rho\) with the percentage of regulatory base \(-rb\) received as a pension \(-p\) and the contributory bases \(-cb\) as follows:

\[
 pmr_t^e = \rho_t^e (n_t^e) p_t (n_t^e) rb (cb_t, cb_{t-1}, ..., cb_{t-15})
\]  

[14]

This average pension benefit is computed as a weighted average of the pensions classified according to the number of contributed years, \(n\) — the latter affecting both \(\rho\) and \(p\). Specific reducing coefficients are used for each group depending on the age of retirement \((e)\). Equation [14] is also disaggregated by sex. Careers’ length \((n)\) is calculated using the sample (MCVL). The number of years of contribution by age and sex is calculated in the past and applied to the projection. Then a gradual (but not complete) convergence of female careers to men is incorporated. In particular we estimate \(n\) by sex and use the observed difference to project the future convergence of female entry pension to male entry pension. This way the evolution of the pension gender gap (only taking into account \(n\)) follows the same pattern as the evolution of participation rates. This allows us to compute the average entry pension benefit for both males and females in each future year and the resulting average entry pension as the average of males \((m)\) and females \((f)\):

\[
 pmr_t = \frac{pmr_t^m R_t^m + pmr_t^m R_t^m}{R_t}
\]  

[15]

- **Permanent disability pensions**

In the following we outline the special features of the projection model for this pension category in what relates to entry pensions and their average pension.

  - **Projection of new entrants and withdrawals.**

The disability pension system consists of various compensations and categories depending on the cause and the degree of disability.\(^{25}\) We need to disaggregate expenditure projection additionally according to degree and cause. The corresponding disability rates applied to participation are disaggregated by age and sex, as well as by cause and degree of disability using mainly the MCVL.\(^{26}\)

  - **Projecting the average pension benefit of new entrants**

The initial pension benefit of the new registered pensioners, i.e., the average pension amount of the new beneficiaries is the key variable for the projection of the average disability pension. This variable depends on the regulatory base, which in turn is a function of the contribution bases and the evolution of consumer price index, as well as the percentage applicable to this regulatory base (the degree of disability). Average pension benefit for new beneficiaries in each period \(t\) \((pmr_t)\) is estimated as follows:

\[
 pmr_t = \sum_{g=1}^{t} \sum_{c=1}^{t} \frac{R_{get}}{R_t} \pi_g r b_{ct}
\]  

[16]

---

\(^{25}\) Specifically, there are three degrees of permanent disability that give rise to a life annuity: total (the worker is disabled for performing his current occupation but may perform some other kind of job), absolute (worker is totally unable to take on any occupation) and complete disability (the worker needs other people’s assistance to carry out basic daily activities). In addition, the disability may have three types of causes: common disease, non-workplace accident or causes attributable to occupation.

\(^{26}\) As the MCVL has no information on the three causes, we also use the EDDES (Encuesta de Discapacidades, Deficiencias y Estados de Salud) carried out by INE in 1999.
\[
\frac{R_{gct}}{R_t} = \text{proportion of new beneficiaries for each degree and each cause with respect to the total in } t; \quad \pi_g = \text{percentage applicable to the regulatory base to a new beneficiary with degree of disability } g; \quad r_{b,c} = \text{regulatory base in year } t \text{ for a disability originated in } c.
\]

Average pension benefits for male and female are obtained following the same strategy than in old-age pension benefit (see the preceding section).

- **Survivors’ pensions**

In the following we outline the special features of the projection model for this pension category in what relates to entry pensions and their average pension.

With regard to widow pensions we could link new entries to the projected withdrawals in old-age and disability pensions. An additional source of widow entry pensions could be obtained by applying mortality rates to the labour participants. This way, we obtain a projection of new entries for the system and also a share of each type of pension that will help us to estimate the average entry pension benefit.

Then, in order to compute the average entry pension benefit, we obtain a weighted average of three elements: a) the 52 percent of the average regulatory base for new entrants coming from labour participants withdrawals, b) the average pension benefit of the old-age withdrawals multiplied by the ratio of the average widow pension benefit to the old-age pension amount, and c) the average pension benefit of disability withdrawals also multiplied by the ratio of the average widower pension benefit to the disability pension amount. This pension benefit is scaled to reach the observed level of the average entry pension benefit for widowers in the base year.

The process described cannot be applied to orphan and relatives entries as there is no clear way to link the age of the causing and the recipient. In this case, it seems plausible to compute the share of entries in each age and gender group in the base year and keep it constant in the future. Nevertheless, as only the total number of entries is available, this is imputed by age and gender according to the proportions observed in the number of pensions at the end of the year.

The average pension benefit for new orphans and relatives’ pensions is obtained as follows. Given the absence of data on the parent status, we have used the following approach. First, if the orphan is aged below 25 we suppose that his/her parent was employed and so we take the 20% of the average regulatory base of the system. Second, if the orphan is aged 25 or older we assume that his/her parent was retired and then we use the same procedure as in the widow case. For relatives’ pensions, only the case of a participant causing the pension is considered.

A final feature of orphan pensions is that most orphans withdraw from the system once they reach working age or finalise their studies, and only those disabled can stay in the system after age 24.

### 2. Description of the private pension projection model and its base data

A model has been elaborated by the Ministry of Economy and Finance (Directorate General of Insurance and Pension Funds) for projecting private pensions (occupational and individual or personal schemes).

The agreed Eurostat demographic and AWG macroeconomic assumptions have been incorporated in the projection for the baseline and sensitivity tests. The base data have required additional information from entities that has been gathered through an extended questionnaire (numbers of contributors, contributions, consolidated rights, beneficiaries, all...
by age) to the 20 major entities with a joint market share of 71%, comparing results with own databases.

The model runs separate projections for individual and occupational pension plans and collective pension insurance plans. The assumptions made are very prudent and do not foresee changes in behaviour.

- The number of contributors (aged 21-64) is calculated as a percentage of population in the base year, 2007, by age. These percentages are kept constant along the projection period, and the number of contributors increases with population projection by age.

- Contributions by age and year increase in line with labour productivity.

- Pensions can be withdrawn at retirement (age 65 assumed) which is the bulk of current withdrawals. Quantitatively less important, withdrawals in case of contributors’ death before retirement have also been considered.

AWG demographic and macroeconomic assumptions have been used, among them, a 3% real interest rate in the baseline that increases to 4% in a sensitivity test that has been carried out.
France

The pension models used for the EPC projection

1. – Coordination with the national projections of the COR
Because of the large number of pension schemes in France, the projection of pension expenditure is a complex exercise. It is necessary to carry out projections for each scheme and then to aggregate the different projections.

One of the missions of the Conseil d’Orientation des Retraites (COR) (the French Pensions Advisory Council) is to carry out projections on a regular basis. These include a baseline scenario and several sensitivity tests. In order to help ensure consistency, the AWG projections were derived from the 2007 projections published by the COR, taking into account the AWG assumptions through a simple model.

Thus the overall model used may be split into two stages:
1 – In a first step, each pension scheme used its own model to make a projection of its financial balance, based on the baseline assumptions defined by the COR. Then all these projections were combined in order to compute projections for the overall pension system.

2 – In a second step, a simple aggregate model was used by the COR to simulate the impact of the demographic and macroeconomic assumptions defined for the AWG projections. Appendix C gives a global diagram of this projection procedure.

2. – First stage: the national projection based on the COR assumptions
As we relied on the work of each of the pension scheme, 21 models were used. We will only describe here the two models for the major pension schemes: the CNAVTS scheme (salaried workers) and the two schemes for civil servants (Central government employee’s scheme and CNRACL for workers for local government and hospitals).

2.1. – Model used for the CNAVTS (salaried workers)
The pension model for the private sector scheme (CNAVTS) is a dynamic micro simulation model, in which the individual data are updated on a quarterly basis. The starting year is 2003. The model is based on a sample of 3.5 million people, which accounts for 5 % of CNAVTS insured population. Before the simulations can be run, 4 stages are needed in order to prepare the data:
1 – Death completion;
2 – Children completion;
3 – Completion of the ages when leaving school;
4 – Working life completion;
After that, transition equations are computed and are used to simulate the evolution of the sample during working life and retirement (stage 5 to 9):
5 – Working life transitions;
6 – Wage estimation;
7 – Pensions for housewives and “househusbands”;

8 – Simulation of retirements;
9 – Survivor pensions.

**Stage 1 to 4**
Stages 1 to 4 are just data completions with econometric methods.

**Stage 5: Working life transitions**
Stage 5 is the main part of the simulation. For each of the quarters before they retire, all individuals in the sample can be in one of seven states:
1 – Labour market participation, working and contribute to the CNAVTS scheme;
2 – Labour market participation, working and contribute to another scheme with the same rules as the CNAVTS scheme;
3 – Labour market participation, working and contribute to a scheme with different rules than the CNAVTS scheme;
4 – Labour market participation but unemployed;
5 – Sick leave;
6 – Disability or pensioners for occupational injury;
7 – Other, without validating any pension right.
The transition equations between these seven states are computed thanks to econometric estimations, and then used to simulate the sample in the future.

**Stage 6: Wage estimation**
Four equations are computed for wages (before and after the school leaving age and, one for males and one for females). The wage in logarithm is explained by several variables. One of them is a temporal trend which grows in line with the labour productivity growth assumption.

**Stage 7: Pensions for housewives and “househusbands”**
A mother or a father may be temporarily out of the labour force in order to educate their children. Then they are eligible to free pension rights. This module simulates the corresponding contributions.

**Stage 8: Simulation of retirements**
Transition equations for retirement are computed in order to simulate retirement in the future. The impact of the 2003 French pensions’ reform is derived from simulations from the French national institute, Insee (Institut National de la Statistique et des Études Économiques). Concerning the CNAVTS scheme, this means a postponement of retirements of 0.6 year in average for men and an earlier retirement of 0.3 year in average for women.

**Stage 9: Survivor pensions**
In order to compute survivor pensions, marriages are simulated between men and women in the CNAVTS population. Departing from the initial stock of survivor pensions, the projection is made from 2004 and afterwards by implementing the death projections.

**2.2. – Projection of the Public sector schemes**
The pension schemes for the territorial public servants and for the State public servants follow the same rules. Therefore, both projections are made with the same model, named ARIANE and realised by the Budget Directorate of the Ministry of Finance. ARIANE is a model of weighted set cases.
2.3. – Aggregation of all the pension schemes projections

The 21 pension schemes have run their projections using the assumptions defined by the COR. These projections have then been aggregated in order to compute the total pension expenditures.

To forecast the average pension, we also need to estimate the number of pensioners. But the global number of pensioners is smaller than the total of pensioners from each pension scheme: as a matter of fact, many people have contributed to several pension schemes and thus benefit from several pensions. We name these people “multipensioners”. We assume that all pensioners have contributed to the CNAVTS. So, we can estimate the number of multipensioners as the number of pensioners in the CNAVTS who contributed to another pension scheme. Finally, we assume, for the beginning year of projection, that the number of pensioners is the sum of pensioners of all schemes minus our estimation of the number of multipensioners. For the following years, we keep constant the difference between the number of pensioners and the number of people aged 55 years and more who are inactive.

3. – Second stage: Taking into account of the AWG hypotheses

3.1. – Taking into account of the AWG hypotheses

The AWG projections rely on specific hypotheses which were discussed by the AWG and the EPC. To take these assumptions into account, the COR, which has been involved together with the DGTPE in these projections, uses an aggregate model of the French pension system. The inputs of the model are reminded and compared in table 10, for the COR 2007 projections and the AWG projections.

<table>
<thead>
<tr>
<th>Table 10: Comparison of the assumptions of the COR and the AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumptions of the COR</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Fecondity Index</td>
</tr>
<tr>
<td>Net migration flow</td>
</tr>
<tr>
<td>Birth life expectancy</td>
</tr>
<tr>
<td>Participation rate</td>
</tr>
<tr>
<td>Unemployment rate</td>
</tr>
</tbody>
</table>

The COR model is an aggregate framework of a single theoretical pay-as-you-go pension scheme. It covers the overall pension system (basic and complementary pensions). This model was built in order to carry out analysis tests to various demographic and economic assumptions. This framework was also used to derive the AWG baseline scenario and sensitivity tests.

Labour supply, labour productivity and unemployment assumptions come from the AWG hypotheses. The average pension is derived from the one used for the COR baseline scenario, adjusted to take into account the AWG productivity growth assumption. The number of pensioners is computed using the number of pensioners in the COR scenario, and the AWG and COR elderly populations and participation rates. Elderly populations (55 years-old and more) grow at very similar rates according to the AWG and to the COR, in spite of the differences of mortality. Additionally, there is a small difference in older labour supply. 55 years-old and more participation declines more in the COR scenario (-3.9 points between
2007 and 2050) than in the AWG scenario (-1.2 point). Taking into account these two differences in the baseline assumptions of the two exercises, we assume that the difference between pensioners and the elderly labour supply is the same in the two scenarios.

3.2. – The COR model

1 – Pension expenditures
Pension expenditures are computed as the result of the average pension times the corrected number of pensioners, calculated as indicated below (cf. diagram in appendix B). Net pension expenditures are computed using the recent past implicit contribution rate paid by pensioners to the social security system. In one part, we compute the amount of social contributions paid by pensioners and, in the other part we estimate the contributions of pensioners in the collected income tax. Then, we compute the tax rate.

2 – Macroeconomic balance and pension contributions
GDP growth is computed with the growth of labour supply and labour productivity. Repartition between wage and capital is supposed to be constant. Without changes in the contribution rate, contributions grow in line with the GDP.
Appendix A: Global diagram of the forecasting models available in France

COR assumptions

- CNAVTS
- Central government employees
- CNRACL
- ...
- ...

Aggregation of the 21 projections
Taking account of polypensioners

COR baseline scenario
- Average pension;
- Number of pensioners;
- Elderly participation rate;
- Elderly population.

COR model:
One theoretical aggregate pension scheme:
- Pensions expenditure (gross and net);
- Contributions;
- Number of pensioners;
- Number of contributors.

AWG and EPC assumptions:
- Labour productivity growth rate
- Unemployment rates
- Participation rates
- Population

AWG baseline scenario / sensitivity tests
- Labour productivity;
- Labour supply;
- Unemployment rate;
- Elderly participation rate;
- Elderly population

Results for the AWG
Appendix B: Diagram of the COR model

**AWG hypotheses:**
- Labour productivity growth
- Unemployment rate by age and gender
- Population by age and gender
- Labour force by age and gender

**COR Baseline scenario**

- Population out of labour force ≥ 55 years-old (COR)

**Adjusted for productivity**

- Average pension

**Difference “Number of pensioners” - “Population out of labour force ≥ 55 years-old” has the same growth in both COR and AWG results**

**COR model**

Aggregated computations:

of gross pensions expenditures;

**AWG results**
## Appendix C: Overview of the sensitivity tests

<table>
<thead>
<tr>
<th>Sensitivity test</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Higher life expectancy</td>
<td>Decrease of 15 % in age-specific mortality rates (ASMRs), via a linear increase from 0 % in 2007. This leads to an increase in life expectancy at birth of roughly 1-1.5 years by 2060.</td>
</tr>
<tr>
<td>2 Higher labour productivity</td>
<td>Labour productivity increases by 0.25 over the period 2010-2020 and remains 0.25 p.p. higher over the period 2020-2060. In 2060, the cumulated effect amounts to an increase of +10.7 % of real GDP.</td>
</tr>
<tr>
<td>3 Lower unemployment</td>
<td>Employment rate increases by 1 p.p. over the period 2005-2015 and remains 1 p.p. higher over the period 2015-2060. The change in the employment rate is reflected in a parallel change in unemployment rate (NAIRU): it converges to 4.8 % instead of 6.2 %.</td>
</tr>
<tr>
<td>4 Higher elderly employment</td>
<td>Participation rate of older workers increases by 5 p.p. over the period 2010-2020 and remains 5 p.p. higher over the period 2020-2060. In parallel, total employment rate is made to increase by 1 p.p by lowering unemployment rates of senior workers.</td>
</tr>
<tr>
<td>5 Zero immigration</td>
<td>Immigration is supposed to be null during the projection period, as opposed to +82 500 each year in the baseline scenario</td>
</tr>
</tbody>
</table>
Appendix D: Results of sensitivity tests

Graph D.1: Balance (points of GDP)

Graph D.2: Expenditure as a share of GDP, basis 100 in 2007
Graph D.3: Benefit ratio (average pension / GDP per worker), basis 100 in 2007

Graph D.4: Coverage rate (Pensioners / Pop 65+), basis 100 in 2007
Graph D.5: Dependency ratio (Pop 65+ / Pop 15-64), basis 100 in 2007

Graph D.6: Inverse of employment rate (Pop 15-64 / Number of workers), basis 100 in 2007
### Table D.0: Baseline scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>246.7</td>
<td>239.3</td>
<td>-7.4</td>
<td>13.3</td>
<td>12.9</td>
<td>-0.4</td>
</tr>
<tr>
<td>2010</td>
<td>269.5</td>
<td>252.9</td>
<td>-16.5</td>
<td>13.7</td>
<td>12.9</td>
<td>-0.8</td>
</tr>
<tr>
<td>2020</td>
<td>332.7</td>
<td>308.5</td>
<td>-24.1</td>
<td>13.9</td>
<td>12.9</td>
<td>-1.0</td>
</tr>
<tr>
<td>2030</td>
<td>411.7</td>
<td>367.0</td>
<td>-44.7</td>
<td>14.5</td>
<td>12.9</td>
<td>-1.6</td>
</tr>
<tr>
<td>2040</td>
<td>499.9</td>
<td>438.4</td>
<td>-61.5</td>
<td>14.7</td>
<td>12.9</td>
<td>-1.8</td>
</tr>
<tr>
<td>2050</td>
<td>587.4</td>
<td>522.8</td>
<td>-64.6</td>
<td>14.5</td>
<td>12.9</td>
<td>-1.6</td>
</tr>
<tr>
<td>2060</td>
<td>694.6</td>
<td>626.1</td>
<td>-68.5</td>
<td>14.3</td>
<td>12.9</td>
<td>-1.4</td>
</tr>
</tbody>
</table>

### Table D.1: Sensitivity test 1, higher life expectancy sensitivity test

<table>
<thead>
<tr>
<th>Year</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
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<td>2007</td>
<td>246.7</td>
<td>239.3</td>
<td>-7.4</td>
<td>13.3</td>
<td>12.9</td>
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<tr>
<td>2010</td>
<td>269.5</td>
<td>252.9</td>
<td>-16.6</td>
<td>13.7</td>
<td>12.9</td>
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<tr>
<td>2020</td>
<td>333.2</td>
<td>308.6</td>
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<tr>
<td>2030</td>
<td>415.1</td>
<td>367.3</td>
<td>-47.8</td>
<td>14.6</td>
<td>12.9</td>
<td>-1.7</td>
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<td>2040</td>
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### Table D.2: Sensitivity test 2, higher labour productivity sensitivity test

<table>
<thead>
<tr>
<th>Year</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>246.7</td>
<td>239.3</td>
<td>-7.4</td>
<td>13.3</td>
<td>12.9</td>
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<td>2010</td>
<td>269.5</td>
<td>253.0</td>
<td>-16.5</td>
<td>13.7</td>
<td>12.9</td>
<td>-0.8</td>
</tr>
<tr>
<td>2020</td>
<td>333.2</td>
<td>313.1</td>
<td>-20.1</td>
<td>13.7</td>
<td>12.9</td>
<td>-0.8</td>
</tr>
<tr>
<td>2030</td>
<td>415.1</td>
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<td>-1.1</td>
</tr>
<tr>
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<td>510.2</td>
<td>467.3</td>
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<td>12.9</td>
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</tr>
<tr>
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</tr>
<tr>
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### Table D.3: Sensitivity test 3, higher employment rate sensitivity test (+1 %)

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<th>Contributions</th>
<th>Balance</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>246.7</td>
<td>239.3</td>
<td>-7.4</td>
<td>13.3</td>
<td>12.9</td>
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<td>269.5</td>
<td>253.0</td>
<td>-16.2</td>
<td>13.7</td>
<td>12.9</td>
<td>-0.8</td>
</tr>
<tr>
<td>2020</td>
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<td>313.1</td>
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<tr>
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<td>-1.4</td>
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<tr>
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<td>444.8</td>
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<td>-1.6</td>
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<tr>
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<td>530.5</td>
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<td>12.9</td>
<td>-1.4</td>
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### Table D.4: Sensitivity test 4, higher elderly employment rate sensitivity test (+5 %)

<table>
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<th>Balance</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>246.7</td>
<td>239.3</td>
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<td>13.3</td>
<td>12.9</td>
<td>-0.4</td>
</tr>
<tr>
<td>2010</td>
<td>268.8</td>
<td>253.3</td>
<td>-15.6</td>
<td>13.7</td>
<td>12.9</td>
<td>-0.8</td>
</tr>
<tr>
<td>2020</td>
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<td>-0.5</td>
</tr>
<tr>
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<td>-1.1</td>
</tr>
<tr>
<td>2040</td>
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<td>14.2</td>
<td>12.9</td>
<td>-1.3</td>
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<tr>
<td>2050</td>
<td>576.8</td>
<td>530.1</td>
<td>-46.7</td>
<td>14.0</td>
<td>12.9</td>
<td>-1.1</td>
</tr>
<tr>
<td>2060</td>
<td>682.2</td>
<td>634.9</td>
<td>-47.3</td>
<td>13.8</td>
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<td>-1.0</td>
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### Table D.5: Sensitivity test 5, zero migration sensitivity test

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<th>Balance</th>
<th>Expenditures</th>
<th>Contributions</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>246.7</td>
<td>239.3</td>
<td>-7.4</td>
<td>13.3</td>
<td>12.9</td>
<td>-0.4</td>
</tr>
<tr>
<td>2010</td>
<td>269.4</td>
<td>252.4</td>
<td>-16.9</td>
<td>13.8</td>
<td>12.9</td>
<td>-0.9</td>
</tr>
<tr>
<td>2020</td>
<td>332.0</td>
<td>301.1</td>
<td>-30.8</td>
<td>14.2</td>
<td>12.9</td>
<td>-1.3</td>
</tr>
<tr>
<td>2030</td>
<td>409.6</td>
<td>349.7</td>
<td>-59.9</td>
<td>15.1</td>
<td>12.9</td>
<td>-2.2</td>
</tr>
<tr>
<td>2040</td>
<td>493.6</td>
<td>406.9</td>
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<td>15.6</td>
<td>12.9</td>
<td>-2.7</td>
</tr>
<tr>
<td>2050</td>
<td>570.2</td>
<td>473.8</td>
<td>-96.4</td>
<td>15.5</td>
<td>12.9</td>
<td>-2.6</td>
</tr>
<tr>
<td>2060</td>
<td>658.4</td>
<td>556.2</td>
<td>-102.3</td>
<td>15.3</td>
<td>12.9</td>
<td>-2.4</td>
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</table>
Appendix E: Projection of the assets of the pension fund

E.1. - Projection method

E.1.1. – From 2000 to 2020

We project the assets of the FRR at the end of each year. \( A_t \) is the assets in euros 2007 at the end of year \( t \) and \( r \) is the net return to capital in real terms. The projection begins in 2008; amounts for 2000 to 2007 are not the results of a projection. The accumulation is given by the formula:

\[
A_t = A_{t-1}(1+r) + F_t
\]

According to the AWG hypothesis, we assume that the net return to capital \( r \) is the no-risk long-term interest rate and its value is 3 % in real terms. This is a conventional hypothesis. In reality, an accumulation of assets in a fund allows a higher return of capital than the no-risk interest rate thanks to a mixed allocation of assets. FRR assets are composed of 64.5 % of shares and 33.5 % of bonds, including an important part of foreign bonds.

The most part of the financial contributions to the FRR consist in specific taxes, which grow at the same pace as the GDP. In order to take account of the AWG scenario, we calculate the additional funding in euros 2007 \( (F_t) \) as a constant part of GDP in the AWG and COR scenarios:

\[
F_t^{AWG} = \frac{GDP_t^{AWG}}{GDP_t^{COR}} F_t^{COR}
\]

This method is quite realistic as far as the most part of the additional funding is concerned. Nevertheless, a significant part of the additional yearly funding comes from the “Fond de Solidarité Vieillesse” (FSV, the Ageing Solidarity Fund)\(^{28}\). The main function of this fund is to pay contributions to the pension schemes for not contributive pension rights: jobless period pension rights and additional pensions for children. The FSV contributes to the FRR with its surpluses. The balance of the FSV depends principally on unemployment; so, additional funding from the FSV to the FRR follows unemployment evolutions. With our simplified method, the sensibility test linked with the NAIRU is not realistic for the FRR additional fund calculations: additional funding would normally depend more on the unemployment rate than in these results.

E.1.2. – From 2021 to 2050

After 2020, there is no more additional funding and we supposed that the share of withdrawals \( (W_t) \) in the GDP would be constant \( (W_t / GDP_t = cst) \). After 2050, the fund will be empty \( (A_{2050} = 0) \). Therefore, the assets follow the rule:

\[
A_t = A_{t-1}(1+r) - W_t
\]

\(^{28}\)In 2020, in the COR scenario with the unemployment rate of 7%, 1/3 of the FRR assets would have come from the FSV.
It is possible to assess the decrease of pension scheme deficit, which these withdrawals could allow in the future, as a share of GDP.

### E.2. – Projection results

#### Table E.1: Additional funding (+) and then, withdrawals (-), in amounts term

<table>
<thead>
<tr>
<th></th>
<th>Billions euros 2007</th>
<th>2008</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline scenario</td>
<td>1.55</td>
<td>3.64</td>
<td>3.92</td>
<td>-4.55</td>
<td>-5.43</td>
<td>-6.48</td>
<td></td>
</tr>
<tr>
<td>Sens. test 1, higher life expectancy</td>
<td>1.55</td>
<td>3.64</td>
<td>3.92</td>
<td>-4.55</td>
<td>-5.43</td>
<td>-6.48</td>
<td></td>
</tr>
<tr>
<td>Sens. test 2, higher labour productivity</td>
<td>1.52</td>
<td>3.58</td>
<td>3.89</td>
<td>-4.47</td>
<td>-5.46</td>
<td>-6.68</td>
<td></td>
</tr>
<tr>
<td>Sens. test 3, lower unemployment</td>
<td>1.55</td>
<td>3.67</td>
<td>3.97</td>
<td>-4.57</td>
<td>-5.45</td>
<td>-6.50</td>
<td></td>
</tr>
<tr>
<td>Sens. test 4, higher elderly employment</td>
<td>1.55</td>
<td>3.67</td>
<td>3.97</td>
<td>-4.57</td>
<td>-5.45</td>
<td>-6.50</td>
<td></td>
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<tr>
<td>Sens. test 5, immigration zero</td>
<td>1.55</td>
<td>3.60</td>
<td>3.83</td>
<td>-4.58</td>
<td>-5.33</td>
<td>-6.20</td>
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#### Table E.2: FRR assets at the end of the year, in amounts term

<table>
<thead>
<tr>
<th></th>
<th>Billions euros 2007</th>
<th>2008</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
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<td>64.29</td>
<td>95.72</td>
<td>80.51</td>
<td>50.91</td>
<td>0.00</td>
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<tr>
<td>Sens. test 1, higher life expectancy</td>
<td>36.98</td>
<td>64.29</td>
<td>95.72</td>
<td>80.53</td>
<td>50.93</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Sens. test 2, higher labour productivity</td>
<td>36.95</td>
<td>63.91</td>
<td>95.04</td>
<td>81.00</td>
<td>51.89</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
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<td>64.38</td>
<td>96.06</td>
<td>80.77</td>
<td>51.07</td>
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<td>Sens. test 4, higher elderly employment</td>
<td>36.98</td>
<td>64.38</td>
<td>96.06</td>
<td>80.77</td>
<td>51.07</td>
<td>0.00</td>
<td></td>
</tr>
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<td>Sens. test 5, immigration zero</td>
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<td>64.16</td>
<td>95.16</td>
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<td>49.25</td>
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#### Table E.3: Additional funding (+) and then, withdrawals (-), as a share of GDP

<table>
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<th>2008</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline scenario</td>
<td>0.08</td>
<td>0.16</td>
<td>0.16</td>
<td>-0.16</td>
<td>-0.16</td>
<td>-0.16</td>
</tr>
<tr>
<td>Sens. test 1, higher life expectancy</td>
<td>0.08</td>
<td>0.16</td>
<td>0.16</td>
<td>-0.16</td>
<td>-0.16</td>
<td>-0.16</td>
</tr>
<tr>
<td>Sens. test 2, higher labour productivity</td>
<td>0.08</td>
<td>0.16</td>
<td>0.16</td>
<td>-0.15</td>
<td>-0.15</td>
<td>-0.15</td>
</tr>
<tr>
<td>Sens. test 3, lower unemployment</td>
<td>0.08</td>
<td>0.16</td>
<td>0.16</td>
<td>-0.16</td>
<td>-0.16</td>
<td>-0.16</td>
</tr>
<tr>
<td>Sens. test 4, higher elderly employment</td>
<td>0.08</td>
<td>0.16</td>
<td>0.16</td>
<td>-0.16</td>
<td>-0.16</td>
<td>-0.16</td>
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<tr>
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<td>0.16</td>
<td>-0.17</td>
<td>-0.17</td>
<td>-0.17</td>
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</table>

#### Table E.4: FRR assets at the end of the year, as a share of GDP

<table>
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<tr>
<th></th>
<th>2008</th>
<th>2015</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline scenario</td>
<td>1.92</td>
<td>2.91</td>
<td>3.93</td>
<td>2.78</td>
<td>1.47</td>
<td>0.00</td>
</tr>
<tr>
<td>Sens. test 1, higher life expectancy</td>
<td>1.92</td>
<td>2.91</td>
<td>3.93</td>
<td>2.78</td>
<td>1.47</td>
<td>0.00</td>
</tr>
<tr>
<td>Sens. test 2, higher labour productivity</td>
<td>1.95</td>
<td>2.94</td>
<td>3.92</td>
<td>2.74</td>
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<td>0.00</td>
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<td>2.89</td>
<td>3.88</td>
<td>2.75</td>
<td>1.45</td>
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<td>2.89</td>
<td>3.88</td>
<td>2.75</td>
<td>1.46</td>
<td>0.00</td>
</tr>
<tr>
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<td>2.94</td>
<td>4.00</td>
<td>2.85</td>
<td>1.53</td>
<td>0.00</td>
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</table>

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Graph E.1: Additional funding (+) and then, withdrawals (-), in Bn€ 2007

Graph E.2: Additional funding (+) and then, withdrawals (-), as a share of GDP
Graph E.3: FRR assets at the end of each year, as a share of GDP

- Baseline scenario
- Sens. test 1, higher life expectancy
- Sens. test 2, higher labour productivity
- Sens. test 3, lower unemployment
- Sens. test 4, higher elderly employment
- Sens. test 5, immigration zero
Italy

The RGS projection model

0.1. Updating and Institutional utilization

The 2009 AWG projections of the Italian pension system have been made with the model of the Department of General Accounts (Dipartimento della Ragioneria Generale dello Stato – RGS), which covers the whole public pension expenditure according to the definition given in paragraph 2.1.

The RGS model has been updated yearly since 1999. Updating procedures have always involved the base year of projection, while demographic and macroeconomic scenario assumptions have been changed only when the availability of new data and information called for a revision. Methodological improvements have also been introduced through time. Any changes to the projection model and to scenario assumptions have been commented on in the RGS annual reports concerning the analysis of mid-long term trends in health, long term care, and pension expenditures.29

Since 2002, a standardised set of tables have also been added which give analytical data of projections and in this way improve comparability through time and amongst different scenario assumptions. The latest report refers to the 2007 updating of the model and embodies the analysis of the financial effects of the latest pension reform passed in 2007.30

Projections of the Italian pension system, based on AWG scenario assumptions, are regularly presented as part of Italy’s Stability Programmes, in the section devoted to analysing the mid-long term sustainability of public finances. Projections based on national scenarios are also reported in special boxes of the Economic and Financial Planning Document.31

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

29 The RGS annual reports may be downloaded from the RGS web site at the following address: http://www.rgs.mef.gov.it/VERSIONE-I/Attivit--i/Spesa-soci/Attivit--d/2008/index.asp. The full version of the reports are in Italian. However, a comprehensive summary and all the tables with analytical results are also available in English.
30 Ministero dell’Economia e delle Finanze-RGS (2007), Le tendenze di medio-lungo periodo del sistema pensionistico e socio-sanitario, Report no. 9, Roma.
31 This document is prepared each year by the Ministry of Economy and Finance and presented to Parliament by the Government.
Compared to the RGS model utilised for the 2006 AWG pension projections, the updated version embodies the following major novelties:

- an updating of the database concerning the major schemes administered by Inps which covers the greater part of private sector employees and the self-employed (artisans, shopkeepers and farmers);
- an updating of the probabilities for a deceased pensioner or contributor of leaving a surviving spouse;
- atypical workers have been modelled as an individual, additional pension scheme, thanks to the more analytical data that has been made available by Inps;
- the modelling of pensioner-contributors, i.e. those who continue to work after retirement, has been significantly improved.

As for the legal framework, the RGS pension model is updated to cover the legislation which had came into force by September 2008. Compared to 2006 AWG projections, it takes into account the effects of laws 127/2007 and 247/2007, which implement the content of the 23rd July agreement on welfare between government and social partners, along with law 133/2008, which has strengthened the possibility of accumulating pension and labour income (Box 1.1).

**0.2. Methodology**

**0.2.1. The general outline**

The RGS pension model has been devised to reproduce accurately the main features of the legal and institutional framework. The latter has been assuming increasing importance in Italy in consideration of the several pension reforms enacted during the last two decades, which have involved extremely gradual solutions. Furthermore, the model is provided with some methodological solutions aimed at guaranteeing, at the same time, consistency with demographic and macroeconomic scenario assumptions.

The pension model is composed of four modules: pension, demography, labour market and productivity. The pension module is strictly interrelated with the others according to the outline reported below:
In particular, the pension module is provided with: \(i\) the probabilities of death by the demographic module, \(ii\) the new entrants into employment by the labour market module, and \(iii\) the dynamics of wages/earnings and GDP from the productivity module. In turn, the pension module provides the labour market module with the probabilities of exiting because of retirement.

The interrelation among the three modules describing the scenario assumptions sees, as a first step, the demographic module providing the labour market with population, probabilities of death and migration flows. The total number of worked hours is then utilised, as labour input, to estimate the contribution of the capital deepening to productivity growth.

The **demographic module** adopts the traditional cohort component approach according to which the number of people by age and sex is 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\(^{32}\).

The **labour market module** mainly consists of a labour force projection to which unemployment rates are subsequently applied in order to calculate the corresponding employment rates. In turn, the labour force projection combines the dimensional effect of the working age population and the cohort evolution of participation rates. The latter is obtained extrapolating the cohort trend in the propensity to enter the labour market on a permanent basis, estimated on labour force data. The extrapolation of past trends is adjusted to take account of further effects brought about by any endogenous factors which can significantly alter the evolution of participation rates. In this regard, an important role is played by the following two factors: \(i\) direct and indirect effects brought about by the evolution of enrolment rates, the latter through changes in educational achievements, and \(ii\) the fulfilment of eligibility requirements for pension

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\(^{32}\) As for national projections, the baseline assumptions are made consistent with the demographic projections elaborated by Istat (National Institute of Statistics).
entitlement, which depends on both pension legislation and the distribution of workers by age and contribution years.

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

Finally, the number of hours worked is determined from the projected number of employees on the basis of the incidence of part-time and full-time workers, and the corresponding average number of hours worked.

The **productivity module** bases its projection on a sum of two components: *i*) an exogenous assumption of the growth rate of total productivity factors, which is kept constant at 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). To this end, a Cobb Douglas production function is utilised.

### 0.2.2. The pension module

The pension module 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 distinct positions within the system. For each segment of the system (fund or specific group of workers), members are distinguished as pensioners, contributors, dormant and pensioner-contributors. Members also differ in terms of their sex, age, typology of pension (old age/seniority, disability) and contribution period (annual classes).

All the possible combinations of the variables listed above are kept distinct for three different regimes (earnings-related, mixed, and contribution-based) stated for workers with different years of contribution at the end of 1995 (at least 18, less than 18, or no contribution at all). This differentiation is important insofar as it implies diverse treatments.

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33 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.
<table>
<thead>
<tr>
<th>State variables</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fund (or group of workers)</td>
<td>13 in the private sector and 5 in public sector</td>
</tr>
<tr>
<td>Sex</td>
<td>Male, female</td>
</tr>
<tr>
<td>Age</td>
<td>[15-74]</td>
</tr>
<tr>
<td>Typology of contributor</td>
<td>Contributor, dormant, pensioner-contributor</td>
</tr>
<tr>
<td>Contribution years</td>
<td>[0-49] before retirement; [1-20] after retirement</td>
</tr>
<tr>
<td>Regime</td>
<td>Earnings-related, contribution-based, mixed</td>
</tr>
<tr>
<td>Typology of pension</td>
<td>Disability (2 types), old age, early retirement</td>
</tr>
</tbody>
</table>

It is possible at any time 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 a 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. The number of people belonging to each cohort involved is updated yearly by applying the corresponding probabilities of surviving that underlie the demographic projection. More specifically, the forecast of members is calculated according to the following general equation:

\[
\begin{align*}
\mathbf{a}_{t,s,x,f} & = \mathbf{a}_{t-1,s,x-1,f} \cdot \mathbf{p}_{t-1,s,x-1,f} \times \mathbf{T}_{t-1,s,x-1,f} + \mathbf{e}_{t,s,x,f} \quad \forall s, f, 15 \leq x \leq \omega \\
\end{align*}
\]

where, for each sex \( s \), age \( x \), and fund (or specific group of workers) \( f \): \( \mathbf{a} \) indicates the row vector of the insured distributed by different states at the end of the year \( t \), \( \mathbf{p} \) is the probability of surviving, \( \mathbf{e} \) indicates the row vector of entrants to the pension system in the year \( t \) (it contains non-null values only in the first few elements), and \( \mathbf{T} \) is the matrix of transition probabilities that serves to calculate the changes in the states of members already enrolled at the end of the year \( t-1 \) and still alive at the end of the year \( t \). The general element \( t_{i,j} \) of the transition matrix represents the probability that a member belonging to state \( i \) at the end of the year \( t-1 \) will transit to state \( j \) at the end of the year \( t \).

New entrants, i.e. those insured 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. Afterwards, the number of entrants by age and sex attributed to each fund, or other appropriate aggregations of workers, is determined by age and sex, on the basis of specific probability distributions.

Monetary variables, such as wages/earnings, amounts of pension etc., are associated with 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.

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\[34 \] 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.
Many of the algorithms used to update the monetary variables involve the application of a multiplier to the individual amounts, either as prescribed by law or as required by the forecasting technique. Consequently, the updating of the average value coincides exactly with the average of the updated individual values. There are some cases, however, in which the information on 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.

In this context, newly awarded pensions are determined according to the probabilities of transiting to the state of pensioner, once the age and contribution requirements foreseen by legislation have been fulfilled. The amount of pension is calculated applying the rules laid down for new retirees by the legal framework, according to the parameters describing the position (combination of state variable specifications) they come from, and the related monetary variables which are relevant to the calculation.

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’ pension. In fact, these latter may be insured in the pension system as contributors, dormant members or recipients of a direct pension. In practice, the number of survivors’ pensions is determined by adding the newly awarded ones to those of the previous year still 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 on the basis of the age of the deceased.

0.3. Internal consistency of the model

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

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35 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.

36 Changes in the probabilities of retiring due to modifications to eligibility requirements already legislated for are modelled on the basis of that simple rule: workers who would have retired once matured the old requirements, postpone their retirement only until the new requirements are fulfilled.

37 It is usually of no importance whether or not a survivor’s pension is paid to a member of the pension system. Similarly, where the beneficiary is a member, their position within the system (pensioner, contributor, etc.) is irrelevant.
According to current legislation, social pension and old age allowances are to be indexed to prices. Furthermore, additional lump sums, available for elderly pensioners with a very low income level, are constant in nominal terms. In these cases, the application of indexation rules as laid down by law would imply, de facto, the disappearance of the social assistance institutes which play an important role within the public pension system. In fact, in the past years improvements of social assistance pensions have been repeatedly legislated for. For these reasons, the RGS pension model assumes that social assistance provisions are indexed to nominal GDP per capita\(^\text{38}\).

Consistency between the pension component of the model and the demographic and occupational ones is definitely favoured by the cohort approach coherently adopted for all of them. The most relevant mechanisms through which such consistency is sought may be summarized as follows:

- as far as mortality is concerned, coherence is assured by applying the probability of death to all insured 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 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 employment rates is attained, 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 pension legislation and retirement behaviour as estimated on past data;
- wages (or labour income in the case of the self-employed) are projected to increase over time by cohort, applying the dynamics of productivity and the further increase due to the carrier progression\(^\text{39}\). In this regard, consistency with

\(^{38}\) The minimum pension utilised for the topping-up of low amount pensions under the earnings-related and mixed regimes (paragraph 1.2.3) and for the calculation of the pension amount brackets required for indexing pension to prices (paragraph 1.2.4) is updated according to GDP per worker.

\(^{39}\) The dynamic of wages is projected by cohort, consistently with the projection of labour force and contributors. As for the latter, projection is made by sex, age and contribution years, distinctly for each segment of the pension system (scheme, fund, regime, etc.). In a very stylised way, the following algorithm is utilised to project wage growth for each gender and segment of the pension system:

\[ w_{t,a,x} = w_{t-1,a-1,x-1} \left( 1 + \sigma_t + \pi_t \right) \left( 1 + \gamma_a \right) \]

where: \( t = \) year; \( a = \) contribution years; \( x = \) age; \( \sigma = \) inflation rate; \( \pi = \) productivity growth rate; \( \gamma = \) additional wage growth rate due to career progression. The latter is applied as long as a further year of contribution is to be matured. Age
macroeconomic assumptions is assured by targeting the carrier progression to guarantee constancy through time of the ratio between the average contribution base (gross wages for the employees and gross labour income for the self-employed) and GDP per capita for the economic system as a whole;

0.4. **Consistency with the AWG assumptions**

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

- the projections of population and employment rates adopted within the AWG are based on a cohort approach which represents a binding condition for the calculation of new entrants into the pension system according to the methodology underlying the RGS pension model;
- the output of such projections shares 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 the demographic and macroeconomic input, 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, the methodological approach utilised by the Commission does not guarantee in itself consistency with the probabilities of retiring that are endogenously calculated by the RGS pension model on the basis of the fulfilment of contribution and age requirements. However, through a bilateral consultation, a satisfactory approximation of the exit probabilities was achieved, at least as an order of magnitude in the mid-long run, allowing some differences in terms of distribution by age, gender and time profile.

As a result, the number of contributors\(^40\) evolves substantially in line with the total of employees for the length of the whole forecasting period, allowing for minor adjustments by sector. Analogously, the number of pensioners is consistent with population projections. Such an aspect may be assessed by comparing the number of pensioners of 65 and over with the population in the same age bracket. However, in doing that the following should be taken into account:

- the definition of population underlying the demographic projections refers to resident people, while pensions are also paid to non-resident people;
- a quota of immigration flow concerns elderly people who do not have the possibility to mature pension rights sufficient to be entitled to an old age pension. Differently, elderly people leaving the country are likely to take their pension trajectories of wage growth due to career progression vary by pension scheme/fund, sex and regime. According to the evidence, the increase is generally stronger at the beginning of the career than afterwards.\(^\)\(^99\)

\(^{40}\) Contributor numbers are slightly adjusted according to the temporary deviation registered between the number of employees consistent with the probabilities of exiting endogenously calculated by the RGS pension model and those calculated by the Commission on the basis of exogenous assumptions.
entitlements with them. Only if the number of the two groups of people equalise would there be 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, according to the assumptions on net migration flows. At the beginning of the forecasting period, however, non-resident pensioners do not have any appraisable compensation, as Italy has only recently moved from being a net sending country to being a net receiving one.

The consistency with other AWG macroeconomic assumptions is also attained 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 evolves in line with the number of employees, as noted above, the contribution base to GDP ratio will remain almost unchanged throughout the forecasting period.
Annex 1 - Decomposition of pension expenditure to GDP ratio – a set of consistent indicators

The ratio between pension expenditure and GDP ($\psi$) can be decomposed as follows:

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

where: $P$ stands for the average pension amount, $\Pi$ for GDP per worker, $V$ for the old-age population (65 and over), $E$ for the population of working age (20-64), $L$ 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 the following formula:

$$\psi = \lambda \delta \alpha \beta$$  \hspace{1cm} [2]

Furthermore, $\beta$ can be decomposed as follows:

$$\beta = \beta^{\text{dir}} + \beta^{\text{sup}} + \beta^{\text{sur}} + \beta^{\text{less}}$$  \hspace{1cm} [3]

where: $\beta^{\text{dir}}$ stands for the number of pensioners of 65 and over entitled to a direct pension (any kind of pension other than survivor’s ones) divided by the old-age population; $\beta^{\text{sup}}$ 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 to which the same person is entitled which are generally small in amount insofar as they are calculated on the contribution years other than those already utilised for the main direct pension; $\beta^{\text{sur}}$ stands for the number of survivor’s pensions of 65 and over divided by the old-age population; $\beta^{\text{less}}$ 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:

$$\beta^{\text{less}} = \beta^{\text{less, norm}} \beta^{\text{less, dem}}$$  \hspace{1cm} [4]

where: $\beta^{\text{less, norm}}$ is the ratio between the number of pensions below 65 and the population in the age bracket (50-64)\(^{42}\) while $\beta^{\text{less, dem}}$ 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:

$$\psi = \lambda \delta \alpha \cdot (\beta^{\text{dir}} + \beta^{\text{sup}} + \beta^{\text{sur}} + \beta^{\text{less, norm}} \beta^{\text{less, dem}})$$  \hspace{1cm} [5]

It is worthwhile pointing out that:

- the indicators: $\alpha$, $\delta$ and $\beta^{\text{less, dem}}$ do not depend on pension model results but only on the labour market and demographic assumptions agreed within the EPC-WGA;
- the indicator $\lambda$ 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 the Social

\(^{41}\) The age bracket (15-64) could also be assumed as an alternative.

\(^{42}\) The age bracket (55-64) could also be assumed as an alternative.
Protection Committee (which are based on the AWG macroeconomic and demographic assumptions), may represent an useful bench-mark to be used as reference;

- the indicator $\beta_{\text{norm}}^{\text{less}}$ mainly reflects the effects of changes in the eligibility requirements already legislated for;

- the evolution of the indicator $\beta^{\text{sur}}$ may be almost entirely explained in terms of demographic forces, namely the increase in life expectancy for both genders, and the mortality rate (number of deaths to population ratio) in the age bracket 65 and over;

- finally, the indicator $\beta^{\text{dir}}$ 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 changes for a given interval of time the equation [2] becomes:

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

where $\nu$ measures the interaction effect amongst the percentage changes of the explicative variables.

Finally, changes in pension expenditure to GDP ratio may be decomposed as follows:

$$\Delta \psi = \left( \frac{\Delta \delta}{\delta} + \frac{\Delta \lambda}{\lambda} + \frac{\Delta \beta}{\beta} + \frac{\Delta \alpha}{\alpha} + \nu \right) \psi$$  \[7\]

The breakdowns described in equations [5], [6] and [7] are given in Tables 1a, 1b and 1c, respectively. Analogous tables are also provided for each of the sensitivity tests.
Table 1a: 2009 AWG pension projections – decomposition of pension expenditure to GDP ratio through a consistent set of explanatory factors

<table>
<thead>
<tr>
<th></th>
<th>baseline</th>
<th>baseline+higher productivity growth</th>
<th>baseline+higher life expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pension expenditure / GDP (Ψ')</td>
<td>14.0%</td>
<td>14.1%</td>
<td>14.8%</td>
</tr>
<tr>
<td>Average pension / GDP per worker (l)</td>
<td>16.9%</td>
<td>16.9%</td>
<td>15.7%</td>
</tr>
<tr>
<td>Pension / employees (Y/l = a b g)</td>
<td>83%</td>
<td>83%</td>
<td>94%</td>
</tr>
<tr>
<td>Old age dependency ratio pop (65+) / pop (20-64) (δ)</td>
<td>32.6%</td>
<td>38.3%</td>
<td>45.9%</td>
</tr>
<tr>
<td>Pop (20-64) / employees (α)</td>
<td>155.5%</td>
<td>145.2%</td>
<td>141.4%</td>
</tr>
<tr>
<td>Pensions / pop (65+) (β) = βdir + βsup + βsur + βless</td>
<td>163.4%</td>
<td>149.6%</td>
<td>145.6%</td>
</tr>
<tr>
<td>Direct pensioners (&lt;65) / pop (65+) (βdir)</td>
<td>88.6%</td>
<td>85.8%</td>
<td>87.8%</td>
</tr>
<tr>
<td>Direct supplementary pensions (2) (65+) / pop (65+) (βsup)</td>
<td>4.1%</td>
<td>7.4%</td>
<td>8.6%</td>
</tr>
<tr>
<td>Survivors' pensions (&lt;65) / pop (65+) (βsur)</td>
<td>33.5%</td>
<td>30.6%</td>
<td>25.8%</td>
</tr>
<tr>
<td>Pensions (&lt;65) / pop (65+) (βless = norm βless * dem βless)</td>
<td>37.2%</td>
<td>25.9%</td>
<td>23.4%</td>
</tr>
<tr>
<td>Pensions (&lt;65) / pop (50-64) (norm βless)</td>
<td>40.2%</td>
<td>26.8%</td>
<td>26.9%</td>
</tr>
<tr>
<td>pop (50-64) / pop (65+) (dem βless)</td>
<td>92.6%</td>
<td>96.4%</td>
<td>86.9%</td>
</tr>
</tbody>
</table>

(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 1b: 2009 AWG pension projections – break-down of percentage changes in pension expenditure to GDP ratio

<table>
<thead>
<tr>
<th></th>
<th>baseline</th>
<th>baseline + higher productivity growth</th>
<th>baseline + higher life expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>'20-'07</td>
<td>'30-'20</td>
<td>'40-'30</td>
</tr>
<tr>
<td><strong>Pension expenditure / GDP</strong> ($\Delta \Psi / \Psi$)</td>
<td>0.8%</td>
<td>4.8%</td>
<td>5.2%</td>
</tr>
<tr>
<td><strong>Pop (65+)/pop (20-64)</strong> ($\Delta \delta / \delta$)</td>
<td>17.5%</td>
<td>19.8%</td>
<td>27.2%</td>
</tr>
<tr>
<td><strong>Average pension / GDP per worker</strong> ($Dl / l$)</td>
<td>0.3%</td>
<td>-7.6%</td>
<td>9.9%</td>
</tr>
<tr>
<td><strong>Pension/pop(65+)</strong> ($\Delta \beta / \beta$)</td>
<td>-8.4%</td>
<td>-2.7%</td>
<td>-7.4%</td>
</tr>
<tr>
<td><strong>Pop (20-64)/employees</strong> ($\Delta \alpha / \alpha$)</td>
<td>-6.6%</td>
<td>-2.6%</td>
<td>-1.5%</td>
</tr>
<tr>
<td><strong>Interaction</strong> ($\nu$)</td>
<td>-2.0%</td>
<td>-2.0%</td>
<td>-3.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>baseline+zero migration</th>
<th>baseline+older workers' participation rate</th>
<th>baseline+unemployment rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>'20-'07</td>
<td>'30-'20</td>
<td>'40-'30</td>
</tr>
<tr>
<td><strong>Pension expenditure / GDP</strong> ($\Delta \Psi / \Psi$)</td>
<td>7.4%</td>
<td>10.1%</td>
<td>10.7%</td>
</tr>
<tr>
<td><strong>Pop (65+)/pop (20-64)</strong> ($\Delta \delta / \delta$)</td>
<td>25.4%</td>
<td>26.8%</td>
<td>36.9%</td>
</tr>
<tr>
<td><strong>Average pension / GDP per worker</strong> ($Dl / l$)</td>
<td>-0.5%</td>
<td>-8.7%</td>
<td>-11.0%</td>
</tr>
<tr>
<td><strong>Pension/pop(65+)</strong> ($\Delta \beta / \beta$)</td>
<td>-8.0%</td>
<td>-2.5%</td>
<td>-7.5%</td>
</tr>
<tr>
<td><strong>Pop (20-64)/employees</strong> ($\Delta \alpha / \alpha$)</td>
<td>-6.4%</td>
<td>-2.5%</td>
<td>-1.8%</td>
</tr>
<tr>
<td><strong>Interaction</strong> ($\nu$)</td>
<td>-3.1%</td>
<td>-3.0%</td>
<td>-5.9%</td>
</tr>
</tbody>
</table>
Table 1c: 2009 AWG pension projections – break-down of changes in pension expenditure to GDP ratio

<table>
<thead>
<tr>
<th>Table 1c: 2009 AWG pension projections – break-down of changes in pension expenditure to GDP ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>baseline</strong></td>
</tr>
<tr>
<td><strong>20-07</strong></td>
</tr>
<tr>
<td>Pension expenditure / GDP ($\Delta \Psi / \Psi$) &amp; 0,1% &amp; 0,7% &amp; 0,8% &amp; -0,8% &amp; -1,1% &amp; -0,1% &amp; 0,5% &amp; 0,6% &amp; -0,9% &amp; -1,1% &amp; 0,1% &amp; 0,7% &amp; 0,8% &amp; -0,8% &amp; -1,1%</td>
</tr>
<tr>
<td>Pop (65+) / pop (20-64) ($\Delta \delta / \delta$) &amp; 2,4% &amp; 2,8% &amp; 4,0% &amp; 1,6% &amp; 0,1% &amp; 2,4% &amp; 2,8% &amp; 3,9% &amp; 1,5% &amp; 0,1% &amp; 2,5% &amp; 2,9% &amp; 4,2% &amp; 1,7% &amp; 0,2%</td>
</tr>
<tr>
<td>Average pension / GDP per worker ($D_l / l$) &amp; 0,0% &amp; -1,1% &amp; -1,4% &amp; -1,5% &amp; -1,2% &amp; -0,1% &amp; -1,2% &amp; -1,4% &amp; -1,5% &amp; -1,1% &amp; 0,0% &amp; -1,1% &amp; -1,4% &amp; -1,6% &amp; -1,2%</td>
</tr>
<tr>
<td>Pension / pop(65+) ($\Delta \beta / \beta$) &amp; -1,2% &amp; -0,4% &amp; -1,1% &amp; -0,7% &amp; 0,0% &amp; -1,2% &amp; -0,4% &amp; -1,1% &amp; -0,7% &amp; 0,0% &amp; -1,2% &amp; -0,4% &amp; -1,1% &amp; -0,8% &amp; -0,1%</td>
</tr>
<tr>
<td>Pop (20-64) / employees ($\Delta \alpha / \alpha$) &amp; -0,9% &amp; -0,4% &amp; -0,2% &amp; 0,0% &amp; 0,0% &amp; -0,9% &amp; -0,4% &amp; -0,2% &amp; 0,0% &amp; 0,0% &amp; -0,9% &amp; -0,4% &amp; -0,2% &amp; 0,0% &amp; 0,0%</td>
</tr>
<tr>
<td>Interaction ($\nu$) &amp; -0,3% &amp; -0,3% &amp; -0,6% &amp; -0,1% &amp; 0,0% &amp; -0,3% &amp; -0,3% &amp; -0,6% &amp; -0,1% &amp; 0,0% &amp; -0,3% &amp; -0,3% &amp; -0,6% &amp; -0,2% &amp; 0,0%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 1c: 2009 AWG pension projections – break-down of changes in pension expenditure to GDP ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>baseline+zero migration</strong></td>
</tr>
<tr>
<td><strong>20-07</strong></td>
</tr>
<tr>
<td>Pension expenditure / GDP ($\Delta \Psi / \Psi$) &amp; 1,0% &amp; 1,5% &amp; 1,8% &amp; -0,7% &amp; -1,9% &amp; -0,2% &amp; 0,8% &amp; 1,0% &amp; -0,7% &amp; -1,2% &amp; 0,1% &amp; 0,7% &amp; 0,8% &amp; -0,8% &amp; -1,1%</td>
</tr>
<tr>
<td>Pop (65+) / pop (20-64) ($\Delta \delta / \delta$) &amp; 3,6% &amp; 4,0% &amp; 6,1% &amp; 2,6% &amp; -0,4% &amp; 2,4% &amp; 2,7% &amp; 4,0% &amp; 1,6% &amp; 0,1% &amp; 2,4% &amp; 2,8% &amp; 4,0% &amp; 1,5% &amp; 0,1%</td>
</tr>
<tr>
<td>Average pension / GDP per worker ($D_l / l$) &amp; -0,1% &amp; -1,3% &amp; -1,8% &amp; -2,1% &amp; -1,7% &amp; 0,1% &amp; -1,1% &amp; -1,3% &amp; -1,4% &amp; -1,1% &amp; 0,1% &amp; -1,0% &amp; -1,4% &amp; -1,5% &amp; -1,2%</td>
</tr>
<tr>
<td>Pension / pop(65+) ($\Delta \beta / \beta$) &amp; -1,1% &amp; -0,4% &amp; -1,2% &amp; -0,9% &amp; 0,1% &amp; -1,3% &amp; -0,2% &amp; -1,0% &amp; -0,8% &amp; -0,2% &amp; -1,2% &amp; -0,4% &amp; -1,1% &amp; -0,7% &amp; 0,0%</td>
</tr>
<tr>
<td>Pop (20-64) / employees ($\Delta \alpha / \alpha$) &amp; -0,9% &amp; -0,4% &amp; -0,3% &amp; -0,1% &amp; 0,1% &amp; -1,1% &amp; -0,4% &amp; -0,2% &amp; 0,0% &amp; 0,0% &amp; -1,1% &amp; -0,4% &amp; -0,2% &amp; 0,0% &amp; 0,0%</td>
</tr>
<tr>
<td>Interaction ($\nu$) &amp; -0,4% &amp; -0,5% &amp; -1,0% &amp; -0,3% &amp; 0,0% &amp; -0,3% &amp; -0,3% &amp; -0,5% &amp; -0,1% &amp; 0,0% &amp; -0,3% &amp; -0,3% &amp; -0,5% &amp; -0,1% &amp; 0,0%</td>
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</table>
Annex 2 - Transformation coefficients: formula and assumptions

The formula used to calculate the transformation coefficients and their updates is given below:

\[ TC_s = \frac{1}{\Delta_s} \left( \sum_{x=m,f} a^{x(t)}_{x,s} + A^{x(t)}_{x,s} \right) \]

\[ \Delta_s = \frac{1}{2} \sum_{x=m,f} \left( \frac{1 + r}{1 + \sigma} \right)^{-t} - k \]

Average present value of direct pension awards:

\[ a^{x(t)}_{x,s} = \sum_{t=0}^{w-x} \frac{l_{x+t,s}}{l_{x,s}} \left( \frac{1 + r}{1 + \sigma} \right)^{-t} \]

Average present value of reversibility pension awards:

\[ A^{x(t)}_{x,s} = \sum_{t=0}^{w-x-1} \frac{l_{x+t,s}}{l_{x,s}} q_{x+t,s} \left( \frac{1 + r}{1 + \sigma} \right)^{-t} \Theta^{x(t)}_{s+t,s} \eta \delta_s \sum_{t=1}^{w-x+t+\epsilon_t} \frac{l_{x+t+\epsilon_t-\epsilon_{s+t},s}}{l_{x+t+\epsilon_t-\epsilon_{s+t},s}} \left( \frac{1 + r}{1 + \sigma} \right)^{-t} \]

Where:

- \( TC_s \) = transformation coefficient
- \( \Delta_s \) = divisor
- \( s = m, f \)
- \( l_{x+t,s} \) = 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 \( x+t+1 \)
- \( \Theta^{x(t)}_{s+t,s} \) = probability of leaving a surviving spouse at the age \( x+t \)
- \( \eta \) = 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
- \( \left( \frac{1 + r}{1 + \sigma} \right) = 1.5\% = \) discount rate

Where:

- \( k \) = adjustment owing to how pension is drawn (one month in advance, two months in advance, a year in advance and so on). This parameter accounts for 0.4615
- \( \epsilon_t \) = 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.
Cyprus

The Model

The pension projections performed were obtained by using two models:

- The model for the General Social Insurance Scheme – Cyprus Pension Model, and
- The Government Employees Pension Scheme model.

Below is a description of the Cyprus Pension Model.

Overview of the Cyprus Pension Model

Cyprus uses an actuarial pension model originally developed by the ILO. The model has been customised in order to closely comply with local legislation and capture national pension peculiarities. It is operated by the Social Insurance Services of the Ministry of Labour and Social Insurance. This model is used primarily for:

- conducting the actuarial valuation of the Social Insurance Scheme, every three years in accordance with section 71 of the Social Insurance Law;
- assessing the long-term financial impact of various pension reform alternatives;
- providing a solid quantitative framework to government authorities that guide future policy decision;
- long-term budgetary planning; and
- performing cash-flow projections between the Consolidated Fund and the Social Insurance Fund.

Cyprus Pension Model is a standard deterministic cohort-based projection model performing long-term projections of income and expenditure for the Social Insurance Scheme (SIS).

For each generation, the transition of an insured person (active, inactive and pensioner) is mapped into the next year’s status by using actuarially assumed transition probabilities (mortalities rates, incapacity rates, retirement rates, etc) and applying eligibility conditions and pension formula.

Projections for pensions are done collectively for all groups of insured, hence not separating workers of the private sector, workers of the public sector, self-employed persons and voluntarily insured persons. Pension expenditure is calculated on the basis of average pension (differentiated by sex, age and pension type).

The projection of the annual investment income requires information on the existing assets of the SIS. Investment income is calculated on the basis of the expected investment return on the assets of the SIS and the level of accumulated reserve of the SIS. An investment return assumption is formulated on the basis of the nature of the
SIS’s assets, the past performance of the fund, the SIS’s investment policy and assumptions on future economic growth and wage development.

**Assumptions and methodologies applied**

The Actuarial Pension Model includes a population model, an economic model, a labour force model, a wage model and a long-term benefits model.

The use of the model requires the development of demographic and economic assumptions related to the general population, the economic growth, the labour market and the increase and distribution of wages. Other economic assumptions relate to the future rate of return on investments, the indexation of benefits and the adjustment of parameters like the basic and supplementary earnings levels and the future level of flat-rate benefits. The selection of projection assumptions takes into account the recent experience of Cyprus to the extent this information was available. The assumptions are selected to reflect long-term trends rather than giving undue weight to recent experience.

**General population**

General population is projected starting with most current data on the general population, and applying appropriate mortality, fertility and migration assumptions. Fertility rate, life expectancy and migration are used in line with AWG/EUROPOP2008 data.

**Economic growth**

Real rates of economic growth, labour productivity increases and inflation rates are exogenous inputs to the economic model. AWG assumptions on these inputs are applied.

**Labour force, employment and insured population**

The projection of the labour force, i.e. the number of persons available for work, is obtained by applying assumed labour force participation rates to the projected number of persons in the general population. Aggregate employment is projected by dividing the real GDP (total output) by the average labour productivity (output per worker). Unemployment is then measured as the difference between the projected labour force and the total employment. The model assumes movement of participants between the groups of active and inactive insured persons. AWG assumptions on labour force participation, unemployment rates and employment growth assumptions are used for the projections.

**Wages**

Based on an allocation of total GDP to capital income and to labour income, a starting average wage is calculated by dividing the wage share of GDP by the total number of employed persons. In the medium-term, real wage development is checked against the labour productivity growth. In specific labour market situations, wages might grow at a pace faster or slower than productivity. However, due to the long-term perspective of
the present study, the real wage increase is assumed equal to the increase in real labour productivity. It is expected that wages will adjust to efficiency levels over time. Wage growth is also influenced by an assumed gradual annual increase of the total labour income share of GDP over the projection period, which is concomitant with the assumed GDP growth.

Wage distribution assumptions are also needed to simulate the possible impact of the social protection system on the distribution of income, for example through minimum and maximum pension provisions. Assumptions on the differentiation of wages by age and sex are established, as well as assumptions on the dispersion of wages between income groups. Average career wages, which are used in the computation of benefits, are also projected.

**Long-term Benefits**

Pension projections require the demographic and macro-economic frame already described and, in addition, a set of assumptions specific to the Social Insurance Scheme.

Pension projections are performed following a year-by-year cohort methodology. The existing population is aged and gradually replaced by the successive cohorts of participants on an annual basis according to the demographic and coverage assumptions. The projection of insurable earnings and benefit expenditures are then performed according to the economic assumptions and the Scheme’s provisions.

Scheme-specific assumptions such as the disability incidence rates and the distribution of retirement by age are determined with reference to the Scheme provisions and the historical experience under the Scheme.

**Data used to run the model**

Data used to run the model was provided by the Statistics department of the Social Insurance Services of the Ministry of Labour and Social Insurance.

The database the insured population by active and inactive status, the distribution of insurable wages among contributors, the distribution of past credited service and pensions in-payment. Data are disaggregated by age and sex.
Latvia

Projection model

The Ministry of Welfare is responsible for pension’s projections in Latvia. The Latvian Social Insurance Budget/Pension Model was built by World Bank consultants and ministry’s experts. The model is a microsimulation model and generates long-term projections of expenditures and revenues of the total social insurance budget. The model rests on five pillars:

- A Demographic Model
- A Population Status and Labour-force Participation Model
- An Income Model
- Pension Model
- Benefit Models

The model is presently designed to produce projections for old age, disability, short-term sickness, work injury, unemployment, maternity, survivor, funeral benefits and other important outlays. The most elaborate modules are those that generate disability and old-age pension projections.

For a specified set of rules for the calculation of benefits, the user steers the projections by choosing parameters that determine scenarios for the development of the population, participation in the labour force, the unemployment rate, the average wage and the degree of participation in the formal economy.

Most of the key assumptions needed to run the model can be varied over the projection period. For example, birth, mortality, unemployment, disability, average wage, and interest rates can develop in various ways specified by the user. Some scenarios are specified by a vector, such as the rate of growth or rate(s) of interest earned by fund reserves. Others are specified as changing age-gender distributions, e.g. survival rates, the distribution of income, and disability, work-injury and unemployment risks. This is done by specifying a set of possible scenarios in the Data Module and then choosing the desired development of parameters and the desired combination of scenarios in the Control panel that steers a run.

The model produces projections on an annual basis through the year 2060, although the projection period can be abridged and in some cases elongated. The year 2060 is presently the limit for the old-age pension projections. It is possible to run the demographic and population status sub-models much longer.

Key assumptions and results are accumulated in standard tables and charts. Other tables and charts may also be chosen at the discretion of the user. The model is programmed in Visual Basic and Excel.
**Basic data required to run the model(s)**

In accordance with the Law there are the following types of the state pensions distributed by age and gender:

1) old age pension;
2) disability pension;
3) survivor’s pension;

- Basic data are prepared by the State Social Insurance Agency and Central Statistical Bureau:
  - labour force and wage profiles
  - pensioners and pension profiles
- Basic data are official and no need to make separate calculations, only some corrections.
  - No missing data.

**Assumptions and methodology used in the calculation of main variables**

- Underlying assumptions agreed by the AWG that have been used in the model(s)
  - demographical assumptions;
  - participation rates;
  - wage growth = productivity;
  - unemployment rates;
  - interest rates;
  - employment rates.

- Additional assumptions and methodology used to estimate:
  - the number of pensioners, including estimates of the average number of newly retired pensioners
  - Average age of retirement of a birth cohort, for men and women separately (according the law, considering early retirement) has been used in the projections (all cohort of gender take retirement in the same year, except those who has been retired earlier). Early retirement - until 31 of December 2011.
  - pension accrual
  - Pension capital for old age pensions (NDC) has been calculated by age and gender in the model. Accumulated capital until year 2007 distributed by age and gender has been put in input data as base. Growth of social insurance wage base is used for capital indexation until retirement.
  - As the financing of the state mandatory funded pension scheme is in the framework of public pension scheme, all subsidies for the individual, paid by the state budget or other social insurance budgets (in case of child care, unemployment etc.) are respectively attributed for both schemes.
Over time, the contributions, designated to the funded pension scheme, will rise gradually to 10 percent in 2011, but contributions to NDC will decline and reaching the same proportion for both pillars (10%+10% = 20%).

### Contribution rate to the state funded pension scheme

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
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<tbody>
<tr>
<td>Rate</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>4%</td>
<td>8%</td>
<td>8%</td>
<td>9%</td>
<td>10%</td>
<td></td>
</tr>
</tbody>
</table>

- average pensions
- NDC and funded pension amount depends on accumulated contributions, life expectancy at the retirement age and pension indexation.
- For calculations of different types of pensions model is making calculations according to the law.
- number of years receiving a pension
- Number of years receiving a pension depends on estimation of life expectancy.

**Incorporation of future effects of enacted reforms**

- retirement decisions
- According to the law – no early retirement since 1 January 2012 and the same retirement age for men and women – 62 years.

- application of indexation rules and adjustments
- The same rules for indexation are applied for both the old-law and new-law pensioners: with consumer price index and 50% contribution wage base.

- supplementary payment for each length of period year till 1996:
  - from 1 January 2006 to 31 May 2008 – LVL 0.19;
  - from 1 June 2008 to 31 December 2008 – LVL 0.40;
  - from 1 January 2009 – LVL 0.70.

**Calculation of Old age pensions**

**Overview**

In principle, the model can be used to compute any defined-benefit or defined contribution pension scheme. The model combines demographic and economic scenarios with user defined rule systems to compute benefits. One of the major uses of the model is to examine the financial development and cohort-benefit profiles of old-age pension benefits over time given different user-specified demographic and economic scenarios. The model is presently programmed to produce calculations to the year 2060, but can be modified to produce calculations over longer time spans.

The model population is specified in terms of birth cohorts and gender. Since the model also contains a function specifying the distribution of income for men and women by
age, by first specifying an age and gender distribution, it is possible to use the model to compute benefit schemes taking into account typical age-earning income profiles.

Together with survival rates, the pension age is instrumental in determining the size of individual benefits and total costs for the pension system(s). The user specifies the average pension age to be employed in the calculations. Since the average pension age may change by either gender or birth cohort or both, do either to legislative or behavioural reasons, the user is responsible for specifying a desired scenario. The effect of this choice on the outcome can be studied in alternative scenarios.

Benefits are calculated according to benefit formulas specified by the user. They reflect assumptions made about the growth and distribution of individual earnings and contributions and the form of benefit indexation. Where appropriate, the user can make assumptions about what happens with survivor’s capital, as well as the development of the real rate of return on funded capital.

The output of the model is summarized in a financial accounting structure. The model keeps track of the development of benefits and the number of recipients by birth cohort and gender. This makes it possible to compare and examine the effects of alternative rule systems by gender and birth cohort. The model aggregates cohort and gender data to aggregate annual data on revenues and expenditures, stocks and flows of assets and liabilities, and numbers of beneficiaries and contributors. There are predefined tables and charts, but a user familiar with EXCEL can create his own output tables.

**The Retirement Age in the Model**

Legislation and behaviour determine the retirement age. Within the scope of the model the user determines the average age of retirement of a birth cohort, for men and women separately. With decreasing death risks and the resultant increase longevity for persons reaching a certain (minimum, mandatory etc.) pension age the average age of retirement may increase, either through legislation or behaviour.

The behaviour of the older work force is influenced by a number of factors. These include the rules for the mandatory social security scheme, incentives connected with individual earnings and job opportunity prospects, the costs of older labour for employers (compared to the advantages in terms of productivity, experience, etc.) health and life expectancy, and the in some occupations by mandatory pension age rules. All of these factors together determine the de facto retirement age of older workers, which is the relevant retirement age to be specified in the model.

**The Calculation of a Defined Benefit**

The exact definition of a defined benefit formula must first be specified in terms of what applies separately to a man and a woman, on average, in a given birth cohort. If the benefit depends on the number of years of contributions, this number will be collected - by gender and birth cohort - from the economic component of the model.

If the benefit is a flat rate benefit, i.e. the same benefit for all, then it is a simple matter to give all surviving persons over a certain age - or in specified birth cohorts - a specified flat rate benefit.
The Indexation of Benefits

All calculations in the model are performed in real values. This means that price indexation of benefits is assumed as the default option. In principle, it is a simple matter to choose any relevant form of indexation, including no indexation.

For example, the no indexation option would be specified as a price-related deflator of real-valued benefits.

Wage sum indexation involves indexing the real-valued benefits with a real-wage sum index. This can be set equal to varying degrees of full indexation, from zero to full indexation.
Lithuania

Description of the pension projection model and its base data

Institutional context

The Ministry of Social Security and Labour is responsible for the projection of the financial development of the statutory pension scheme.

As functioning and financing of the social insurance pension scheme and the state pension scheme are different in Lithuania, the number of recipients and expenditure projections for each of them are prepared separately and they are only put together in the last stage – the calculation of public finances’ income and expenditure.

The social insurance and private mandatory pension schemes projections have been done using the Pension Reform Illustration and Simulation Model (PRISM) - universal macro simulation model (Patrick Wiese is the author of the model). For the 2009 year projections a revised version (in 2006) of the model was used.

The projections of the number of recipients and expenditure of the state pensions and social assistance pensions are carried out on the basis of the mini models for each different scheme created by the specialists of the Ministry of Social Security and Labour using Microsoft Excel software. All the data used for the models was prepared in close cooperation with the institutions responsible for awarding of the state pensions and the Department of Statistics to the Government of the Republic of Lithuania.

In the preparation of the projections the conditions determined by the AWG were followed – the impact of the laws adopted before 1 July 2008 was considered. Those projections were not submitted to a peer review in the country.

Assumptions and methodologies applied and data used to run the model

The most important agreed demographic and macroeconomic assumptions were incorporated into the PRISM model exogenously: population projection\(^{43}\), rate of real GDP growth, rate of inflation, real rate of return, age-sex specific labour force rates and age-sex specific unemployment rates.

Rate of real wage growth was calculated endogenously. It is possible to endogenize either GDP growth or wage growth.

For projecting the number of contributors to voluntary privately funded pension scheme as a percentage of all contributors, four parameters are used: a male rate for age 20, a male rate for age 30, a female rate for age 20, and a female rate for age 30. Each rate is equal to the number of funded pillar contributors at a particular age and sex, divided by the total number of contributors at the same age and sex. The model uses linear

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\(^{43}\) The model has two options for forecasting the general population: (1) the model can perform an endogenous projection, in which the user is responsible for making assumptions about future expected lifetimes, fertility rates and migration rates, or (2) an exogenous population projection can be imported into the model.
interpolation to calculate the rates between age 20 and 30. The model assumes that the rates below age 20 are equal to the rate at age 20. Above age 30, the model assumes that a cohort’s rate remains unchanged over time.

The most important parameters for pension expenditure calculation, e.g. average retirement age (considering early retirement), average service period of new retirees, distribution by age and sex of the number of social insurance pensioners (old-age, disability, widowers and orphans), number of contributors to voluntary privately funded pension scheme as a percentage of all contributors (disaggregated by age and sex) and pension amounts for the base year were extracted from the database of the Social Insurance Fund for the year 2007. For future years the model equalizes, for each cohort, the number of service years awarded in the form of pensions with the number of years of contributions.

The number of the old-age pensioners is calculated according to the demographic rates, taking into consideration the assumptions of the past employment, i.e. eligibility to social insurance old-age pension. The number of the recipients of the disability, widow’s and orphan’s pensions extrapolates the tendencies existing up to 2007 and enacted reforms.

The current level of collecting social insurance contributions rate is fixed. Due to the lack of automatic pension indexation (pensions are increased by Government decisions each year), in this projection the assumption was made that old-age, disability, widow's and orphan's pensions would increase in line with the productivity growth (real wage growth).

Real rate of return was used when accumulating the contributions diverted to funded pillar. As regards payouts from private mandatory pension scheme, a single annuity was assumed, calculated by sex-specific life expectancy (from EUROPOP2008) and using annuity rate of return.

**Assumptions and methodologies applied and data used to projections of the State pension system**

The state pension system expenditure projections are made on the basis of AWG macroeconomic assumptions and the projections on the number of the state pensions recipients are made in line with AWG demographic and labour force assumptions. The data of the Department of Statistics of Lithuania and public institutions awarding and paying the state pensions about distribution of the number of the state pension receivers and pension amounts have been used as the primary data for these projections.

The following assumptions were used as the basis in calculation of the projections of the state pension system for the years 2007-2060:

- The number of individuals eligible to state pensions for officials and military servants and judges was projected to increase gradually as only a small part of these persons have acquired the right to the state pension of yet. Age and sex distribution of currently employed in the systems was used for the projections, and the tendencies of future employment development, the expected mortality rates and forecasted pension age (49 for female and 47 for male in case of officials and military servants) were applied. The average pension amount was calculated by indexing current amount of the pension to the rate of the
productivity growth, since the amount of the present type of pensions depends on the earnings the person received before retiring.

- The number of the deprived persons and victims will decrease markedly (with agreed mortality rates applied), as the majority of pension receivers are over the retirement age, and few new such pensioners will appear. The amount of this pension is related to the amount of the specific state pension base and the assumption was made that this type of the state pension would be indexed to the inflation rate.
- The number of the receivers of the 1st and 2nd degree pensions and social assistance pensions for disabled pensions are kept quite stable through the whole projection period due to the assumption of no policy change.
- The number of social assistance old age pension receivers is an output of pension projection model PRISM. It increases significantly to 13% of retirement age population (according to model PRISM projection results). The amount of social assistance old age pension is related to the amount of the basic pension and the assumption of its indexation to the real wage growth is made.

**Reforms incorporated in the model**

All legislated reforms are incorporated in the model.

**General description of the model(s)**

Model PRISM works with aggregated data (by sex, age cohorts and benefit types); exhaustive administrative data is used for preparation of the aggregates. Methodologically the program is based on the “average person” parameter modelling. The average contributions and pensions for each type of pensions is multiplied by the number of average persons in each group in order to produce the contribution revenues and pension expenditure at the aggregate level. Forecasting (model PRISM) of old age pensions is methodologically based on the age cohorts, and pension system pillars.
Luxembourg

Description of the pension projection model and its base data

Institutional context

A data-processing tool (SOBULUX, Social budget simulating software for Luxembourg) was implemented by the Inspection générale de la sécurité sociale (IGSS) in order to perform the financial projections of the pension schemes. In order to take account of peculiarities of the Luxembourg labour market (high proportion of migrant workers), the instrument was designed to include dimensions such as country of origin or employment status (beyond the general breakdown by age, sex and benefit type). The model thus makes a difference between total labour force and 'national' labour force. The tool is used for long-term planning, the assessment of pension reform options and in political debates.

With a view to regular evaluation of the financial situation of the general private-sector pension scheme, SOBULUX is used by the IGSS to draw up a report at the end of each seven-year period of coverage in accordance with Article 238(6) of the Social Insurance Code which states that “For each subsequent period of coverage, the overall contribution shall be continued, or reset by special law on the basis of a technical review of the preceding period and actuarial forecasts for the new period of coverage to be drawn up by the supervisory authority”.

Coverage of old age provision in the projection

Pension projections include pension provisions from the general pension scheme of the private sector and from special schemes. Expenditure items include of type of old age benefit granted by the schemes, including disability and survivor pensions for people aged less than 65. In addition, projections do include minimum pension provision guaranteed in the context the pension schemes.

Occupational pension schemes are voluntary for employees and have developed mainly in foreign or very large industrial and commercial companies, as well as in the banking sector. In 2002 a new legislation on individual old-age savings was introduced, favouring their development through tax incentives. Individual pension provisions are not included in the pension projections.

The high level of pension provision from public pensions leaves only a limited need for supplementary schemes. In addition, until now, no detailed information is available not on occupational pension schemes, nor on individual private pensions. For both reasons supplementary pension projections are excluded from the projections.

Social assistance expenditure to people in retirement age (0.055% of GDP in 2007) is not included in the projections.
Reforms incorporated in the model

No reforms are incorporated.

Compliance of the projection with an effective constant policy scenario

The constant policy scenario is strictly applied.

No reforms impacting the results of the pension projection exercise have been implemented between 2004 and 2007 so that no legislated changes are included in the projections (see section 2.3).

Indexation of pension is fully aligned to price and wage evolutions (see section 1.7).

All AWG assumptions have been implemented in the model (see section 2.6).

Assumptions and methodologies applied

The data-processing tool SOBULUX includes the following components:

- an economic component computes productivity growth, needed to determine the real growth of wages and the adjustment of pensions to the evolution of living standards,
- a demographic component projects the number of contributors and pensioners, and
- a financial component to evaluate receipts and expenditures of the systems.

All model components are calibrated in order to fully comply with AWG assumptions.

Fertility rate, life expectancy and migration are in line with EUROPOP2008 base scenario (AWG baseline).

Aging working group employment growth assumptions are used for the projections. Due to the specific situation of the composition of the labour market, labour supply cannot be proxied by applying participation rates to resident population. Exogenous labour supply assumptions, computed by the Commission, have been used in order to compute cross border labour force. The Commission assumptions are such that employment will increase in parallel for residents and cross border workers from about 2020 onwards (see section 2.8).

Labour force participation rates are computed by applying entry probabilities to inactive population or exit probabilities to active population. In the long run it is assumed that exit probabilities of the various socio-economic agents converge to those currently observed for the resident male white collar workers by the year 2060. Exit probabilities are calibrated in order to proxi the AWG assumptions on labour force participation rates (see section 2.8).
The total number of civil servants is supposed to increase at the rate of 0.5% per year. Due to the fact that civil servants schemes apply the same pension formula as the general pension scheme from 1999 onwards, the relative share of civil servants within the employed does not have a major impact on pension expenditure in the medium and long run.

Age specific earning profiles are used to compute total economic wage levels. Aging working group labour productivity assumptions are applied to model real wage growth.

**Data used to run the model**

Projections are based on register data available in the Datawarehouse at the IGSS.

**General description of the model**

SOBULUX is a cohort-based standard simulation model, based on previous ILO-type macro-projections. The model covers the general pension scheme of the private sector and the special civil servants pension schemes.

Basic dimensions of the model are age, sex and origin. Additional dimensions allow differentiating employment status (blue collar, white collar or civil servants) and pension type (disability, old age, early old age or survivor pension).

Pension expenditure is calculated on the basis of average pension (differentiated by sex, age, origin, employment status and pension type). New pensions to be granted are computed on the basis of the available career elements and the pension formula. The model applies a specific module to compute the acquisition of pension accruals. Cohort career elements (aggregate life time salary and aggregate compulsory insurance periods) are established from data available in the Datawarehouse for the reference year. For the following years, lifetime income increases by the annual income of the cohort and the career length is increased by 1 unit per year. Pension levels are adjusted every two years to wage growth.

Survivor pension are computed in different steps. In first step the number of eligible survivors is computed on the basis of known information of married couples. In a second step, survivor age is determined by applying an average age difference between married partners. In a last step, the average survivor pension is computed on the basis of legal dispositions.

Disability and survivor pensions paid out to persons over the standard retirement age are included in the old age category in order to reflect properly the expenditure related to old-age.

Net pensions are computed at the cohort level by deducting from the gross pension the estimated tax and compulsory social security contributions by beneficiaries paid on pensions. Benefit specific average itemised tax rates are applied (ESSPROS-net social benefits, 2003).
Receipts relating to the assets of the general pension scheme are calculated on the basis of the accumulated reserve of the scheme. The real yield is fixed at 3%.

Gross average replacement rate is computed as the ratio of the first pension of those who retire a given year over an economy-wide average wage in the same year. Only old-age and early pensions are considered.

**Additional model characteristics relevant to understand the projection results**

**Exogenous cross border employment growth as computed by Commission services**

Over the period from 1990 to 2003, the number of people in employment in Luxembourg increased at an average rate of 3.5%. The strong growth in the job market was accompanied by exceptional growth in the number of cross-border commuters, which averaged more than 11% over the course of the period. In 2003, 52% of cross-border commuters came from France, 27% from Belgium and 20% from Germany. In 2004, more than 100 000 members of the labour force were cross-border commuters. At present 34% of the labour force are Luxembourg nationals, foreign residents account for 27% of the working population, and 39% of people in gainful employment are cross-border commuters.

The approach used by the Commission to compute cross border employment growth is based on a comprehensive approach. It focuses on the peculiarity specific to Luxembourg – that of a huge number of cross-border workers – rather than on the 'top-down' approach to make GDP projections – first fixing GDP on the demand side and subsequently 'filling the gap' with the required labour input externally – in order to exclusively address the Luxembourg-specific situation.

The Commission methodology involves the following steps:

- Cross-border workers are proxied by the difference between the total number of persons employed according to the National accounts and the total number of employed persons according to the Labour force survey.
- The ratio of cross-border workers to total employment ('foreigner ratio') has risen over time, but the growth rate of this ratio has been on a downward trend over time.
- A regression function of the growth rate of the foreigner ratio, using a constant and a linear time-trend as explanatory variables (over the full period available: 1983-2007) is estimated.
- The trend (slope) was extrapolated linearly from 2008 onwards and hence the foreigner ratio was allowed to increase until the growth rate would turn negative; at this point, we fixed the foreigner ratio (at about 0.5).
- This would result in an excess growth of cross-border workers (over the growth of domestic employment) until 2018 and from then onwards, both cross-border workers and resident workers evolve at the same pace.
- All data series are updated (agreement on cohort simulation model, medium-term potential growth estimates based on the Commission's spring 2008 forecast,
latest available national accounts data from DG ECFINs database AMECO, latest updates from Eurostat's LFS database).

The charts below show the resulting estimations.

In the data set for the pension projection, the adjustment for cross-border workers was made in the production function model directly on the employment and hours worked series and not on the population series.

*Retirement age and exit probabilities*

Exit probabilities are applied to active population, including cross border workers, in order to determine for each cohort the number of new retirees. The model is calibrated in order to fully comply with AWG assumptions regarding participation rates of residents as well as cross border employment as given by Commission computations. The figure here below compares participation rates of residents in 2060 as assumed by the AWG to those generated by the model.
The following figure shows employment growth of cross border workers computed by the Commission and cross border employment growth generated by the model.

![Employment Growth Graph]

Comments on the evolution of the exit age in the future as assumed by the AWG.

- Any insured person who has reached his or her 65th birthday is entitled to a retirement pension, subject to proof of at least 120 months’ compulsory and/or voluntary insurance.
- Any insured person who has reached his or her 60th birthday is entitled to an early retirement pension, subject to proof of 480 months’ compulsory and/or voluntary insurance, including credited non-contributory periods, provided that compulsory insurance accounts for at least 120 months of this total.
- Any insured person who has reached his or her 57th birthday is entitled to an early retirement pension, subject to proof of 480 months’ compulsory insurance.

So in practice people are only eligible for retirement between age 57 and 60 if they do present 40 years of contributory periods which means that those people have started their professional career before the age of 20 and that they present no career interruption. On the other hand, people can go into retirement at age 60 or more if compulsory and credited non-contributory periods (child care, education,….) sum up to 40 years.

The graph here below shows the evolution of the average entry age to the general pension system insurance between 1960 and 2000. A clear increase of entry age is observed over the whole period. At present, a great share of older workers is eligible for retirement before age 60 as those people started their professional career before the age of 20. In the future, as average entry age of future retirees is far above the age of 20 years, it can be assumed that more and more people need to wait at least until the age of 60 in order to get eligible for early retirement.
In this regard an almost constant profile of exit probabilities over the entire projection period seems not realistic.

**References**


Hungary

Description of the pension projection model and its base data

1. General description of the model

The projections have been done by an Excel based semi aggregate simulation model, using data from administrative sources. The model makes deterministic calculations broken down by age, gender and type of benefit. The instrument is supported by a typical agent sub-model which calculates changes in lifetime (longitudinal) average earnings for various individual life paths that can be regarded as representative for certain groups of people within cohorts. The entire modelling instrument has been newly developed by the Ministry of Finance in collaboration with a contracted expert (former AWG member, András Horváth) during 2007-2008. It’s methodology differs in several points from that used in the previous AWG exercise. The differences will be described in detail in the following sections. Since autumn 2007, this new tool has been applied for the purpose of national projections and policy simulations.

2. Demographic and macroeconomic assumptions

The pension projections are based on Eurostat’s latest population projection, EUROPOP2008.

<table>
<thead>
<tr>
<th>Demographic assumptions</th>
<th>2008</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertility rate</td>
<td>1.35</td>
<td>1.35</td>
<td>1.39</td>
<td>1.42</td>
<td>1.46</td>
<td>1.50</td>
<td>1.53</td>
</tr>
<tr>
<td>Life expectancy at birth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>69.6</td>
<td>70.1</td>
<td>72.6</td>
<td>75.1</td>
<td>77.3</td>
<td>79.5</td>
<td>81.4</td>
</tr>
<tr>
<td>Female</td>
<td>77.9</td>
<td>78.3</td>
<td>80.2</td>
<td>82.0</td>
<td>83.8</td>
<td>85.4</td>
<td>86.9</td>
</tr>
<tr>
<td>Net migration as % of population</td>
<td>0.20</td>
<td>0.19</td>
<td>0.23</td>
<td>0.18</td>
<td>0.24</td>
<td>0.20</td>
<td>0.17</td>
</tr>
<tr>
<td>Total population (mill)</td>
<td>10.0</td>
<td>10.0</td>
<td>9.9</td>
<td>9.7</td>
<td>9.4</td>
<td>9.1</td>
<td>8.7</td>
</tr>
<tr>
<td>Population (15-64)</td>
<td>6.9</td>
<td>6.9</td>
<td>6.5</td>
<td>6.2</td>
<td>5.8</td>
<td>5.2</td>
<td>4.8</td>
</tr>
<tr>
<td>Population (65+)</td>
<td>1.6</td>
<td>1.7</td>
<td>2.0</td>
<td>2.1</td>
<td>2.3</td>
<td>2.7</td>
<td>2.8</td>
</tr>
<tr>
<td>Old age dependency ratio (%)</td>
<td>23.5</td>
<td>24.2</td>
<td>30.3</td>
<td>34.1</td>
<td>40.1</td>
<td>50.8</td>
<td>57.6</td>
</tr>
</tbody>
</table>

Since disability pensions have historically had a significantly lower mortality rate, the projection model makes a distinction between mortality rates of disability pensioners and those of the rest of the population. Based on data from the Central Administration of National Pension Insurance (ONYF), we have worked out the number of deaths among disability pensioners by age and gender in years 2004-2007 and by way of deducting these figures from the total number of deaths in respective cohorts, we got the mortality rates of the non-disabled population. For each single year of age the ratio of disability pensioners’ mortality rate to that of those not receiving disability pension has then been calculated. We assumed that the age and gender specific ratio of these two types of mortality rates will remain constant throughout the projection horizon. Using these ratios, we derived specific prospective mortality rates for these two subgroups so that their averages weighted by the number of people belonging to the respective subgroup equal the EUROPOP2008 mortality rate for all ages and genders.
With regard to labour market and productivity projections, the modelling has been carried out with the assumptions agreed in the EPC Ageing Working Group and prepared by the European Commission. Wage growth is assumed to equal productivity growth.

### Macroeconomic assumptions

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population growth (15-64)</td>
<td>0.0</td>
<td>-0.4</td>
<td>-1.0</td>
<td>-0.3</td>
<td>-1.2</td>
<td>-0.8</td>
<td>-0.7</td>
</tr>
<tr>
<td>Employment growth (15-64)</td>
<td>-0.1</td>
<td>0.7</td>
<td>-0.4</td>
<td>-0.6</td>
<td>-1.2</td>
<td>-0.9</td>
<td>-0.6</td>
</tr>
<tr>
<td>Participation rate (15-64)</td>
<td>61.7</td>
<td>63.4</td>
<td>66.6</td>
<td>65.9</td>
<td>64.3</td>
<td>64.9</td>
<td>65.0</td>
</tr>
<tr>
<td>Employment rate (15-64)</td>
<td>57.2</td>
<td>58.5</td>
<td>62.5</td>
<td>61.8</td>
<td>60.3</td>
<td>60.9</td>
<td>61.0</td>
</tr>
<tr>
<td>Unemployment rate (15-64)</td>
<td>7.4</td>
<td>7.7</td>
<td>6.2</td>
<td>6.2</td>
<td>6.2</td>
<td>6.2</td>
<td>6.2</td>
</tr>
<tr>
<td>Real GDP growth rate</td>
<td>2.9</td>
<td>3.3</td>
<td>2.4</td>
<td>2.1</td>
<td>1.1</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Labour input growth rate</td>
<td>-0.3</td>
<td>0.8</td>
<td>-0.2</td>
<td>-0.6</td>
<td>-1.0</td>
<td>-0.9</td>
<td>-0.7</td>
</tr>
<tr>
<td>Labour productivity growth rate</td>
<td>3.2</td>
<td>2.5</td>
<td>2.6</td>
<td>2.7</td>
<td>2.1</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

### 3. Coverage of the projections

All pensions and pension-like regular social assistance benefits have been covered by the projection. A detailed list of benefits can be found in the table below. Beyond these benefit types, mandatory private pension funds have also been included in the projections. We did not cover voluntary supplementary schemes.

#### List of benefits covered in the projection exercise

<table>
<thead>
<tr>
<th>Type of benefit</th>
<th>Expenditure in 2007 as % of GDP</th>
<th>Number of beneficiaries (in thousand)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits financed from the Pension Insurance Fund</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Old age benefit (incl. general early retirement scheme and pensions of</td>
<td>10.28%</td>
<td>2 743</td>
</tr>
<tr>
<td>the armed forces [„öregségi nyugdíj, előrehozott öregségi nyugdíj,</td>
<td>6.46%</td>
<td>1 691</td>
</tr>
<tr>
<td>fegyveres szervek nyugdíja”)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Disability benefit [„rokkantsági nyugdíj”)</td>
<td>2.49%</td>
<td>798</td>
</tr>
<tr>
<td>- Survivors’ benefit (incl. widows’ pensions and orphans’ benefit)</td>
<td>1.33%</td>
<td>255</td>
</tr>
<tr>
<td>[„hozzáállítottja ellátások, özvegyi nyugdíj, árvaellátás”)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pensions financed from other sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Miners’ early pension [„bányásznyugdíj”), artists’ pensions</td>
<td>0.09%</td>
<td>24</td>
</tr>
<tr>
<td>[, „művésznyugdíj”), early pension subsidized by the employer [, „korengedményes</td>
<td>0.07%</td>
<td>11</td>
</tr>
<tr>
<td>nyugdíj”)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Accident allowance [, „baleseti járadék”)</td>
<td>0.01%</td>
<td>13</td>
</tr>
<tr>
<td>Pension-like regular social allowances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Allowances of people with reduced work capacity (incl. pre-pension</td>
<td>0.54%</td>
<td>257</td>
</tr>
<tr>
<td>provisional allowance [, „átmeneti járadék”), regular social allowance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[, „rendszeres szociális járadék”) miners’ health impairment allowance</td>
<td>0.29%</td>
<td>191</td>
</tr>
<tr>
<td>[, „bányász egészségkárosodási járadék”)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Disability allowance [, „rokkantsági járadék”)</td>
<td>0.05%</td>
<td>30</td>
</tr>
<tr>
<td>- Spouse’s supplement [, „hazastársi pótlék”)</td>
<td>0.02%</td>
<td>29</td>
</tr>
<tr>
<td>- Regular allowances for agricultural workers [, „mezőgazdasági szövetkezeti</td>
<td>0.02%</td>
<td>7</td>
</tr>
<tr>
<td>járadékok”)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Supplementary benefits compensational supplements for former political</td>
<td>0.16%</td>
<td>-</td>
</tr>
<tr>
<td>persecutions [, „politikai rehabilitációs nyugdíjkiegészítések”),</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Input data

The projection is based on the following data, all of them disaggregated by type of benefit, age and gender:

- number of stock pensioners and their average primary and total (ie. primary plus supplementary) benefit (allowance) – source: Directorate of National Pension Insurance;
- number of new pensioners, the average amount of newly granted pensions and the underlying average lengths of service and average valorised earnings – source: Directorate of National Pension Insurance;
- number of members of the mandatory private pension scheme; inflows and outflows of membership; average contribution payment and accumulation of members – source: Hungarian Financial Supervisory Authority;
- average taxable earnings – source: Tax and Financial Inspection Office.

5. Old age benefits

The stock of old age beneficiaries (including old age benefit [„öregségi nyugdíj”], general early retirement benefit [„előrehozott nyugdíj, csökkentett összegű előrehozott nyugdíj”], and pension benefits for the armed forces is increased each year by the inflow of new retirees and decreased by the outflow of deceased retirees as calculated by mortality rates of non-disabled people. The acquisition of pension rights has not been modelled explicitly. Instead, historical averages and trends deducted from age and gender specific data received from the ONYF (for years 2004-2007) served as a starting point for calculating the number and average amount of newly granted pensions. We assumed that the age and gender specific retirement rates would remain constant if past and future labour market participation patterns were the same for all cohorts and no regulatory changes took place. As these two latter conditions cannot be held valid, a series of adjustments have been made to these historical retirement rates.

- First, due to amendments in the standard and early retirement eligibility rules, retirement behaviour of both men and women will change considerably. However, it was assumed that only the timing of retirement and the amount of benefit will change, whereas the total share of people in each cohort qualifying for old age pension will remain constant. The share of early retirees will fall significantly.
- Second, the recent decline in disability retirement rates required a slight upward adjustment in old age retirement rates for the next few years. The magnitude of the adjustment was determined so that the combined share of people receiving old age and disability pension at age 70 in each cohort will remain unaffected.
- Third, the most sizeable impact will most probably be exerted by the changing employment history of subsequent cohorts. Currently, almost all people approaching retirement age meet the qualifying conditions, ie have at least 15 years of service. Consequently, 98 per cent of men and 95 per cent of women aged 62-70 receive
either old age or disability pension benefits. These high percentages have resulted from the high participation and employment rates in the pre-1990 times, when virtually everybody in the working age population could (and was expected) to find occupation and women could already earn pension rights while being recipients of various child care allowances. Cohorts retiring nowadays started their careers sometime around 1965-1970, so they had a continuous labour history of about 20-25 years prior to the systemic change. Therefore, they could easily gather the minimum required number of service years even if they experienced long spells of unemployment in the past 15 to 20 years. However, as we proceed in time, younger cohorts will have a smaller and smaller fraction of their lives spent in the pre-1990 era and a growing fraction of their lives spent in periods characterized by low employment rates. As a result, there will be more and more people who will not have a sufficiently long contributory period to qualify for old age pension. However, due to the lack of retrospective data on pension accruals, it is very difficult to estimate the share of population which will probably fail to accumulate enough rights. Digitalized (alphanumeric) records are only available for rights that accrued since 1997, otherwise data are processed only at the time of award. Therefore, estimates can only be based on data of the past ten years – that is about one quarter of a regular career. Augusztinovics et al. [2008] carried out a thorough research on this issue and found that the proportion of people with less than 20 years of service at retirement age might climb to as high as 33%. In the present projection we took a more cautious approach (from the point of view of pension expenditures) and assumed that the share of cohorts without pension in own right at age 70 will gradually mount to 15 per cent by 2025 and stay at that level thereafter. The reason for this cautiousness is that an amendment passed at end 2007 preserved the possibility of retiring with 15 years of service (earlier the law envisaged the discontinuation of the so called partial pension from 2009).

- Fourth, retirement rates of cohorts reaching pensionable age after 2025 were adjusted to reflect projected changes in average participation rates.

As regards the projection of the lengths of service periods behind newly granted pensions, averages observed in the past and broken down according to the age of retirement were adjusted to reflect changes in the regulation as well as in the labour market situation. The most important adjustments were the following ones:

- It was assumed that due to tightened early retirement eligibility conditions the average service length of those retiring at the standard retirement age (62) will go up, because a considerable number of people with relatively (but in the new regulatory framework not sufficiently) long contribution history will be forced (or in part incited by the early retirement penalty) to defer retirement. Apart from further adjustments (see below), this would mean a 3.1 years (women) or 0.2 years (men) increase in cohort specific average service lengths as compared to 2006-2007 averages.

- The severe fall in employment rates that occurred during the systemic change in the 1990s will impact not only the share of eligible people but also the average service lengths of those fulfilling eligibility requirements. Predicting the magnitude of this impact is however equally difficult since both issues have their roots in the profound...
change in intra-cohort distribution of people along the dimension of lifetime (longitudinal) labour market performance. In the projection it was assumed that the cohort average service lengths (following the adjustments set out in the previous paragraph) will gradually fall by 5 per cent by 2025.

- Years of full-time university studies count as service periods only for periods before 1 January 1998 (unless contribution was paid on the basis of the minimum wage retroactively, what is expected to remain a rare occurrence). Therefore, average service lengths of cohorts attaining retirement age around 2035-2040 have been reduced gradually by 1.5 years in a differentiated manner (i.e. a relatively bigger reduction was ascribed to exit ages coupled with longer service lengths and higher average earnings as a possible sign of higher share of graduates).

The projection of average valorized pension base of new retirees is also based on averages observed among people who retired in 2006-2007 (evidently, 2006 values were uprated to 2007 levels). Proportions between age and gender specific averages (after being adapted to the amended regulations) were kept constant throughout the projection horizon. The rationale behind this assumption was that those capable of fulfilling the stricter early retirement conditions will continue to have a higher average salary than those who retire only upon reaching standard retirement age. These observed averages have been uprated with the help of a typical agent submodel. The submodel reconstructs life paths with characteristics similar to those of various groups of new beneficiaries who retired in 2006-2007. Using the economic assumptions specified by the AWG, the submodel calculates prospective changes in average valorised pension base for the representative careers.

Although the careers used will likely to become less representative in the future, several trials showed only a negligible distortion in projecting trends concerning the evolution of average pension base. This method enabled us to assess the impacts of regulatory changes affecting pension calculation which could not have been evaluated by a cohort average model alone. Beyond amendments taking force in 2008 and 2013, also the effects of the gradual extension of the salary assessment period ["keresetbeszámítási időszak"] could be taken on board. (When calculating the pension base, all earnings since 1988 are taken into account, regardless of the time of retirement, i.e. each year the salary assessment period gets longer by one year. As the typical salary path is concave, the extension of the assessment period gradually lowers replacement rates.)

The average amount of newly granted old age benefit comes as a product of the age specific valorised pension base and a rate depending on the length of service. As from 2013, the latter will be based on new accrual rates as specified by the law. Those who retire as members of the mixed system, will receive a 25 per cent lower social security benefit.

As regards the amount of stock benefits, the model recalculates the average amount for each cohort and gender in all years of the projection (averages of deceased beneficiaries get out of the cohort average and new benefits weighted by the number of new recipients are added to it; benefits granted earlier get indexed according to rule). Expenditures are calculated through the multiplication of these stock averages by the number of beneficiaries (pensioners deceased or entered during the calendar year are assumed to stay in the system for an average of six months, respectively).
6. Disability and survivors’ benefits

In the case of disability benefits, age and gender specific disability rates were calculated on the basis of 2006-2007 fact data from the ONYF. We assumed however that the steady and significant reduction of disability rates as exhibited by recent data series (2003-2007) for both men and women will continue until 2015, although at a decelerating pace and bring about a further 12 per cent reduction in newly granted disability pensions. (This trend may be the combined effect of poorer labour market records in the past two decades and a stricter assessment of disability status.) Furthermore, age specific disability rates of women have been subjected to an upward adjustment at higher ages in order to reflect a possible consequence of tighter early retirement rules. The incidence of discontinued benefits due to recovered health status has also been estimated from past data and held constant in relation to the stock of benefits. The amount of new benefits was projected by a method similar to that used for old age pensions. It was assumed that in the event of disability, all members of the mixed system will choose to transfer their private pension accumulation back to the social security scheme in order to get entitlement to a full disability benefit.

The projection of widows’ pensions and orphans’ benefit was also based on past age and gender specific figures expressed as percentage of the respective cohort population. Corrections were made in order to take account of changes in mortality rates. In the case of widows’ pensions, the projected convergence of male and female mortality rates implies a decreasing incidence of widowhood in the future. Similarly, calculations show the possibility of getting orphaned also becoming lower as time goes on. Widows’ pensions were also adjusted to expected changes in the share of people acquiring eligibility for old age pension. The age and gender specific amounts of survivors’ benefits were calculated by a function of old-age and disability benefits.

7. Pension like regular social allowances

Pension-like regular social allowances [„nyugdíjszerű rendszeres szociális ellátások”] are not pensions in the strict sense of the word but they are similar to pensions in several aspects and were therefore included in the projection. Typically, they are paid until the death of the recipient (eg. the disability allowance [„rokkansági járadék”] goes to people who lose at least 80 per cent of their work capacity before the age of 25) or until their reaching regular retirement age (eg. pre-pension provisional allowance [„átmeneti járadék”]) or they are supplementary to pensions. Although there is no legal obligation, these benefits have been indexed in line with regular pension increases.

The projection of pension-like regular social allowances was done on a case by case basis, paying attention to the characteristics of the specific benefit type. Certain allowances (regular allowance for agricultural workers [„mezőgazdasági szövetkezeti járadékok”), spouse’s supplement [„házastársi pótlék”]) are no longer awarded and therefore related expenditures will gradually disappear as the current recipients die out. The same applies to the bulk of those pension-like regular social allowances that are accessory to other benefits (such as compensational supplements for former political persecutions [„politikai rehabilitációs nyugdíjkiegészítések”), blind people’s allowance [„vakok személyi járadéka”), etc.). The miners’ health impairment allowance [„bányász egészségkárosodási járadék”) was also treated similarly since mining activities in
Hungary declined substantially in the last decade and the number of new allowance awards has been very low in recent years.

For the disability allowance [„rokkantsági járadék”] it was assumed that the proportion of people getting handicapped at young ages will remain constant in the future. The assumption of constant proportions was the starting point for the projection of pre-pension provisional allowance [„átmeneti járadék”], regular social allowance [„rendszeres szociális járadék”] and accident allowance [„baleseti járadék”], as well, but the number of recipients was adjusted so as to respond to changes in the share of people acquiring eligibility for regular pensions.

8. Mandatory private pensions

The membership of the private pillar is projected to grow each year by the number of new labour market entrants. Beyond the event of death, the outflow is constituted by people starting to draw either disability or old age pension or reaching standard retirement age. These quantities were calculated from regular retirement rates with due account on how the number of private scheme membership is related to the not-yet-pensioner part of the cohort population (the former being adjusted to reflect a higher-than-average participation rate among private scheme members). We assumed that in the event of disability all members of the mixed system will choose to transfer their accumulation back to the social security in exchange for a full amount of disability benefit (otherwise they could only get of a reduced one). In the case of death of the private scheme member, 50 per cent of the deceased people’s heirs were assumed to ask for a transfer to the social security and the rest for a lump-sum withdrawal.

As regards regular payouts from private pension funds, a single life annuity was assumed. Calculations were based on unisex mortality rates derived from EUROPOP2008 probabilities. Annuities were indexed in line with social security pensions as stipulated by law. The technical interest rate was chosen so that combined annuity reserves run out upon the extinction of the respective male and female cohorts. Real investment yield was set to equal 3 per cent.

9. Taxation

Currently, all pensions are exempt from taxation. Gross and net values in the projection results are therefore equal. As from 2013, however, newly granted social security pensions will be calculated from gross earnings and at the same time, they will be subject to personal income tax. Special tax rules applicable to pensions have not been specified by law yet. We assumed that benefits awarded prior to 2013 will continue to be exempt from tax, whereas benefits awarded from 2013 onwards will carry a tax burden that is calculated in line with general tax rules applicable to wages.

Income tax rules effective in 2008 served as a basis for the calculation. For a start, effective tax rates for a large number of wage levels were calculated for year 2008 (only general tax credits were taken into account; special tax allowances eg. those related to child raising were omitted). Wage levels were then expressed as percentage of nationwide average wage (see table below). It was assumed that tax rates corresponding to relative wage levels will remain constant in the future. Implicitely, this means that tax rules will be indexed to wage growth.
### Computed income tax rates at different income levels

<table>
<thead>
<tr>
<th>Wage level, relative to nationwide average wage</th>
<th>Income tax rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>0.0%</td>
</tr>
<tr>
<td>40%</td>
<td>3.5%</td>
</tr>
<tr>
<td>45%</td>
<td>5.1%</td>
</tr>
<tr>
<td>50%</td>
<td>6.4%</td>
</tr>
<tr>
<td>55%</td>
<td>7.7%</td>
</tr>
<tr>
<td>60%</td>
<td>9.3%</td>
</tr>
<tr>
<td>70%</td>
<td>11.8%</td>
</tr>
<tr>
<td>80%</td>
<td>15.4%</td>
</tr>
<tr>
<td>90%</td>
<td>18.7%</td>
</tr>
<tr>
<td><strong>100%</strong></td>
<td><strong>21.3%</strong></td>
</tr>
<tr>
<td>120%</td>
<td>25.1%</td>
</tr>
<tr>
<td>150%</td>
<td>27.3%</td>
</tr>
<tr>
<td>200%</td>
<td>29.5%</td>
</tr>
</tbody>
</table>

New pensions granted as from 2013 were projected in gross amounts according to the new benefit assessment rules. Gross amounts (disaggregated by age and gender) were then related each year to the nationwide average wage in order to get the relevant tax rate needed to arrive at net pensions. This method also allowed us to take into account the effects of pension indexation (as pensions are indexed less than then wages, their tax burden is decreasing with time due to the progressivity of the tax system).

As the gross replacement rates decrease from around 50 per cent to 38 per cent during the projection period. Along with the growing ratio of benefits granted after 2012 in the stock, the overall average tax burden of old age pensions will rise from zero to 5.5 per cent by 2060. Disability pensions will carry an even lower tax burden. Taxes on survivors’ benefits which are supplementary to old age or disability pensions were calculated with regard to the amount of the primary benefit.

As contributions payable to private pension funds have been subject to personal income tax since 2006, we assumed that payout from private funds will not be taxed (in order to avoid double taxation) but form part of the tax base ie. they might push other revenues, eg. social security pensions into higher tax brackets. Pension-like regular social allowances were also assumed to stay exempt from tax.

### 10. Contributions

For the starting year, age and gender specific average contribution base was calculated by polynomial interpolation from 2006 averages specific to age groups as received from the tax office. Earnings increases were projected so that the overall average will grow in accordance with the AWG assumptions while at the same time relations between single age specific averages remain constant (ie. the shape of the longitudinal earnings path does not change). Employment rates applied to members of mandatory private funds have been assumed to be higher than general employment rates (based on fact data), because only those who ever entered the labour market could become contributors to the private pillar. The participation rates and average salaries of the current fund members of higher ages had to be put to an additional adjustment as people with good positions on the labour market proved to be overrepresented among voluntary switchers when the mixed system was introduced.
Malta

Description of the pension projection model and its base data

1 Institutional context

The model used in projecting pension expenditure was the World Bank’s Pension Reform Options Simulation Toolkit (PROST) and it is the same model used in the projecting pension expenditure for the previous AWG budgetary projections exercise. Staff from the Economic Policy Division within the Ministry of Finance, the Economy and Investment (MFEI) were licensed to use PROST in order to model the development of the current pension system and analyse various options for pension reform.

The pension projections baseline was prepared by the World Bank with the assistance of expertise from the MFEI and the Ministry of Social Policy. The results obtained were subject to a process of internal review by pension experts within Government.

2 Assumptions and methodologies applied

The PROST input files were updated in order to incorporate the Ageing Working Group assumptions. The following is a list of the main assumptions that have been taken on board in our PROST calculations. Charts 2.1-2.6 show some of the demographic and macroeconomic assumptions.

Demographic Assumptions:
- Population (EUROPOP 2008)
- Fertility Rate by age (EUROPOP 2008)
- Mortality Rate by age and gender (EUROPOP 2008)
- Net Migration by age and gender (EUROPOP 2008)

It is interesting to note that population projections according to the EUROPOP 2008 assumptions indicate that total population is projected to grow to around 432,000 by 2030 and then decline to around 405,000 by 2060. As shown in Chart 2.1, these population figures are lower than under the EUROPOP 2004. Under EUROPOP 2004 total population was projected to grow to around 479,000 and increase further to around 508,000 by 2050. Consequently, the old-age dependency ratio reaches 49.8 per cent in 2050, 11.6 p.p. higher than the ratio projected in the EUROPOP 2004 exercise. However, the Maltese Authorities expressed reservations on the EUROPOP 2004

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45 The model used in this current round was PROST 12 which is very similar in terms of structure to PROST 11 which was the model used in the 2006 projections exercise.

46 After incorporating the AWG demographic assumptions PROST is projecting a population which is 0.9% lower than EUROPOP 2008 by 2060. For illustrative purposes we have estimated the impact of scaling the population in 2060 to EUROPOP 2008 levels whilst assuming that the proportion of the pensioners in total population remained constant. All else kept constant, pension expenditure (as a % of GDP) in 2060 would be at most 0.1 percentage points higher.
population projections exercise in view of the strong assumptions on net migration embedded in this exercise.

**Macroeconomic Assumptions:**

- Real GDP (growth rate)
- Labour Productivity (growth rate per hour)
- Inflation rate of 2%
- Participation rate by age and gender
- Unemployment rate by age and gender

In terms of the macroeconomic assumptions, the inflation rate is assumed to remain constant at 2 per cent during the period of 2007-2060. Real GDP is projected to grow by 2.6 per cent in 2010, increasing gradually to reach around 2.7 per cent growth by 2020, and then to decline to around 0.8 per cent by 2050 and to reach 1.0 per cent growth by 2060. The unemployment rate is assumed to remain relatively stable at around the rate of 6.2 per cent. The female participation rate (15-64 years) is assumed to increase to 45.5 per cent by 2030 and to decline marginally to 45.1 per cent by 2060. The male participation rate (15-64 years) is assumed to decline to 77.6 per cent by 2010, increase gradually to 84.0 per cent by 2030, decline to 83.0 per cent by 2040 and maintain that rate throughout the projection period. As shown in Charts 2.3 – 2.6, when compared to the previous round of projections, real GDP growth rate is projected to be lower, in line with a lower rate of growth in labour input. It is also notable that the participation rates in the 2009 round are lower than those projected in 2006. At the same time, the unemployment rate is projected to be lower than in 2006.

Tables 2.1 and 2.2 illustrate some of the assumptions submitted by the AWG that were taken on board in the previous round of budgetary projections and assumptions used in the present round of projections.

**Table 2.1**

<table>
<thead>
<tr>
<th>AWG Assumptions for the 2004 Budgetary Projections Exercise</th>
<th>2007</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP (growth rate)</td>
<td>2.5</td>
<td>2.5</td>
<td>2.7</td>
<td>3.1</td>
<td>1.9</td>
<td>1.7</td>
</tr>
<tr>
<td>Labour input (growth rate)</td>
<td>1.7</td>
<td>1.6</td>
<td>0.3</td>
<td>0.4</td>
<td>0.0</td>
<td>-0.1</td>
</tr>
<tr>
<td>Labour productivity (growth rate)</td>
<td>0.7</td>
<td>0.9</td>
<td>2.4</td>
<td>2.7</td>
<td>1.9</td>
<td>1.7</td>
</tr>
<tr>
<td>TFP (growth rate)</td>
<td>0.1</td>
<td>0.3</td>
<td>1.5</td>
<td>1.8</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Capital deepening (contribution to labour productivity growth)</td>
<td>0.7</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Inflation rate</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Male Participation rate (15-64yrs)</td>
<td>80.1</td>
<td>79.8</td>
<td>81.5</td>
<td>82.4</td>
<td>80.0</td>
<td>80.1</td>
</tr>
<tr>
<td>Female Participation rate (15-64yrs)</td>
<td>40.8</td>
<td>43.3</td>
<td>50.4</td>
<td>53.3</td>
<td>51.8</td>
<td>51.8</td>
</tr>
<tr>
<td>Unemployment rate (15-64yrs)</td>
<td>8.9</td>
<td>8.3</td>
<td>7.0</td>
<td>7.0</td>
<td>7.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Population</td>
<td>411,675</td>
<td>422,600</td>
<td>454,020</td>
<td>479,110</td>
<td>494,875</td>
<td>508,268</td>
</tr>
</tbody>
</table>

*Source: Ageing Working Group*
Table 2.2

AWG Assumptions for the 2009 Budgetary Projections Exercise

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP (growth rate)</td>
<td>2.9</td>
<td>2.6</td>
<td>2.7</td>
<td>1.7</td>
<td>1.2</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Labour input (growth rate)</td>
<td>1.4</td>
<td>0.4</td>
<td>0.0</td>
<td>-0.1</td>
<td>-0.5</td>
<td>-0.9</td>
<td>-0.7</td>
</tr>
<tr>
<td>Labour productivity (growth rate)</td>
<td>1.5</td>
<td>2.2</td>
<td>2.7</td>
<td>1.8</td>
<td>1.7</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>TFP (growth rate)</td>
<td>1.0</td>
<td>1.4</td>
<td>1.7</td>
<td>1.2</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Capital deepening (contribution to labour productivity growth)</td>
<td>0.5</td>
<td>0.8</td>
<td>1.0</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Inflation rate</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Male Participation rate (15-64yrs)</td>
<td>78.5</td>
<td>77.6</td>
<td>81.2</td>
<td>84.0</td>
<td>83.0</td>
<td>83.0</td>
<td>83.0</td>
</tr>
<tr>
<td>Female Participation rate (15-64yrs)</td>
<td>39.9</td>
<td>40.5</td>
<td>44.1</td>
<td>45.5</td>
<td>45.0</td>
<td>45.0</td>
<td>45.1</td>
</tr>
<tr>
<td>Unemployment rate (15-64yrs)</td>
<td>6.2</td>
<td>6.3</td>
<td>6.2</td>
<td>6.2</td>
<td>6.2</td>
<td>6.2</td>
<td>6.2</td>
</tr>
<tr>
<td>Population</td>
<td>410,300</td>
<td>413,542</td>
<td>427,045</td>
<td>431,601</td>
<td>424,334</td>
<td>414,781</td>
<td>404,737</td>
</tr>
</tbody>
</table>

Source: Ageing Working Group

Chart 2.1: Total population

Chart 2.2: Old-age dependency ratio

Chart 2.3: Real GDP

Chart 2.4: Labour Input
3 Data used to run the model

Modelling in PROST is based on the main input sheet which includes general assumptions pertaining to the economy and various parameters of the pension system. Inputs are further subdivided into sheets related to Population, the Labour market, and Pensions. For this exercise data was collected from national sources, including the National Statistics Office, the Inland Revenue Department within the Ministry for Social Policy. Four specific beneficiary categories are modelled in PROST and these comprise all pension benefits granted in Malta under the contributory scheme:

- **2/3 retirement pensions** (2/3 retirement pension (TTP); national min pension (NMP); increased national minimum pension (INMP); increased retirement pension (IRP); decreased national minimum pension (DNMP))
- **invalids** (national minimum invalidity pension (NMIP); invalidity pension (IP); increased invalidity pension (IIP); decreased national invalidity pension (DNIP))
- **survivors** (national minimum widows pension (NMWP); survivors pension (SRP); early survivors pension (ESRP))
- **top-ups** (retirement pension, widows pension)

Base year used in the model is 2007. While some input variables require assumptions for the projection interval others are generated in the various output sheets of PROST. The main inputs variables set in the **General** sheet include:

- GDP in Nominal terms in the base year
- The contribution ceiling (for employee and government contributions)
- Wage and pension cumulative income distributions for base year
- Demographic trends – sex ratio at birth
- Macroeconomic Growth trends for Real GDP, the inflation rate, the real interest rate, Government bond rate and the discount rate
- The retirement age by sex
Revenue sources mainly from contributions of employees, employers and Government
Pension indexation assumptions, minimum and maximum pension indexation, minimum wage indexation and contribution ceiling indexation
Benefit formula parameters: required years of service for basic replacement rate, the maximum replacement rate, etc.

The Population worksheet in PROST includes inputs for the following main variables:
- Maltese Population by age and by sex for the base year (2007);
- The age specific fertility rate for the base year and any projections or theories about the way fertility rates are most likely to behave over the simulation horizon (as per EUROPOP 2008);
- Probability of dying (males and females): age specific probability of dying for males/females in the base year as well as over the projection period in line with EUROPOP 2008 assumptions regarding life-expectancy;
- Net migration (males and females): age specific net immigration in each age group. Data in the base year as well as for the projection period in line with EUROPOP 2008.

The Labour worksheet in PROST includes inputs for the following main variables:
- Labour force participation (males and females): data are entered for the base year and for the for the projection period in line with AWG assumptions;
- Unemployment rate (males and females): data for each age group by gender are entered for the base year and for the projection period in line with AWG assumptions;
- Earnings profile for males and females in terms of minimum wage: this reflects the average gross wage of individuals relative to the minimum wage.
- Pension profile in terms of the minimum pension: this represents the initial distribution of pensions across pensioners of different ages.

The Pensions worksheet in PROST includes inputs for the following main variables
- Contributors (males and females): data is entered for each age cohort for the base year. Specific pensions category: data is entered for the number of pensioners receiving 2/3 pensions, number of invalids and survivors and top-ups for the base year.
- Assumptions for the length of service at retirement;
- The evolution of the number of pensioners as a stock of population over the projection period.

4 Reforms incorporated in the model

The modelling work reflected as far as possible to the rules spelled out by the legislation thus covering the reforms enacted in December 2006.

5 General description of the model

5.1 Overview

PROST projects pension contributions, entitlements, system revenues, and system expenditure over the long term. It is designed to promote informed policymaking, bridging the gap between quantitative and qualitative analysis of pension regimes. It is a
flexible, computer-based toolkit, easily adapted to a wide range of countries’ circumstances.

PROST is designed to answer the following kinds of question:

- How much will the pension system cost in the future? Is it viable and sustainable?
- What kind of benefits can people expect to receive in the future?
- Is the pension system equitable? Does it provide a decent retirement income to different categories of people?
- How large are the government’s implicit pension liabilities?
- How would broadening coverage, changing eligibility, changing benefits, or adjusting contribution rates affect the system? How will costs, expenditures and liabilities change under various reforms?

The model takes country specific data provided by the user. It generates population projections, which, combined with economic assumptions, are used to forecast future numbers of contributors and beneficiaries. These in turn generate flows of revenues and expenditures. The model then projects fiscal balances, taking account of any partial pre-funding of liabilities.

The PROST program produces five output modules:

1. **Population projections**: including life tables, population pyramids, population dependency ratios etc.
2. **Demographic structure**: labor force and employment, numbers of contributors and beneficiaries, system dependency ratio.
3. **Financial flows**: projections of wages, benefits, revenues and expenditures of the pension system, pension scheme balance and the implicit pension debt. The financial flows module also calculates the adjustments—to benefit levels or contribution rates—that would ‘balance’ the system, i.e. bring revenues and expenditures into line.
4. **Fundamental, systemic reform**: this module looks at the effect of a shift to a ‘multipillar’ regime, incorporating both a pay-as-you-go, defined benefit pension and a funded, defined contribution scheme or exclusively one or the other. Again, it measures the impact both on the public finances and on individual’s pension entitlements, including measurements of transition costs. The total pension benefit and the value of each of the pillars are provided separately.
5. **Effects on example individuals**: the model works out contributions and benefits for different example individuals, specified by age, sex, age of labor market entry, retirement age, earnings profile, mortality etc.

### 5.2 Main equations

When using PROST, the user needs to specify a time- and age-frame. The simulation horizon is defined by two time points: the base year (2007) and the end year (2060). PROST processes data in terms of single-year age cohorts. The starting age is 0 (infants younger than 1 year old) and the maximum age is usually set in the interval between 75 and 100 years. This time and age frame can be changed to accommodate the data availability.
5.3 Indexation

Table 2.3 outlines the indexation modeled in our pension projections. This reflects as far as possible the changes enacted to the local pension regime in the December 2006 pension reform.

Table 2.3

<table>
<thead>
<tr>
<th>Income Benefit</th>
<th>Indexation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Wage</td>
<td>COLA</td>
</tr>
<tr>
<td>Average Wage</td>
<td>Productivity growth</td>
</tr>
<tr>
<td>Contribution Ceiling</td>
<td>70% Nominal Wage growth and 30% Inflation rate after 2013</td>
</tr>
<tr>
<td>Minimum Pension</td>
<td>Initially linked to COLA. 60% of the National Median Income for persons retiring from 2026 onwards</td>
</tr>
<tr>
<td>Maximum Pension</td>
<td>70% Nominal Wage Growth and 30% Inflation rate for persons retiring from 2026 onwards</td>
</tr>
<tr>
<td>Average Pension</td>
<td>Currently linked to collective agreements and COLA. Indexed to 70% Nominal Wage Growth and 30% Inflation rate for persons retiring from 2026 onwards</td>
</tr>
</tbody>
</table>
Netherlands

The model

This section describes the methodology that is used to carry out the long term projections of pensions. The three pillars that form the pension system are treated separately. The projections are made by using the OLG-General Equilibrium model of the Netherlands, GAMMA, developed by the CPB Netherlands Bureau for Economic Policy Analysis.

The first pillar

The flat rate nature of the Dutch system of public pensions entails that a relatively simple methodology suffices to carry out projections. GAMMA relates the development of public pension expenditure to only two factors: the productivity in the economy and the number of people over the age of 65. The dependency on productivity is linear and reflects the fact that the pensions are linked to the (minimum) wage level. In turn, wage levels are assumed to increase in line with productivity. The dependency on the number of over 65 year olds is slightly more complicated. Some age-specificity within this group is introduced to take account of the positive correlation between age and the share of singles. As described above, singles are more expensive than married couples on a per capita basis. It is clear that this system leads to an increase of the ratio of public pensions to GDP that almost exactly coincides with the rise of the old age dependency ratio.

The second pillar

To project the development of contribution rates, pension payments, assets of pension funds etcetera, the 600-plus pension funds in the Netherlands are assembled in a model of a single average pension fund. This average pension fund offers a pre-funded average pay scheme, aiming at a replacement rate of 70% of average pay. Survivors pensions are not modelled explicitly but are taken into account through a surcharge on the old age pension. The existence of the flat rate public pension, the AOW, is taken into account by the pension fund through a franchise. Only workers with a wage above this franchise are building up an occupational pension. The accumulated assets are invested in a mixed portfolio of bonds and equity. For the baseline case the portfolio mix is 50-50. Furthermore, actuarial cost-effective contribution rates are charged. It should be noted that the contribution rate is cost effective on an aggregate level, i.e. for the whole pension fund. Because building up pension rights is usually linear, e.g. 2% of the pension wage per year worked, the contribution rate is not cost-effective on an individual level. Younger workers pay more than the actuarial value of the additional pension right they receive, older workers pay less. As a result, the occupational pension system gives a positive incentive to the labour force participation of older workers.

Most pension funds in the Netherlands aim at wage or price indexation. It is, however, not guaranteed but conditional on the financial position of the fund (coverage ratio). In recent years many pension funds have constructed more explicit indexation rules,
providing no indexation at all if the funding ratio is below a certain lower bound, full indexation if the funding ratio is above an upper bound and a linear cut in indexation in between. Our average pension fund aims therefore at a mixture of wage and price indexation and gives full indexation at a funding ratio of 135% (of the nominal liabilities) or more. No indexation is given if the funding ratio is below 100%. Roughly 70% of the pension funds aims at wage indexation.

The pension fund has to follow the supervision rules of the FTK. These rules prescribe, among other things, the required levels of the funding ratio and which part of the liabilities has to be covered by the cost-effective contribution rate. For our average pension fund, the funding ratio required by the FTK is 130% of the nominal, i.e. non-indexed, liabilities. In the long term, the pension fund aims at full funding of the indexed liabilities. Given the interest rate, inflation rate and real wage growth, this implies a funding ratio of about 145% of the nominal liabilities. Note that, according to the FTK, pension funds do not have to pre-fund their indexation as long as they have a consistent and transparent policy on promises made with respect to indexation.

The pension model, as well as the GAMMA model, contains 99 overlapping generations. For the first year of the projections, the total level of occupational pension liabilities is divided over the different generations. For every subsequent year the liabilities of each generation grow with the additional rights build up through an additional year of work. Of course, only workers build up occupational pension rights. The level of the pension benefit depends on the number of contributing years and the average wage. The assets grow with the contribution rates paid by the workers, the investment returns minus the pension benefits paid to the retirees.

In case shocks occur that affect the funding ratio (e.g. stock market crashes, changes in the interest rate, productivity shocks, etcetera) the pension fund restores the funding ratio by cutting indexation as well as raising contribution rates. Because of the ageing of the population, the wage sum will become much smaller relative to the size of the liabilities. As a result, cutting indexation will become a more important instrument to deal with shocks than increasing contribution rates.
Austria

Description of the pension projection model and its base data

Austrian Institutional Framework for Long-Term Pensions

Traditionally, medium-term pension projections, covering at least five future years, are contained in the yearly opinion submitted by the Austrian Pension Advising Council (PAC) to the federal government in preparation of annual pension adjustments. This consultative body represents the main forum for periodic policy discussions. It is composed of experts, academics, government and social partner representatives.

Initially, these medium-term projections which are limited to the private social insurance schemes ("gesetzliche Sozialversicherung") have been the central policy instrument for assessing pension developments. However, the tendency towards a more frequent use of quantitative analyses and external advice was intensified during past reform efforts. As a result, long-term pension projections based on demographics by Statistics Austria were presented as a complementary tool to clarify the need for adjustment and to assess the impacts of the major past reform efforts initiated by the federal government. This has proven to be a very helpful and transparent instrument. This is why, with the aim to have long-term pension projections constantly available and to safeguard long-term financial sustainability of the Austrian pension system, the federal government set up a permanent monitoring mechanism as of 2007. The PAC will then review financial developments in the pension system every three years and in particular with regard to the sustainability factor newly established in 2005. This sustainability factor does not operate automatically. The analysis of the financial sustainability of the Austrian pension system by the PAC is based on recent demographic projections of Statistics Austria, in particular projections of life expectancy at the age of 65. If life expectancy exceeds the reference value as defined in the law by more than 3% the committee is obliged to put forward respective proposals to offset potentially higher pension expenditures (e.g. through changes in the contribution rate, retirement age, benefit adjustment). The last review was in September of 2007 (with a revised version in February 2008) which resulted in no proposals. In the government programme of the new Austrian government (being in place since 2 December 2008) some changes are foreseen in order to safeguard the sustainability of the pension system. A new and more effective monitoring mechanism as well as a reform of the PAC are foreseen.

Description of the Applied Projection Models within the EU Framework

The Austrian pension projections within the given EU framework are based on two autonomous models, covering the private social insurance sector and the civil service schemes, respectively. They include all benefits and contributions to old-age, early-
retirement, disability and survivor schemes. The pension projections, therefore, include all public pension expenditure, amounting to 12.8% of GDP in total, but do not cover additional social assistance benefits. Total pension spending is defined as the outlays before taxation and before social contributions, health care contributions in particular. The pension projections contain the effects of all existing major pension reforms. This implies that the most recent 2008 minor reform steps have already been built completely into the pension projections. The cut-off date for measures included, therefore, is 1 October 2008.

Both models consist of partial equilibrium models and comprise deterministic elements only. In order to achieve consistency in the results, the two basic models for the private social insurance and the civil service sectors are consolidated, both as to macroeconomic developments and to expected shifts of contributors from one to the other category of schemes. For instance, the developments in civil service sector employment are captured by the private social insurance sector model; vice versa the macro scenario of the private social insurance sector schemes forms an important input into the civil service projections. Hence, though the two models are fully autonomous, they have been made fully consistent with regard to employment and wage developments.

The private social insurance sector model, accounting for nearly three quarters of total public pension expenditure is central to simulate the financial effects of population ageing. It covers all relevant social insurance schemes, for blue and white collar employees (ASVG), self-employed and farmers, among others. The model is composed of two major blocs that are intimately linked together. The macro part is made up of ten modules, reflecting economic, labour market, public finance and pension insurance developments. In effect, most single parameters are endogenously determined with the exception of participation and inflation rates, which fit in as exogenous inputs. The pension-specific micro part relies on inputs from the macro side on employment and on the payroll, from demographics and from age-related time series describing past pension contributions and benefits. These micro modules are designed so as to incorporate already enacted reforms with their effects in the near and distant future and to simulate reform options. These pension modules permit to calculate the great bulk of already existing pensions, the number of new pensions and of exits, average pension benefits and replacement rates as well as aggregate figures in a given (future) year. In the opposite direction, pension contribution rates and the level of the social insurance pension deficit covered by the federal budget feed back into the macro modules.

Secondly, the civil service model takes into proper consideration the fact that these pension benefits are fully financed out of the federal, Länder and the various communal budgets. The federal sector clearly dominates by size. In this vein, the federal segment comprises all pension and survivors’ benefit payments to civil service retirees of the federal government, the postal, telecom and railway services and specific groups of regional governments, such as primary and secondary school teachers. However, the model also takes account of all vital developments at the other government levels. With respect to these numerous schemes and some differing features and evolutions in these schemes, a number of rough approximations had to be incorporated into the model, especially for pension payments of the Länder and municipalities.
This also applies to ongoing structural reforms in the civil service sector which aim at enhanced application of private-sector-based labour contracts to their employees. As a general trend, civil service developments are assumed to be much more exposed to the present age-structure in the civil service and the future internal reforms rather than to demographics and economic developments, which are nonetheless taken into adequate consideration. These reform measures will dwell upon the comprehensive efforts to harmonise private social insurance and civil service sector pension systems, raising effective retirement ages and contribution rates as well as pursuing restrictive recruitment in the civil service sector in general and into the civil service status in particular. In the long run, while gradually phasing in, it is presumed that around 120,000 employees (of about 286,000 civil servants in 2007) in the public sector will shift from civil service to private social insurance sector contracts. This goes together with the assumption of restrictive civil service sector recruitment until 2015, including in the postal, telecom and railway services. As a result, the number of civil service pensions will fall markedly in the long run.
Poland

Description of the pension projection model and its database

Institutional context

The forecasts concerning the General Pension System have been prepared using the actuarial model of Social Insurance Institution47 (ZUS). This institution manages Social Insurance Fund (FUS), collects contributions and pays benefits. ZUS is required by the Social Security System Act to provide a long term projection every three years, which must be presented to the government and the public. Actuarial model used by ZUS has been tailored to its specific revenue-expenditure structure. In order to meet the requirements of the AWG projection this model has been extended to project the expenditures of the mandatory private part of the general pension system. The remaining pension systems: farmer’s pension system, security provisional system and pre-retirement benefits have been modelled using tools based on ILO methodology.

Assumptions and methodologies applied

The main part of the Polish pension system was modelled using the current version of ZUS’s model. Its kernel is a classical multiple decrement cohort-component actuarial model which evaluates present and nominal for essential pension-type payments. Elemental calculation unit is “same-sex-and-age” cohort. The kernel is boosted with complementary modular sub-models projecting other benefit expenditures.

The contribution revenue forecast is derived from past experience and projected changes in demographics and the labour market.

The deterministic actuarial calculations were performed with an Excel – VB background. The model is updated on an annual basis. It covers four social insurance schemes: old-age, disability, survivors, sickness and accident insurance. The tool distinguishes between different mortality rates of certain types of benefit recipients. Main outputs of the model include the standard fiscal indicators (expenditures, revenues, surplus/debt of the Social Insurance Fund) and various standard ratios (e.g. benefit ratio). Previous version of the model have served as a tool for the AWG pension projections in 2006 but because of the introduction of numerous changes model used in current projection should be treated as a new tool.

The expenditures form the remaining parts of the Polish pension system: farmer’s pension system, security provision systems and pre-retirements benefits were modelled using additional small cohort based simulation models.

Models used in the projections do not cover voluntary savings and the minimum pension in the new system.

47 The Social Insurance Institution (ZUS) plays a major role for the Polish social security system. ZUS manages the Social Insurance Fund (FUS), collects contributions and pays out benefits, which are not solely social security ones by nature, but also some state budget financed payments.
Regarding voluntary savings, establishment of a system of special incentives and preferences allows Polish country to support voluntary savings for retirement pension in the form of occupational pension schemes and individual pension accounts. First occupational pension schemes were established in 1999 and individual pension accounts in 2004. 1,019 occupational pension schemes including 312,000 employees had been functioning till the end of 2007. Individual pension account is an account that allows additional savings for retirement pension without the necessity of paying capital income tax. Individual pension account savings allow gathering funds that will supplement retirement pension income from state system. Till the end of December 2007 over 915.4 thousand of accounts were operating.

The minimum retirement guarantee shall include persons who will have insurance period (20 years for women and 25 years for men) in the old retirement pension scheme (including persons born before 1949) and in the agricultural system this pension is directly financed within insurance. In the new retirement pension scheme, the minimum retirement guarantee shall be financed by state budget and paid when total compulsory retirement pension scheme is lower than the minimum.

**Data used to run the model**

All models used in the projection used common macroeconomic and demographic projection send by AWG. The parameters of the model have been calculated or estimated on the data experience from the years 1999-2007. The data from the deeper past were not appropriate for the projections because of changes resulted from the huge reform of the social security system in 1999.

**Reforms incorporated in the model**

The model incorporates all reforms implemented before July 2008 mentioned in the chapter 1.2.
Description of the pension projection model and its base data

The projections now presented were obtained by using three models:
- The model for the general regime of social security – ModPensPor model;
- The public sector employees model – CGA model;
- The occupational pensions model

The ModPensPor model was developed and is maintained by the Cabinet for Strategy and Planning of the Portuguese Ministry of Labour and Social Solidarity (GEP/MTSS) while the CGA model was developed and is run by the Strategic Planning, Economic Policy and International Affairs Office of the Ministry of Finance and Public Administration (GPEARI/MFAP). In the latter case, the input data is provided by the Caixa Geral de Aposentações. The model for occupational pensions was developed by the Portuguese Insurance and Pension Fund Supervisory Authority - Instituto de Seguros de Portugal (ISP). GPEARI also coordinates the projection exercise and discussed with the other two institutions (GEP and ISP) the respective results.

All the input data refer to the base year (2007). Social Security (MTSS) and CGA (MFAP) provided the required statistics concerning the public pensions and ISP the data on the occupational pension schemes. The National Statistics Institute (INE) provided demographic data also for 2007.

The three models will be described separately. However, the main results of ModPensPor and CGA models are presented together as the CGA is a closed subsystem and the analysis should be done for the public pension system as a whole.

1. ModPensPor model

This model was firstly used for the White Paper on Social Security Commission, during the 2nd half of the 90’s, in order to estimate the impacts of the subsequent reform. This evaluation was carried out by a consortium that joined experts from three universities research centres – the Portuguese CISEP (Research Centre on the Portuguese Economy) and CIES (Centre for Research on Financial Economics) and the Spanish FEDEA (Fundación de Estudios de Economía Aplicada).

Since 2005, ModPensPor has been the model used for the general regime of social security projections in the context of the Ageing Working Group. In 2006, ModPensPor was also used to evaluate the impacts of the “Measures for Reforming Social Security” presented by the government to the social partners committee and has been used for the Social Security Projections included in the Portuguese State Budget since 2007.

Basically ModPensPor is a partial equilibrium model run on Gauss language, developed to access long term impacts of ageing, economic growth and policy making on the Social Security balance sheet. The model takes into account a set of structural data of the Social Security system (considering, for every allowance, the number of
beneficiaries by age, gender and average benefit). Then, regarding a base year and according to a macroeconomic and a demographic scenario, it makes projections assuming that the fundamental relations of the Social Security system will remain constant.

Assumptions and methodology

Mortality rates applied to pensioners are those implicit in the demographic scenario considered. New pensioners by age and gender are determined by assuming a constant proportion of the set of new pensioners for a combination of sex and age on the overall population in the base year for that same age and gender.

So, the number of new pensioners for each eventuality (old age, survivors and disability) will be given by the following relation:

\[ NewPens_{t,a,g} = \frac{NewPens_{2007,a,g}}{Pop_{2007,a,g}} \times Pop_{t,a,g} \]  

where \( NewPens_{t} \) stands for new pensioners in year \( t \), for age \( a \) and gender \( g \).

Each year, new pensioners will be added to the existing stock of pensioners, such that the number of total pensioners could be written in the following way:

\[ TotalPens_{t,a,g} = NewPens_{t,a,g} + \left( TotalPens_{(t-1),(a-1),g} \right) \times \mu \]  

The parameter \( \mu \) expresses the survival function, deterministically given by the demographic scenario considered, of total living pensioners in year \( t-1 \) that survive to \( t \):

\[ \mu_{t,a,g} = \frac{POP_{t,a,g}}{POP_{(t-1),(t-\alpha),g}} \]  

Average old age and disability pensions for new pensioners are calculated in a specific procedure within the model according to age, gender and a theoretical wage history derived by the model. This wage history is derived by applying to the pensioner’s last wage a matrix of average wage growth in the Portuguese economy since the 1960’s\(^{48}\).

Survivor’s pensioners grow in line with old-age pensioners’ mortality and they keep the distribution by gender and age of the base year.

The value of new survivors’ pensions is also indexed to the old-age pension amounts that originate them.

\(^{48}\) This series was built from historical series published by the Banco de Portugal and, since 2001, it refers to wages declared to Social Security.
Employment grows, for each age group and gender, at the same rate as the average employment growth rate given by the macroeconomic scenario and wages grow in line with productivity levels, given by the macroeconomic scenario.

\[ Wage_{t,a,g} = Wage_{(t-1),a,g} \times (1 + \omega_t) \]  

(4)

where \( \omega_t \) represents the wage annual growth rate.

So, total contributions can easily be derived by the following formula:

\[ Contrib_t = Contrib_{(t-1)} \times (1 + \omega_t) \times (1 + \phi_t) \]  

(5)

where \( \phi_t \) represents the employment annual growth rate.

Individual profiles of pensioners and beneficiaries (that are based upon monthly input data) are calibrated on an annual basis according to the Social Security’s balance sheet. Employment and salaries are also calibrated for the entire projection horizon in order to simulate the fact that new public employees join the Social Security from 2006 onward. In fact, ModPensPor and the CGA model results are integrated: until 2011, it is considered that for each two public employees that leave (from CGA) only one new employee is hired (Social Security contributor). From 2012 on, it is assumed that public employment keeps it share on total employment (around 13%). It should be stated that due to higher qualifications, average wages of public sector workers are 10% higher than average wages in the private sector.

On what concerns policy rules, the model takes into account the impacts regarding the progressive introduction of the new benefit formula as well as all the features regarding the financing model established to the Social Security system, namely the pension trust fund and the specific State Budget revenues.

There are also some main assumptions in which projections are based on:

- It is assumed that all workers retire when they reach the legal retirement age (65 years-old);
- In the long run, old age pensioners have an average contributory career of 32 years;
- It is assumed an effective overall contributory rate of 32.55% (which is the effective rate underlying total contributions to the Social Security in 2007);
- The surpluses generated by the social insurance subsystem as well as 6% of overall contributions are transferred to the trust fund.

2. CGA model

The pension model used for the CGA projections is the same that was used in the 2007 Peer Review exercise on the Portuguese pension reform. It is an accounting/actuarial model that allows a detailed parameterization of the system, including the simulation of different demography or macroeconomic assumptions and changes in the reform parameters. However, as it is not a general equilibrium model, it does not permit
endogenous analysis of the changes in supply and demand and in the consumption and
investment decisions of economic agents stemming from their adjustment, for example,
to the reforms in social security that were enacted.

Assumptions and methodology

The model has four main modules: the first one relates to input data (including
macroeconomic and demography data), the second one comprises the dynamics for
contributors and number of pensions, the third one refers to the dynamics of
contributions and pensions and the last one provides the outputs. Modules two and three
are structured by age and gender strata in order to allow more precise results.

Module for contributors and pensioners dynamics

Due to the fact of CGA being a closed system, the dynamics of contributors is quite
simple: the number of contributors decreases each year due to new retirees and due to
mortality and to other motives like moving to the private sector or exoneration, as well.
The number of CGA contributors at the end of year is given by:

\[
C_{t,a,g} = C_{t-1,a,g} \times \left[1 - \mu_{t,a,g} - \pi_{t,a,g}\right] - np_{t,a,g}
\]

where,
- \(C_{t,a,g}\) - Number of CGA contributors in year \(t\), for age \(a\) and gender \(g\)
- \(\mu_{t,a,g}\) - Mortality rate in year \(t\), for age \(a\) (for those who would complete age
  \(a\) during year \(t\)) and gender \(g\)
- \(\pi_{t,a,g}\) - Contributors rate of exoneration in year \(t\), for age \(a\) and gender \(g\)
- \(np_{t,a,g}\) - Number of new pensioners (includes old-age pensioners and disability
  pensioners) in year \(t\), for age \(a\) and gender \(g\).

The dynamics of pensioners is done for old age and disability pensioners together and
for survivors separately. The stock of pensioners increases with new pensioners and
decreases according to pensioners’ mortality. In this model, survivor pensioners also
depend on a “depreciation rate” that applies mainly to descendants when conclude their
studies.

Old age and disability pensioners

New pensioners (and pensions) are computed according to the legal regime that applies
to each type of contributors: regime of Estatuto de Aposentação that applies to public
employees registered in the CGA until August 1993 and social security regime that
applies to public employees registered in CGA between September 1993 and December
2005. For each legal regime, new pensioners are projected with a breakdown by motive:
disability, old age (including early retirement) or age limit (at 70 years old).

New pensioners are computed by using “retirement probabilities”. The later are defined
as the base year ratios of new pensioners over contributors, for those who are aged less
than 70. This means that new pensions are not determined only as a function of the legal
criteria.
Number of new old-age pensioners:

\[ op_{t,a,g} = op_{t-1,a,g} \times \frac{C_{t-1,a,g-1}}{C_{t-2,a,g-1}} \]  \hspace{1cm} (7)

where, \( op_{g,a}(t) \) - Number of new old-age pensioners during year \( t \) for age \( a \) and gender \( g \)

In the case of old age, including early pensioners, the above mentioned ratios move along legal retirement age (LRA)\(^{49}\). It should be recalled that the LRA for CGA contributors is increasing from 60 years old in 2005 to 65 years old in 2015, at a pace of 6 months per year, in order to achieve convergence to the private sector regime.

It was assumed that the retirement probabilities for disabled do not change with the above mentioned increase in the LRA.

The number of CGA new disability pensioners is given by:

\[ dp_{t,a,g} = dp_{t-1,a,g} \times \frac{C_{t-1,a-1,g}}{C_{t-2,a-1,g}} \]  \hspace{1cm} (8)

where,

\[ dp_{t,a,g} \] - Number of new disability pensioners in year \( t \), for age \( a \) and gender \( g \)

The dynamics for the number of old-age and disability pensioners at the end of year \( t \) is given by:

\[ Op_{t,a,g} = Op_{t-1,a-1,g} \times (1 - \mu_{t,a,g}) + op_{t,a,g} + dp_{t,a,g} \]  \hspace{1cm} (9)

where, \( Op_{t,a,g} \) - Number of old-age and disability pensioners at the end of year \( t \) for age \( a \) and gender \( g \)

**Survivor pensioners**

New survivor pensioners are a function of old age and disability pensioner’s mortality. In the past, on average, 80 per cent of pensioners who die had a survivor entitled to a pension, but this percentage is expected to decrease (to near 60%), as spouses beneficiaries tend to have their own wage/ pension and would not be eligible to a survivor pension and the number of children tend to decrease as well. Having the estimate for total new survivors’ pensioners, the age and gender distribution is the same of base year.

\(^{49}\) For pensioners aged between LRA-10 and 70 (age limit).
It is also considered that the stock of survivor pensioners depend on a “depreciation rate” that applies mainly to descendants when conclude their studies. So it is necessary to divide the age strata into the following:

- $18 < a < 27$
  \[ Sp_{t,a,g} = Sp_{t-1,a,g} \times \left[ \left( 1 + \mu_{t,a,g} \right) - \chi_{t,a,g} \right] + sp_{t,a,g} \]  
  \( (10) \)

- Other $a$
  \[ Sp_{t,a,g} = Sp_{t-1,a,g} \times \left( 1 - \mu_{t,a,g} \right) + sp_{t,a,g} \]  
  \( (11) \)

where,
- $Sp_{t,a,g}$ - Number of survivor pensioners in year $t$, for age $a$ and gender $g$
- $sp_{t,a,g}$ - Number of new survivor pensioners in year $t$, for age $a$ and gender $g$
- $\chi_{t,a,g}$ - Depreciation rate of the survivor pensioners stock, unrelated to the death of the beneficiary in year $t$, for age $a$ and gender $g$

**Module for contributions and pensions dynamics**

Contributions to CGA are a fixed percentage of employees remuneration (10% supported by employees and 13.1% by the employer). Therefore, the contributions dynamics depends on the remunerations evolution. The data available for 2007 contained average values for remunerations of the subscribers by age and gender strata. The updated and adjusted average remuneration is:

\[ W_{t,a,g} = \max \left( W_{t-1,a,g} \times (1 + \gamma_t) W_{t-1,a-1,g} \times (1 + \gamma_t) \right) \]  
  \( (12) \)

where, $\gamma_t$ is the annual update rate for public sector wage scale.

Contributions in each year are given by:

\[ Cont_{t,a,g} = \tau_t W_{t,a,g} \times C_{t,a,g} \]  
  \( (13) \)

where, $\tau_t$ is the CGA’s contributory rate

The average old-age pension is determined by:

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50 In practice, only some general government subsectors employers actually contribute to CGA, while in the case of State it makes an annual transfer to CGA. However, the contributory rate of 13.1% was considered to all employers (as an imputed one, in the case of State) by analogy with the contributory rate to Social Security general regime of new public employees.
\[
\text{Pens}_{t,a,g} = \frac{(Op_{t,a,g} - op_{t,a,g}) \times \text{Pens}_{t-1,a,g} \times (1 + \alpha_t) + op_{t,a,g} \times npens_{t,a,g})}{Op_{t,a,g}}
\]  

(14)

where \(\alpha_t\) represents annual pension update and \(npens_{t,a,g}\) is the new old-age pension in year \(t\), for age \(a\) and gender \(g\).

Total old-age and disability pensions expenditure is given by:

\[
TE_{t,a,g} = pens_{t,a,g} \times (Op_{t,a,g})
\]  

(15)

The dynamics of survivor’s pensions follows the old-age pension’s one:

\[
\text{SurvPens}_{t,a,g} = \frac{(Sp_{t,a,g} - sp_{t,a,g}) \times \text{SurvPens}_{t-1,a,g} \times (1 + \alpha_t) + sp_{t,a,g} \times nsurvPens_{t,a,g})}{Sp_{t,a,g}}
\]

(16)

where \(\alpha_t\) represents annual pension update (the same of old age pensions) and \(nsurvPens_{t,a,g}\) is the new survivors pension in year \(t\), for age \(a\) and gender \(g\).

Each new survivor’s pension, according to the law, is equivalent to 50% of the old age pension that originate it. In the model, it was assumed the average new survivors pensions to be around 40% of the average old age pensions.

3. Occupational pensions’ model

This new model for the occupational pensions’ projection in Portugal was based on current market statistics, relationships between fundamental economic and demographic variables and on assumptions that were made on the future behaviour of those variables. In brief, the projection exercise can be described as follows:

- The pension fund participants were modelled taking into account the normal decrements (disability, survival and retirement) and an assumption regarding the coverage ratio of the pension population out of the total employed population. These pension fund population coverage ratio allow projecting the total number of participants for each year;
- The beneficiaries’ population was modelled by taking the current population, applying the mortality rates defined in the AWG assumptions for Portugal to determine the exiting population and adding the new beneficiaries for each year (which corresponds to the exiting population from the participants);
- Taking the current market statistics and trends from the last three years, the per capita financial values were computed in order to project the financial cash flows. Main financial variables determined and projected were pensionable salary, benefit ratio, contribution rate, average pension from which the cashflow benefits paid, contributions and pension fund assets were determined.

IMPORTANT REMARK: The projections of the financial variables were made upon assumptions of how these variables are expected to behave in the future. Some of these relevant assumptions, for example benefit ratios in the future, were based on past
experience and knowledge of the market. In other words, some of the assumptions are based on expectations and are not determined from any scientific formula. It is important to emphasize that some of the assumptions on the variables’ behaviour and modelling formulas have indeed a substantial effect on the final results. Therefore, sensitivity analysis plays an important role on the projection exercise.

**Assumptions and methodology**

Despite presenting only the aggregated figures for occupational pensions, the entire projection exercise was made separately for three pension plan schemes: 1st pillar DB plans, other DB plans and DC plans.

**Pension fund population modelling**

- The current (2007) pension fund population coverage ratio (number of pension fund participants over total employed population) was determined and an assumption was made of how this coverage ratio would evolve until 2060.
- Having the total population and employment rate projections enabled the projection of the total participants’ population.

\[
\text{total participants,}_i = \text{total population,}_i \times \text{employment rate,}_i \times \\
\times \text{pension fund coverage ratio,}_i
\]

- For each year, the number of participants for the DB scheme was determined considering the population in the year before and the variation occurred in that year (i.e., plus new entrants and minus the exiting population). For the DC scheme the total number of participants was computed as the difference between the total population and the DB scheme population.
- The vectors of population decrements for each scheme were determined with the help of some statistics for later ages (50 – 75) while for earlier ages assumptions were made based on coherent expectations.
- It was established that the number of new entrants for the DB scheme was equal to a percentage of the number of participants in the year before. The idea underneath this assumption is that the number of new DB plans will be very small and one only expects some population refreshment for the existent plans, therefore assuming a fixed low percentage of new entrants for the DB scheme. For the DC scheme, it was determined as a balancing item between population in that year and population in the year before plus exits. In both cases, a distribution of new entrants by age was created to allocate the number of new entrants to each age. This distribution was determined based fully on an expectation basis.

For each year and age, the number of participants was determined in the following way:

\[
\text{participants}_t,i = \text{participants}_{t-1},i - \text{participants exits}_t,i + \text{new participants}_t,i
\]

In a similar way, the number of beneficiaries for each year and age was calculated as:
Due to legal reasons, the payment of benefits in the DC plans has to be made through a life insurance annuity, at least 2/3 of the accumulated amount. As the pension decumulation phase is transferred to the insurance market (by buying the life annuities), available pension fund statistics only capture the total outflows from the DC funds, instead of regular pension payments. In order to maintain the same modelling approach as for the DB scheme, the total accumulated amounts was converted into annual payments by using an annuity conversion factor.

The pensionable salary for the DB plans was taken from the mandatory reporting maps that these plans are subject to. As there are no such reporting requirements for DC plans an assumption was made about the relationship between these two. The “benefit ratios” for the DB schemes were calculated from the statistical analysis, namely the average pension benefit amount received by the beneficiaries over the average salary of the participants. Assumptions were made on what is expected these “benefit ratios” would be in the future. Regarding the DC schemes the benefit ratio had to be determined according to what was explained above. Although the replacement rate is a required output for this pension projection exercise, the available information only allowed determining the benefit ratio, which could be used as an indicator of what the replacement rate might be.

Per capita pensionable salary:

\[ \text{pensionable salary}_t = \text{pensionable salary}_{t-1} \times (1 + \text{average salary growth}_t) \quad (20) \]

Benefit ratio:

\[ \text{benefit ratio}_t = \left( \text{benefit ratio}_{t-1} \right) \times (1 + \text{benefit ratio growth}_t) \quad (21) \]

The average benefit paid each year (for all schemes) was divided into two segments, the first one being the average benefit for the new entrants and the second one the average benefit for the remaining beneficiaries. The reasoning for this was the fact that the benefits for the new entrants will be different (according to the behaviour of the benefit ratio defined as an assumption) from the remaining beneficiaries, for which the average pension will increase with a pre-determined assumption. The average pension for the new entrants is determined from the corresponding average pensionable salary and the benefit ratio. For the current pensioners the average pension is determined by weighting (using population numbers) the average pension of current pensioners with the average pension of the new entrants.

Per capita average pension:

New entrants - 1st pillar DB plans/Other DB plans/DC plans:
Current pensioners - 1st pillar DB plans/Other DB plans/DC plans:

\[
\text{average pension}_i = \frac{\text{current pensioners average pension}_i \times (\text{total beneficiaries}_{t-1} - \text{new beneficiaries}_{t-1}) + \text{new entrants average pension}_i \times \text{new beneficiaries}_{t-1}}{\text{total beneficiaries}_{t-1}} \times (1 + \text{pension growth rate}_{t})
\]  

The benefits paid are just the beneficiaries’ population (both current beneficiaries and new entrants) times the corresponding average pension for each year.

New entrants - 1st pillar DB plans/Other DB plans/DC plans:

\[
\text{benefits paid}_i = \text{new entrants average pension}_i \times \text{new beneficiaries}_i
\]  

Current pensioners - 1st pillar DB plans/Other DB plans/DC plans:

\[
\text{benefits paid}_i = \text{current pensioners average pension}_i \times (\text{total beneficiaries}_{t-1} - \text{new beneficiaries}_{t-1})
\]  

The contribution rate was determined from the statistics available from reporting requirements. For the DC scheme the rate was determined dividing current contributions by the gross salaries while for the DB plans “normal contributions” were mainly used, since there is a high volatility of the real contributions according to market conditions.

\[
\text{contribution rate}_i = (\text{contribution rate}_{t-1}) \times (1 + \text{contribution rate growth}_i)
\]  

Contributions cash flows for the occupational pension funds were determined by multiplying the average per capita pensionable salary by the contribution rate times the participant’s population for each scheme.

\[
\text{contributions}_i = \text{contribution rate}_i \times \text{pensionable salary}_i \times \text{total participants}_i
\]  

The pension fund assets for each scheme were modelled taking into account the current value for each scheme plus the contributions minus the benefits paid. A pre-determined assumption on the real return on investments was used to project the pension fund assets considering that pensions are due, on average, at the middle of the year and contributions occur for the DB scheme at the end of the year and for the DC scheme at the middle of the year.
\[
assets_i = assets_{i-1} \times (1 + \text{return on investments real rate}_i) + \text{contributions}_i - \text{benefits paid}_i \times (1 + \text{return on investments real rate}_i)^{\frac{1}{2}}
\]  

(28)

DC plans:

\[
assets_i = assets_{i-1} \times (1 + \text{return on investments real rate}_i) + \text{contributions}_i - \text{benefits paid}_i \times (1 + \text{return on investments real rate}_i)^{\frac{1}{2}}
\]  

(29)
4. Public pension reforms considered in the models:

4.1. General regime of social security pensions

The most representative measures taken into account in this exercise are:

**Sustainability factor**

The increase in life expectancy, that will take place in the next decades, will have a considerable impact on social security systems that must be faced. This way, it was introduced the following formula for the sustainability factor, which consists in the ratio between life expectancy in 2006 and life expectancy in the year prior to retirement, and is applied to all new required pensions since the beginning of 2008:

\[
Pension \times \left( \frac{LE_{2006}}{LE_{t-1}} \right)
\]

where,

- **LE**: Average Life Expectancy at the age of 65, published in an annual basis by the INE.
- **t**: year the pension is required.

It should be stressed that contributors can opt for a combination between two extreme alternatives:

- they can put off retirement age until they completely offset the effect of the sustainability factor; or
- they can retire at the statutory age and accept the financial penalty levied on the pension.

In this exercise, it was assumed that all individuals accept the financial penalty retiring at the statutory age, with no changes in the behaviour of the economic agents. This option is a “conservative” one in terms of the effects of this measure. In fact, an increase in the retirement age would lead to a higher participation rate for older workers (whose importance is increasing) raising the contributory revenue, which is only partially offset by a marginal increase of the new pensions value for those contributors who retire later.

Taking into account the evolution for the weighted average of (male and female) life expectancy at 65 in the AWG demography scenario, the projected trend for the sustainability factor is the following:

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sustainability factor evolution</strong></td>
<td>1.000</td>
<td>0.975</td>
<td>0.929</td>
<td>0.883</td>
<td>0.842</td>
<td>0.806</td>
<td>0.774</td>
</tr>
</tbody>
</table>

51 A third possibility is also available. This involves additional voluntary contributions to public or private capitalization schemes. In its essence, this alternative is already available through pension savings funds (known as PPRs).

52 For further details on this issue, see Pinheiro, M. and Cunha, V. (2007).
The new rule for updating pensions

This new rule determines that the annual increase of pensions is linked to effective change rate of Consumer Price Index (CPI) and also to the effective growth of Gross Domestic Product (GDP), which affects the Social Security’s revenues pattern. This means a change from recent years, where there have been increases significantly higher than inflation, above all as a result of the rise in minimum pensions. The new rule brings pension up-dates within a regulatory framework, removing the discretionary element. The annual increase of all types of pensions should be set according to the following table:

<table>
<thead>
<tr>
<th>Pensions under 1.5 IAS</th>
<th>GDP real variation rate less than 2%</th>
<th>GDP real variation rate from 2% to 3%</th>
<th>GDP real variation rate equal or greater than 3%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CPI change rate</td>
<td>CPI change rate + 20% GDP real variation rate (minimum: CPI change rate + 0.5 percentage points)</td>
<td>CPI change rate + 20% GDP real variation rate</td>
</tr>
<tr>
<td>Pensions 1.5 to 6 IAS</td>
<td>CPI change rate – 0.5 percentage points</td>
<td>CPI change rate</td>
<td>CPI change rate + 12.5% GDP real variation rate</td>
</tr>
<tr>
<td>Pensions 6 to 12 IAS</td>
<td>CPI change rate – 0.75 percentage points</td>
<td>CPI change rate – 0.25 percentage points</td>
<td>CPI change rate</td>
</tr>
</tbody>
</table>

It should be mentioned that to assure that the National Minimum Wage constitutes itself a instrument of Labour Market policy, it was established that it should be replaced as a reference for the indexation of pensions by a new social support index *Indexante de Apoios Sociais* (IAS). For 2007, it was defined as the 2006 mandatory minimum wage updated by the consumer inflation of that year (Law 53-B/2006). This Law provides that the rule for IAS updating in the future is to be identical with the rule for updating lower pensions (lower bracket), which is independent from the annual update set for National Minimum Wage.

To determine the reference GDP growth rate it was established that, in the first year of implementation of this new rule (2008), the GDP considered should be the real growth rate of GDP in the previous year and, thereafter, the consideration of average GDP growth rate of the two previous years. So, this average will be firstly used for the 2009 update, taking into account the GDP growth in 2008 and 2007. The annual GDP growth rates to be considered are the ones ended on the third quarter of the year prior to the pension update or the quarter before if there are no official figures regarding the third quarter until December 10.

The relevant CPI corresponds to the effective average growth rate of CPI (without considering housing prices) regarding the last 12 months available on November 30 of the year before the pensions update.

53 The main reason for this was the convergence of minimum old age and disability pensions to the mandatory minimum wage until 2006 as set down in the Social Security Framework Law of 2002 (Law 32/2002).
54 Including minimum pensions that range from 44.5% to 89% of IAS and are updated according to the first bracket of the pensions value.
In 2008, the first year the new rules were applied, and in order to compensate pensioners for changing the month when pensions were updated (January), the pensioners received the equivalent to 2/14 of the increase they were entitled by these rules.

In the current exercise, it is assumed that this new rule corresponds fundamentally to indexation to the consumer price index plus 0.35 p.p. (minus 0.15 p.p.), depending on the economic growth above (below) 2%. These drifts were obtained from the 2005 distribution for Social Security pension amounts and computing a weighted average of the drifts for each bracket of pension value according to the above mentioned rule. In 2005, 72% of the pensioners belong to the first bracket, 24% to the second and 4% to the highest one. As new pensions tend to be higher than the existing ones, the model takes into account the distribution change in the next 15 years and then keeps it constant for indexation purposes.

According to the approved legislation, this rule for updating pension will be re-assessed every five years in order to check its adequacy in terms of the financial sustainability of the social security system and of the pensions’ real value. However, unless there is a strong reason to change it, the current rule is to be kept in future and, therefore, in the current exercise, it was considered to prevail.

The earlier transition to the new pension benefit formula which considers the whole contributive career

Decree Law 35/2002 set out a formula for calculating the amount of new pensions in social security general regime which differs from the one set out in Decree Law 329/1993 in two fundamental points: it takes the earnings over the whole contributive career (instead of the best ten out of the last fifteen years) and sets out different accrual rates, depending on the workers compensation (the lower the compensation, the higher the rate, varying between 2 and 2.3 per cent) as presented in Figure III.4.1. Decree Law 35/2002 set out a transitional period, during which the pension to be applied will be whichever is the higher, either the new regime one or as calculated as a weighted average of the pension from the last regime and from the new regime, where the weights correspond to the number of years of service before and after 2001. Decree Law 35/2002 set down 2017 as the start of the transitional period but in 2006 the decision was taken to bring forward the transition to the new formula to 2007. As far as the transition to the new pension benefit formula affects the income of new pensioners there are transition clauses to the full application of the new rules:

i) to all contributors registered on Social Security before 2001 and that will retire until 2016, the pension is calculated according to a temporary benefit formula that accounts proportionately the length of service before and after 2007 through the application of the old and the new benefit formula

\[
Pension = \frac{P_1 \times C_1 + P_2 \times C_2}{C}
\]

Table taken from the Ministry of Labour and Social Solidarity site (on www.seg-social.pt), which does not reflect yet the 2006 reform measures (Decree Law 187/07), with the new transitional scheme to be applied between 2007 and 2016, overriding the provisions for this period set down in Decree Law 35/02.
where,
Pension is the monthly amount of statutory pension (before the application of the sustainability factor); P1 stands for the pension calculated with the benefit formula that accounts the best 10 out of the best 15 years of wage history (old formula); P2 stands for the pension calculated according to the new formula that considers the whole contributory career; C is the number of years of contributory career with registered wage; C1 stands for the number of years of contributory career with registered wages until the 31st of December 2006; and C2 stands for the number of years of contributory career with registered wages after the 1st January 2007.

ii) for those registered on Social Security before 2001 but that will retire after 2016, pension will be calculated as a weighted average between the pensions that result from new benefit formula and the old benefit formula, with reference to the length of service before and after 31st of December 2001;

iii) for all the others first registered on Social Security after 2002, the pension will be calculated with the new rules, accounting the whole contributory career. In the computation of pensions, the component that takes into account the best ten out of the last fifteen years of declared wages will always be based on the effective last years of contributory career and not on the last fifteen years before the introduction of the mechanism of transition to the new benefit formula.

The pension global accrual rate (GAR) is set according to the number of calendar years with a contributory density equal to or higher than 120 days (up to the limit of 40). It is also set according to the number of insurance years, as follows:

- For those with 20 or less years of earnings registration, a flat accrual rate of 2% is applied. In these cases, GAR is obtained by multiplying the total number of insurance years by 2% (by law, its minimum value must be of 30%).
- For those with 21 or more years of earnings registration, the annual accrual rate varies between 2% and 2.3%, according to the level of wages declared (calculated by reference to the Social Support Index).

By the new pension rules, the reference earning is set according to the individual whole contributory career (up to the limit of 40 years).
### Table I - Statutory Pension Amount

<table>
<thead>
<tr>
<th>Registration</th>
<th>Qualifying Period</th>
<th>Pension Beginning</th>
<th>Amount Payable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Until 31/12/2001</td>
<td>The required qualifying period is fulfilled on 31/12/2001</td>
<td>From 1/1/2002 to 31/12/2016</td>
<td>Highest amount - calculation rules as shown in Table II, nss. 1, 2 and 3.</td>
</tr>
<tr>
<td></td>
<td>The required qualifying period is not fulfilled on 31/12/2001</td>
<td>From 1/1/2002 to 31/12/2016</td>
<td></td>
</tr>
<tr>
<td>From 1/1/2002</td>
<td></td>
<td>From 1/1/2017</td>
<td></td>
</tr>
</tbody>
</table>

### Table II - Calculation of the Invalidity and Old Age Pensions

<table>
<thead>
<tr>
<th>Calculation Rules</th>
<th>Reference Earnings (RE)</th>
<th>PENSION FORMATION RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Decrease Law no 329/93, of 25/09</td>
<td>Correspond to R / 140, whereby: R = Sum of all earnings of the 10 calendar years with the highest earnings within the last 15 years, after they have been adjusted (1) 140 = 10 years x 14 months of earnings (2)</td>
<td>ANNUAL RATE: It corresponds to 2% for each calendar year with earnings registration. GLOBAL RATE: It corresponds to the product of 2% and the number of calendar years with earnings registration. It can neither be lower than 30% nor higher than 80%.</td>
</tr>
<tr>
<td>2. Decrease Law no 35/2002, of 19/02 (in force from 1/1/2002)</td>
<td>Correspond to TE / (mx14), whereby: TE = sum of all annual earnings after they have been adjusted (3)</td>
<td>ANNUAL RATE: It corresponds to 2% for each calendar year with earnings registration. Insured persons who have 21 calendar years or more with earnings registration. It varies between 2.3% and 2%, depending on the Reference Earnings (RE) amount indexed to the Minimum Legal Earnings in force when the pension begins, as follows:</td>
</tr>
<tr>
<td></td>
<td>Reference earnings (RE) portions indexed to the Minimum Legal Earnings (MLE)</td>
<td>Annual rate</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>1st portion</td>
<td>Up to 1.1 x MLE</td>
<td>2.30</td>
</tr>
<tr>
<td>2nd portion</td>
<td>Higher than 1.1 x MLE up to 2 x MLE</td>
<td>2.25</td>
</tr>
<tr>
<td>3rd portion</td>
<td>Higher than 2 x MLE up to 4 x MLE</td>
<td>2.20</td>
</tr>
<tr>
<td>4th portion</td>
<td>Higher than 4 x MLE up to 9 x MLE</td>
<td>2.10</td>
</tr>
<tr>
<td>5th portion</td>
<td>Higher than 9 x MLE</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td><strong>GLOBAL RATE</strong>: Insured persons who have 20 calendar years or less with earnings registration. It corresponds to the product of 2% and the number of calendar years with earnings registration. Its lower limit is 30%. Insured persons who have 21 calendar years or more with earnings registration. It corresponds to the product of the annual rate and the number of calendar years with earnings registration up to the limit of 40, in what concerns each one of the portions that form the Reference Earnings.</td>
<td></td>
</tr>
</tbody>
</table>

### Proportional application of the calculation rules established by the Decrease Law no. 329/93, of 25 September and by the Decrease Law no. 35/2002, of 19 February

The Statutory Pension amount results from the application of the following formula: \[ P \times C \times C \times 2 \]

Whereby:
- \( P \): pension calculated by applying the calculation rules of the Decrease Law no. 329/93, of 25/09.
- \( C \): number of calendar years with earnings registration of the whole insurance career.
- \( P_3 \): pension calculated by applying the calculation rules of the Decrease Law no. 35/2002, of 19/02.
- \( C_3 \): number of calendar years with earnings registration completed until 31/12/2001.

(1) The registered annual earnings are adjusted according to the Consumer Price Index (CPI) without considering the home factor.
(2) Whenever the number of years with earnings registration is lower than 10, the Reference Earnings are obtained by dividing the total existing earnings by 14 times the corresponding number of calendar years.
(3) The registered annual earnings are adjusted as follows: until 31 December 2001, according to the Consumer Price Index (CPI), without considering the home factor; from 1 January 2002, according to an index which results from the weighting both of the CPI and of the average evolution of the earnings which underlies the contributions stated to the Social Security.
(4) Where there are more than 40 years, it will be taken into account the sum of the 40 highest annual earnings, after they have been adjusted.
Introduction of a ceiling to higher pensions

In a context of sustainability strengthening of social security and in order to complement the professional solidarity embedded in the pension benefit formula, but also safeguarding the earning-related principle, it was considered adequate to establish a pension ceiling as well as freezing very high pensions. It must be stressed that pensions that result from a benefit formula that accounts the average of lifetime wages do not have any ceiling. This way this measure has a temporary effect. In terms of the pension ceiling it was decided and considered in the model:

- Introduce a pension ceiling for the new pensions, exclusively for the component that considers the best 10 out of the last 15 years of recorded earnings (P1).
- When the pension component calculated with the new formula (P2) is higher than the pension component calculated with the old formula (P1), no pension ceiling will be applied to P1.
- If P1 and P2 are higher than the pension ceiling and P1 is larger than P2 only the new formula will be applied (where there is no pension ceiling).
- All existing pensions above the ceiling will not be annually updated. This rule does not apply when the two prior conditions are verified for the new pensions and for those computed under previous legislation (considering that the value of P2 is calculated according to the new formula). This rule, as the new indexing rules, should be re-accessed every five years.
- The ceiling mentioned has a value of 12 IAS.

However, this restriction only applies to a few cases (less than 1%).

The reinforcement of the combat on fraud and contributory evasion

Some of the efforts to be developed at this level are the set up of a process for processing official DR (wage declaration) whenever employers do not perform this operation, the strengthening of the procedures of matching information from tax administration databases, the revision of the sanctions code of Social Security, and the implementation of a new model to manage the debt to Social Security by establishing automatic procedures in the executive process of debt recovery. In the current projection exercise, it was considered an increase in the contributory revenue due to these measures until 2015 and, afterwards, that increase remained constant.

All of the previous mentioned measures have been accounted for in the present projections. Aside from the projections stayed those measures aimed at promoting active ageing, namely:

- The sustainability factor may be (partially) offset if workers decide to continue working;
- The penalty for early retirement, before the legal age of 65 (possible for beneficiaries with at least 30 years of contributory career at the age of 55) rose from 4.5% to 6% per year;
- For long contributory careers the retirement age without any penalty can be reduced one year for each three years of contributory career above 30 years at the age of 55 (beneficiaries can retire, without penalty, at the age of 64 with 42 years of...
contributions, at the age of 63 with 44 years of contributions, at the age of 62 with 46 years of contributions and so forth);  
- When claimed after 65 years of age (with more than 15 calendar years of earnings registration and, at most, 70 years of age), the pension is increased by applying a monthly rate to the number of months of effective work completed between the month the pensioner reaches 65 years of age and the month of pension beginning.

These measures were not considered within the projection model as far as one of its main assumptions is that all workers retire when they reach the legal retirement age.

4.2. CGA pensions

The most significant reform measures considered in the CGA model are:

Sustainability factor

The “sustainability factor” that relates the amount of new pensions to the evolution of life expectancy at age 65 is applied from 2008 on. In the case of the CGA contributors, it was assumed that in order to offset (in part) the financial penalty derived from this factor, they tend to postpone the retirement proportionally to the evolution of the factor until the legal age limit for retirement (70 years old).

The new rule for updating pensions

The new rule for updating pensions as a function of consumer inflation (without housing prices), the real growth of GDP and the pension amount is also applied to CGA pensioners. In the current exercise is assumed that this rule for pension updating corresponds fundamentally to indexation to the consumer price index plus 0.1 p.p. (minus 0.4 p.p.), depending on the economic growth above (below) 2%. These drifts were obtained by using the 2007 distribution for CGA pension amounts and computing a weighted average of the drifts for each bracket of pension value according to the above mentioned rule. In 2007, 32% of the pensioners belong to the first bracket, 60% to the second and 8% to the highest one.

According to the legislation, this rule is in force from 2008 on only for pensions less than 1.5 IAS, from 2009 on for pensions between 1.5 and 6 IAS and from 2011 on for pensions above 6 IAS. However, in the projection exercise, it was assumed that the rule applies to the whole range from 2008 on.

The earlier transition to the new pension benefit formula which considers the whole contributive career

The new pension formula considers the whole contributive career and increases the accrual rate for lower wages. In the case of CGA subsystem, the anticipation of this transitional period is in force from 2008 on. However, the effects of this change are quite mitigated in this subsystem: for the contributors covered by the Estatuto da Aposentação, the only relevant change is the one of different accrual rates (higher) that applies for the years of contribution from 2008 on instead of 2016 on. For the other public employees (enrolled since September
1993), the new rules also apply in what concerns the consideration of the whole contributive career instead of the best ten out of the last fifteen years, but the probability of this contributors retiring before 2016 is quite small and, therefore, the impact is negligible.

**Additional penalty for early retirement**

Other of the measures – within the scope of the so-called “promotion of active ageing” – consists in introducing a disincentive to early retirement, with a bigger financial penalty for retirement prior to the legal retirement age, but computed on a monthly basis (0.5% for each month of anticipation) instead of an yearly basis (4.5% per year). The projection exercise for CGA includes the additional financial penalty to be applied to new pensions from 2015 on and do not consider any change in the probability of those eligible actually retiring. This assumption is a cautious one in what concerns the effects of this reform measure.

### 4.3. Effects of the reform measures

The reform measures considered in the model accounted for a saving of 3.6% of GDP by 2050, according to the October 2007 Peer Review exercise. In the current projections, there are no additional measures. But, taking into account the new demographic and macroeconomic assumptions, the introduction of the sustainability factor, which is the measure with the most significant effect in the long-run, represents a reduction in pension expenditures of 1.9% of GDP by 2050 and 2.4% of GDP in 2060.

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>2060</th>
<th>Peak year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current projections (1)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social security pensions</td>
<td>11.4</td>
<td>12.4</td>
<td>12.6</td>
<td>12.5</td>
<td>13.3</td>
<td>13.4</td>
<td>2053</td>
</tr>
<tr>
<td>Old-age and early pensions</td>
<td>9.1</td>
<td>10.2</td>
<td>10.4</td>
<td>10.2</td>
<td>10.8</td>
<td>10.8</td>
<td>2053</td>
</tr>
<tr>
<td>Other Pensions</td>
<td>2.3</td>
<td>2.2</td>
<td>2.2</td>
<td>2.3</td>
<td>2.6</td>
<td>2.7</td>
<td>2060</td>
</tr>
<tr>
<td>Social Security Funds Assets</td>
<td>4.5</td>
<td>12.3</td>
<td>12.9</td>
<td>9.1</td>
<td>0.0</td>
<td>0.0</td>
<td>2026</td>
</tr>
<tr>
<td><strong>Projections exclud. Sust. Factor (2)</strong></td>
<td>11.4</td>
<td>12.7</td>
<td>13.4</td>
<td>13.8</td>
<td>15.2</td>
<td>15.9</td>
<td>2060</td>
</tr>
<tr>
<td>Social security pensions</td>
<td>9.1</td>
<td>10.5</td>
<td>11.1</td>
<td>11.2</td>
<td>12.3</td>
<td>12.7</td>
<td>2060</td>
</tr>
<tr>
<td>Old-age and early pensions</td>
<td>2.3</td>
<td>2.3</td>
<td>2.3</td>
<td>2.6</td>
<td>2.9</td>
<td>3.2</td>
<td>2060</td>
</tr>
<tr>
<td>Social Security Funds Assets</td>
<td>4.5</td>
<td>12.0</td>
<td>12.2</td>
<td>7.7</td>
<td>0.0</td>
<td>0.0</td>
<td>2026</td>
</tr>
<tr>
<td><strong>Difference (1) - (2)</strong></td>
<td>0.0</td>
<td>-0.4</td>
<td>-0.8</td>
<td>-1.3</td>
<td>-1.9</td>
<td>-2.4</td>
<td></td>
</tr>
<tr>
<td>Social security pensions</td>
<td>0.0</td>
<td>-0.3</td>
<td>-0.6</td>
<td>-1.0</td>
<td>-1.5</td>
<td>-2.0</td>
<td></td>
</tr>
<tr>
<td>Old-age and early pensions</td>
<td>0.0</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.2</td>
<td>-0.4</td>
<td>-0.5</td>
<td></td>
</tr>
<tr>
<td>Other Pensions</td>
<td>0.0</td>
<td>0.3</td>
<td>0.8</td>
<td>1.4</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>
Moreover, as it can be observed in the table, in the scenario that excludes the sustainability factor effects, the increasing trend of pension expenditure is permanent, reaching the “peak year” in 2060, while in the baseline scenario it reaches the maximum in 2053 and decreases afterwards.

5. Additional information

1. It should also be stressed that within the models a pensioner can be accounted twice since the model considers as a pensioner a person that is entitled to one specific pension. If, by chance, that pensioner is entitled to two pensions (old age and survivor) he is counted twice. That’s why the reported data refers to pensions and not to pensioners.

2. The difference between lines “Old age and early pensions” and “Earnings-related pensions” refers to non earning related pensions (minimum pensions of non-contributive regime).

3. CGA disability pensions are classified along old age pensions.

4. Survivor pensions for the DC plans are not relevant because it was assumed that the accumulated amount at retirement would be used to buy a single life annuity. For the DB plans, the statistics of the number of plans with survivorship after retirement were not conclusive of its importance.

5. The retirement age used in the projections for occupational pensions was determined on the past experience.

6. Net pension expenditure is computed considering that the weight of tax related to pensions on total tax is the same as the weight of pensions’ income on total income. This assumption is due to the fact that pension income is added to total income and the tax estimating procedure is applied from here on, that is, it is not possible to estimate taxes concerning pensions separately. The average tax rates obtained were 6.35% until 2005, 6.64% in 2006 and 7.38% in 2007 and on the following years.

The Stability Programme update of June 2005 established a gradual convergence of pension income taxation to labour income taxation, through a cut in the deduction of pension income for tax purposes. Since 2006, State Budgets have included changes in line with this aim, what explains the gradual increase in the average tax rate for pension income in 2006 and 2007.

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56 This deduction refers to an amount that is deducted to the annual income, both for pension income and labour income. However, this amount is bigger in the case of pension income, which implies an average tax rate for pension income lower than the one for labour income.
6. References


Romania

Model description

The main data for forecasting the expenditure for the pension system are accordingly to EUROPOP demographic projections and AWG macroeconomic assumptions:

*Entry Indicators:*

1. the number of employees contributing to the system (categories)
2. the average monthly and yearly income
3. the rate of collection
4. the average life expectancy at birth, at the real retirement age, at the potential retirement age, on gender.
5. life expectancy
6. fertility rate and mortality rates
7. GDP growth
8. immigration flows
9. productivity growth
10. real interest rates
11. age structure of population
12. participation rate of population in the workforce
13. unemployment rate
14. the statutory age of retirement
15. the average real age of retirement (according to gender, economic branches, areas/counties etc.)
16. employee cohorts and their participation on the labour market
17. data concerning internal and external migration (immigration and emigration)

We took into consideration the following assumptions:

1. Value of a point is:
   a. 37.5% of average wage starting November 2007.
   b. 37.5% of average wage in 2008 increased to 45% of average wage in October 2008.
   c. 45% of average wage in 2009 and kept at 45% of average wage thereafter.
2. Increases in the point value are reflected to the existing pensions.
3. Contribution rate for employers is assumed at 19,4% starting 2008. Total contribution rate therefore is 28,9 % (9.5 % employee, 19,4% employer)
4. Collection rate is assumed for expected improvement in collection.

Basically the model consists in a:

1. Demographic model based on AWG assumptions
   We compute the number of pensioners grouped on old age and early and, respectively, disability and survivors, according to the observed trends in the past and the Commission demographic projections
2. Financial model: revenue and expenditure
Contributors (we followed Eurostat structure):
- employees full and part time
- self employed
- temporary employed
- military (included as number in employees full and part time, but with different contribution)
- unemployed for which the Agency of Unemployment pay out.

Beneficiaries
- PAYG pensioners grouped on old age and early and, respectively, disability and survivors,
- Farmers
- Military force

Contributions for pension insurance are determined applying the contribution quota to the gross monthly earnings 28.9% (9.5% employee, 19.4% employer).

Pension benefit results from multiplying the average pension points by the current value of one pension point (measured in lei per month).

In the case where contribution period is less than established by law, in order to compute one’s average pension points, the sum of pension points over the working period is divided by the number of years that corresponds to the complete contribution period, as established by law.

According to the current legislation, we can synthesize the somewhat complicated provisions of the law into a mathematical formula:

\[ P = app \times ppv \times Cf \times Cp \]

Where:

- \( P \) = pension benefit
- \( app \) = average pension points = \( \sum_{t=1}^{T} p_t / n \)
- \( p_t = e_t / w \)
- \( p_t \) = pension points
- \( e_t \) = earning in year \( t \)
- \( w \) = wide economy average earnings
- \( n \) = number of years that corresponds to the complete contribution period
- \( ppv \) = pension point value,
- \( Cf \) = coefficient for flexible conditions (i.e. for disability pension)
- \( Cp \) = coefficient that takes into account the reduction in PAYG contribution due to Pillar 2.
The pension point value is established by the social insurance law on annual basis and, in fact it is adjusted in relation to the gross wage growth as the law indicate that is update each December at least accordingly to the inflation rate but a pension point cannot be less than 37.5 percent of the average gross wage in 2008\textsuperscript{57} and less than 45 percent of the average gross wage in 2009.

The pension adjustment is in line with the increase of average gross wage and irrespective of the year of retirement, all pensions (including disability and survivor pensions) are adjusted annually with the current pension point value.

\textsuperscript{57} the rate between the pension point and the average gross wage used for the assessment of the Social Insurance Budget was 31.2 percent in 2007.
Slovenia

Description of the pension projection model and its base data

- **Who actually runs the model?**
  Projections were made at the Faculty of Economics in Ljubljana; the author of the model and one of its driving forces is Jože Sambt, the Faculty of Economics; the Ministry of Finance is another holder of the model, with Slaven Mićković responsible for its use.

- **Are those projections submitted to a peer review in your country?**
  All activities linked to the model preparation are led by the government working group for the preparation of projections of the population ageing effects. This group monitors the results and keeps the ministries and the government informed. There is no special peer review in Slovenia.

**General description** of the model(s)

- **Assumptions and methodologies applied**
  Technically, the “generational accounting” model has been used for the projections. One of the main purposes of generational accounting is to project long term sustainability of the current public system in combination with the forthcoming demographic changes. The name is derived from the fact that it concentrates on the relations between different generations (especially current ones as compared to those who will be born in the future) or cohorts. Using different data sources, including survey data, all the public revenues and expenditures are assigned to the representatives of the individual cohort representatives. Obtained age profiles are applied to the demographic projections resulting in future projections of all public revenues and expenditures. Those future revenues and expenditures are discounted back to the base year whereby the intertemporal fiscal stance (imbalance) is identified. At the same time the results show, how much representatives of certain cohort will pay net (their payments to the government minus what they will receive) in their remaining lifetime. Generational accounts present the effect on different cohorts (again, especially the currently living against future born generations) if transfers are being reduced and/or taxes are being increased (to achieve intertemporal fiscal balance).

The core of generational accounting is the inter-temporal budget constraint of the government; for the year $t$ we can write it as:

$$\sum_{s=0}^{D} N_{t,s} + \sum_{s=1}^{\infty} N_{t,t+s} + W_t^g = \sum_{s=t}^{\infty} G_s (1+r)^{-s-t}$$

The first term on the left hand side of (1) represent the sum of present values of the net payments of existing generations. $N_{t,s}$ (s = 0...D) denotes present (discounted to the year t) value of net payments that generations born in year $t-s$ will pay in their remaining lifetime to the government. Index s runs from the age 0 up to the age D, denoting which is the maximum length of life. So the first element is $N_{t,t}$, which is the present value of net

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58 Jože SAMBT, Faculty of Economics, Ljubljana, Slaven MIĆKOVIĆ, Ministry of Finance, Slovenia, Ljubljana, Tomaž Kraigher, IMAD, Institute of Macroeconomic Analysis and Development, Ljubljana.
payments of generation just born in the base year \( t \) and the last element is \( N_{t,t-D} \), which is the present value of remaining net payments of the oldest generation that is still alive in the year, \( t \) i.e. those who were born in the year \( t-D \).

Analogously the second term of the left hand side of the equation (1) is the sum of present values of the net payments of future generations, i.e. those who were not yet born in the base year \( t \). Theoretically the sum should run to infinity but in practice it is enough to stop at 100 to 200 years in the future. Because of the discounting factor the happening in such distant future has negligible effect on the results.

The third term represents the government’s net wealth in year \( t \). It is \( net \), because public debt is subtracted from the government’s wealth. On the right hand side there are government consumption expenditures, discounted to the base year \( t \) with the pre tax rate of return \( r \).

The zero sum nature of intergenerational fiscal policy is very explicit. If we hold the right hand side of Equation (1) unchanged and since the third term on the left hand side is constant, then smaller second element of the left hand side requires higher value of first left hand side element. If we put this identity into the words, it is saying that there is no free lunch. What will not be covered by the net payments of currently living generations, it will have to be paid from future generations.

Term \( N_{t,k} \) (which is general notation for \( N_{t,t-s} ; s = 0...D \) and \( N_{t,t+s} ; s = 1...\infty \)) is defined as:

\[
N_{t,k} = \sum_{s=\text{max}(t,k)}^{k+D} T_{s,k} P_{s,k} (1+r)^{-(s-t)}
\]

Term \( T_{s,k} \) denotes average net payments which will be paid by the generations, born in year \( k \). With «average net payment» we mean average payments of all members of (existing) generation in the year \( s \). Element \( P_{s,k} \) denotes number of members, born in year \( k \), who are still alive in year \( s \). Equation (2) shows that for generations born before the year \( t \) the sum begins in year \( t \); for generations born in year \( k \), when \( k > t \), the sum begins in the year \( k \). Regardless to the year of birth the values are always discounted (back) to the year \( t \). Generational accounts are formed separately for male and female, but to avoid further complications of mathematical expressions we skipped notations for gender.

Thus, generational accounts are constructed by applying the age profiles (by age groups and gender) of net taxes on population projections (by age groups and gender). Thereafter the obtained values are discounted back to the base year. To form age specific net (tax) payments we dismember the average age-specific net tax payment in the year \( s \) paid from individuals, born in the year \( k \), into:

\[
T_{s,k} = \sum_i h_{s,k,i}
\]
where \( h_{s,k,i} \) stands for the average tax or transfer of type \( i \), paid or received in the year \( s \) from the person, born in the year \( k \), i.e. aged \( s-k \) years. If \( h > 0 \) then \( h \) denotes paid taxes and if \( h < 0 \) then \( h \) denotes received transfers.

Herby it is assumed that the initial public finances policy and economic behaviour will not change and that categories grow with productivity growth\(^{59}\). Under this simplified assumption future profiles of paid taxes and received transfers can be formed, resting on the profiles from the base year:

\[
h_{s,k,i} = h_{t,(s-k),i}(1+g)^{s-t} \tag{4}
\]

where \( g \) denotes annual productivity growth. Equation (4) thus assigns in the year \( s \) to the person aged \( s-k \) taxes and transfers from persons who were in this age (in which he/she is now) in the base year.

For creating age profiles it would be ideal to have the aggregate data by age groups available. However, this is usually not the case so we calculate them in two steps. First we estimate tax and transfer payments of a representative member of each cohort from surveys or some other micro-data available. In the second step they are weighted by the respective cohort numbers and adjusted proportionally to fit the aggregate macroeconomic budget data. This calibration eliminates general over- or under-reporting at the micro level.

\( N_{t,k} \) in Equation (2) denotes the aggregate of net payments that members of certain cohorts will pay to the government in their remaining lifetime. Distributing these aggregate values over the corresponding age groups in the base year results in average payments that will representative of specific cohort pay to the government in his/her remaining lifetime. I.e. we obtain generational accounts:

\[
GA_{t,k} = \frac{N_{t,k}}{P_{t,k}} \tag{5}
\]

The analysis doesn’t end with constructing generational accounts. They are prepared to simulate effect of different policy measures on improvement or worsening of different generations.

For the purpose of AWG projections the model of generational accounts has been adjusted accordingly. It doesn’t concentrate on following future revenues (taxes and non-tax incomes) and expenditures by cohorts, but by the calendar years instead. This model can be easily used directly in the Slovenian case since one of the cornerstones of the Slovenian pension legislation is the principle of equal benefits for individuals with the same pension conditions, regardless of the time when they retire. This legal provision assures equal rights for pensioners, who have retired at different time points. Modeling is therefore simpler, since we can model new and old pensioners together (for the same conditions they get the same pensions).

The modified model is based on a pension profiles matrix, population matrix and a coefficient matrix. The pension profile matrix includes average pensions by age. It builds on the situation from the base year (2007). The key assumption of the model remains that next generations

\(^{59}\) There is an exception to that. Researchers try to estimate the effect of changes in the public system which were legally already accepted, but they have not yet stepped (fully) into force – because implementation has not been done yet or because there is transition period.
“inherit” the situation of the previous ones in the base year, on which the further matrices (of legally enforced changes etc.) are applied. The population matrix is based on the Eurostat demographic projections EUROPOP2008, prepared in the year 2008 and also included in the set of assumptions, submitted by the European Commission.

The coefficient matrix summarizes the effects of the Pension and Disability Insurance Act introduced in 1999 (PDIA-1999) and gradually coming into effect after the year 2000. The transition period of PDIA-1999 will end in the year 2024. This transition period is taken into account, together with the further changes to the pension legislation which followed in the year 2005. With detailed data about individuals retiring before introducing the PDIA-1999 we have simulated the retirement behaviour, wage level etc. – according to the new conditions.

Technically, the matrices have age (\(a\)) in their rows and calendar years (\(t\)) in their columns. The matrix of pension profiles (\(PROF\)) has the pension levels in its cells; the population matrix (\(P\)) has the number of people in its cells; and the coefficients matrix (\(C\)) contains the coefficients of adjustments. Pensions paid to individuals aged \(k\) in year \(t\) are thus calculated as:

\[
PENS_{a,t} = PROF_{a,t} P_{a,t} C_{a,t} G_t
\]

where \(G\) contains coefficients of the cumulative growth of wages from the base year (in our case 2006) to time \(t\). Namely, according to the Slovenian pension legislation the growth of pensions is fully indexed to the growth of wages (but in practice in the period up until 2024 pensions will grow more slowly due to certain provisions of the pension legislation which are captured by the coefficient matrix (\(C\))). Pension expenditures in year \(t\) are calculated as the sum of projected pension expenditures by all age groups:

\[
PENS_t = \sum_{a=0}^{D} PENS_{a,t}
\]

where index \(a\) runs from 0 to \(D\); with \(D\) denoting the maximum length of life (in our model it is the age group 100+).

This pension module is linked to the GDP module. Pension expenditures are namely expressed as a share of GDP. GDP growth is calculated from the projected productivity growth rate and the labour input growth rate (set of assumptions, provided by the European Commission). In the baseline scenario and other scenarios where input data are provided, it reproduces the provided GDP results, since it uses the same approach as European Commission.

In the model demographic projections thus affect public pension expenditures expressed as share of GDP through the pension expenditures and through GDP, since GDP depends on labour input that is influenced by the demographic development. Labour productivity growth enters into the calculations exogenously.

- **Data used** to run the model

In the calculations many different data sources have been used, so we will just point out those most extensively used. At the aggregate level the key data source is Statistical office of the Republic of Slovenia, especially their system of national accounts (European system of accounts – ESA). They provided also data at the micro level (Consumer Expenditure Survey and the data assembled for the “Microsimulation Model of the Taxes and Transfers”) which have been used for creating age profiles. For the pension part the key institutions is the
Institute of Pension and Disability Insurance of Slovenia. Their annual and monthly reports have been used as the source of aggregate data, but they provided also numerous age profiles based on the data with complete coverage. On their data about individuals various simulations have been performed to estimate the behaviour of individuals because of changes in the pension legislation. For the health and long-term care data the main data sources are the Health Insurance Institute of Slovenia and the Statistical office of the Republic of Slovenia with the System of health accounts – both with macro data and also corresponding age profiles. All those institutions exhibited special work on data to provide the needed data for AWG calculations. Another important source was Ministry of finance with detailed aggregate data about categories of public revenues and expenditures.

• **Reforms incorporated in the model**

Model incorporates the estimated effects of the earlier presented current pension legislation, including the changes that are following from the current legislation as compared to the previous arrangement. The main effect comes from a decreasing replacement rate for people newly entering in retirement (yearly accrual rate 0,5 ppts less than year before for same pension period), which will continue up until 2024 and increasing retirement (and working period) age, which is for women still in progress until the year 2013.

**Table 9: Reduction of pension indexation due to equalization principle (index of valorization is reduced by coefficient between total accumulated accrual rates in two consecutive years)**

<table>
<thead>
<tr>
<th></th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2010</th>
<th>2024</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL ACCUMULATED ACCRUAL RATE IN THE OLD SYSTEM</td>
<td>85,00</td>
<td>85,00</td>
<td>85,00</td>
<td>85,00</td>
<td>85,00</td>
<td>85,00</td>
<td>85,00</td>
</tr>
<tr>
<td>TOTAL ACCUMULATED ACCRUAL RATE IN THE NEW SYSTEM</td>
<td>84,50</td>
<td>84,00</td>
<td>83,50</td>
<td>83,00</td>
<td>82,50</td>
<td>82,00</td>
<td>72,50</td>
</tr>
<tr>
<td>RELATIVE DECREASE</td>
<td>0,59%</td>
<td>0,59%</td>
<td>0,60%</td>
<td>0,60%</td>
<td>0,60%</td>
<td>0,62%</td>
<td>0,68%</td>
</tr>
<tr>
<td>CUMULATIVE RELATIVE DECREASE</td>
<td>0,59%</td>
<td>1,18%</td>
<td>1,76%</td>
<td>2,35%</td>
<td>2,94%</td>
<td>5,88%</td>
<td>14,71%</td>
</tr>
</tbody>
</table>

Some effects have are just coming to the end (from 10 to 18 best consecutive earning years), while some of them will end before the year 2024 (the increase of retirement age and qualifying period for women).
### Transition from current to legislated full retirement age women

- **Age at the end of the calendar year:**
  - 1999: 50, 60
  - 2003: 53, 63
  - 2007: 55, 65
  - 2011: 58, 68
  - 2015: 60, 70
  - 2019: 63, 73
  - 2023: 65, 75
  - 2027: 67, 77

- **Pension qualifying period:**
  - 2003: 35, 45
  - 2007: 36, 46
  - 2011: 37, 47
  - 2015: 38, 48
  - 2019: 39, 49
  - 2023: 40, 50
  - 2027: 41, 51

**Additional assumptions:**

- **Expert’s judgments needed for modelling the pensioners’ behaviour and pension accrual (maturation, indexation, ...).**

The model bases on the current situation, therefore different processes that will influence the retirement decisions, like later entering the labour market (because of staying longer in the educational process), incentives for staying longer in the employment status, etc. have to be taken into accounts. As explained, having individual data about individuals retiring before introducing the PDIA-1999 we simulated the retirement behaviour according to the new conditions. Various micro-simulations have been performed and the partial results have been used for constructing matrices for the model. The sub-model for simulating retirement process (depending on the set of employment and unemployment rates, provided by the European Commission) has been prepared by the IMAD and incorporated into the model of generational accounts.

- **Additional model characteristics relevant to understand the projection results:**
  - **Number of different persons modelled per generation.**
    The persons are not presented and analysed individually, i.e. each individual is not modelled separately. The unit of analysis are cohorts – their average values for each category of expenditures and revenues, their simulated results of changed pension legislation on them etc. In the pension part all different kinds of pensions have been modelled, and afterwards aggregated to the broader categories required by the AWG form of reporting (for example, disability, family and widow pensions have been summed up to the “disability and survivor pensions”, required by the questionnaire. Some form of pensions (like army pensions, state pensions etc.) have been excluded from the main fields in the questionnaire and added under the “additional information” section at the end of the questionnaire.

- **How is the replacement rate of new retirees calculated?**
  Replacement indicator in practice is differently understood, usually in the following two forms:
  - **Replacement rate, defined as average (gross or net) pension in the economy, divided by the average (gross or net) wage in the economy.**
  - **Replacement rate, defined as the individual’s first pension after retirement compared with the last wage before retirement.**
In the presented results for Slovenia the option a) was chosen. This decision was driven by the available data. The first pension that individual receives after retiring is calculated from the net wages in 18 most favourable consecutive years (after applying valorisation coefficients). We can thus simulate the ratio of the first pension against this average, but not against the individual’s last wage, since data about the level of last received wage are not available.

In Slovenia a “net pensions” concept is used. Model generates the number of pensioners and pension expenditures from which average pension is calculated. Net replacement rate is thus drawn directly from the model. Gross pensions are not calculated in Slovenia, therefore we do not present “gross replacement rate” required in the questionnaire (tables) but “net replacement rate” under the “additional information” section at the end of questionnaire.

**How are careers being modelled?**

As explained, we assume that next generations “inherit” the situation from the base year, on which the further matrices (of legally enforced changes, changes in employment and other rates etc.) are applied. Therefore the careers are not explicitly modelled. At the time of constructing the model no detailed data has been available about the careers of individuals. Average working periods by age groups have been available, but without the information about the distribution of collected years round about the average. We consider this issue as main deficiency of the model. On the other hand, even in the case of having appropriate sub-model for this purpose, its use for the AWG simulations would be limited. The set of participation rates, employment rates and unemployment rates is namely provided by European Commission in their set of assumptions, which predefines or limits country own parameters regarding the transition from employment into retirement status.

**How are pension being calculated?**

As no official projection of the number of pensioners up to 2060 has yet been prepared in Slovenia (the Pension and Disability Insurance Institute of Slovenia/ZPIZ only prepares short-term projections for the period of a few years), an auxiliary, working projection was made at the IMAD for the purpose of this paper. We used the method of projecting gender and age retirement ratios for individual pension categories, which we applied to the projection of Slovenia’s population according to the EUROPOP 2008 convergence scenario made by Eurostat. We calculated the ratios for old-age, disability, family, widow’s and state pensions. The projection of gender and age retirement ratios is based on an estimate of the gender and age structure of ZPIZ pensioners by individual pension category for the 1995–2007 period obtained by means of the available ZPIZ data. We estimated the ratios for five-year gender and age groups in the interval between 15 and 74 years of age and for the age group of 75 years and over, while for family pensioners – children we estimated the ratio for the age group of 0–29.

In the projection of ratios by five-year gender and age groups for disability and survivors (family and widow’s pensions) we used the principle of the average ratio increases in the last five years: this means that the retirement ratio in the calendar year t in the age group of x-years is equal to the ratio in the age group of x-5 years five years ago, plus the average increase between the age groups of x and x-5 years in the last five years. (This principle is consistent with the no-policy-change assumption and also gives the most reasonable results). The projection of the old-age retirement ratios is estimated as a residual under the assumption that there are no new contributors to the pension system after the age of 60, so the sum of age and gender specific ratios of the contributors (in projection direct proportionality with
employment rates is assumed), old-age, disability and widow’s pensioners from the 55-59 age group onwards must remain unchanged.

The projection of the number of pensioners by pension categories was then made as a sum of products of the projected number of people by gender and age group and the projected ratios for individual categories of pensions for the same gender and age groups. The projection of recipients of family pensions – children takes account of the average ratio in the 0-29 age-group in the last five years.

- How is the retirement age computed?
The retirement age is not explicitly modeled. However, it can be roughly estimated from the shifted age profiles by adding years of delay in the age profiles to the current situation about the age at retirement.
Additional Information

Projection of expenditure and revenue of the supplementary voluntary collective pension insurance

By the PROJECTION OF EXPENDITURE AND REVENUE OF THE VOLUNTARY PENSION INSURANCE we modeled the number of pensioners, the amounts of paid-out pensions, the number of insured persons paying premiums, premiums and resources allocated to meet the obligations for each individual year up to 2050.

1. DESCRIPTION OF THE MODEL (input parameters, model, assumptions)

The model of the projection of the voluntary collective pension insurance for individual years is based on the data on the voluntary collective pension insurance as per 31.12.2007, gross domestic product and the number of persons in formal employment in Slovenia for individual years up to 2060.

Definition

Insured persons under the voluntary pension insurance in this projection are persons who are included in compulsory pension insurance schemes and whose employers partly or fully finance the pension scheme.

PENSIONER is a person who is eligible for retirement according to ZPIZ-1 and was included in a collective pension scheme for at least 10 years before retirement and earned his/her pension through savings.

PENSION is the monthly/annual amount paid out after retirement on the basis of savings to persons who were included in a collective pension insurance scheme before they retired.

Financial resources in pension funds include funds of the insured persons still paying contributions to personal accounts plus mathematical provisions for pensioners.

Assumptions and methods used in the projection

Number of ensured persons

- Our projection is based on data on the number of persons included in collective insurance schemes at the end of 2007, which are the starting point for the projection of the number of insured persons until 2060.
- The participation in collective pension insurance schemes is assumed to increase slowly from the present initial participation to approximately 70% of the employed population until 2030 and to remain at that level until 2060.

Contributions to pension funds

- The average premium for 2007 with regard to the insured person’s age was the starting point for the projection of premiums until 2060.
- The projection of premiums paid was determined under the assumption that the average premium increases annually with regard to labour productivity growth.

Entries into and exits from insurance schemes
- The number of entries/exits in a given year is projected by comparing the number of insured persons at the beginning and end of the selected year. All exits beyond the age of 55 are projected under the assumption of retirement; otherwise, exits from the insurance scheme take place by paying out the surrender value.
- The model takes into account that until 2011, the insured persons were not included in the voluntary collective pension insurance scheme for more than 10 years. The exits before 2011 therefore do not take account of retirements.

Financial resources of the insured persons
- The model also takes account of the distribution of resources collected as per 31.12.2007 by individual age groups for the insured persons who have not yet become eligible for pension. This was the starting point for the projection of the financial resources of the insured persons.
- The projection of the financial resources was based on the formula

\[
\text{Financial resources (x, Y)} = \text{Financial resources (x-1, Y-1)} \times 1.03 + \text{Premiums (x, Y)} \times \sqrt{1.03} - \text{Purchase},
\]

where \(x\) represents age and \(Y\) represents year. Purchases in the above formula should only be subtracted if exits occurred in the year \(Y\).
- The insured person was included in the pension insurance for so long that at the time of his/her exit, his/her purchase value was equal to the average purchase value. The average value of purchase was determined by age and years as

\[
\text{Purchase} = \frac{\text{Financial resources (x, Y)} \times \sqrt{1.03} \times \text{No. of purchases}}{\text{No. of insured persons (x, Y)}},
\]

where \(x\) represents age and \(Y\) represents year.

Pensions paid out by years from 2011 to 2060
- According to ZPIZ-1, pensions under voluntary collective pension schemes become payable 10 years after the entry into the insurance scheme. Since this insurance became operative in 2000/2001, the first pensions will be payable in 2011. Before 2011, the insured persons exiting the insurance scheme are not eligible for pension.
- All exits from the insurance scheme beyond the age of 55 and after 2010 are projected under the assumption of retirement.
- Purchases determined using the method described in the item “Financial resources of the insured persons” after 2011 and beyond the age of 55 served as a basis for the actuarial calculation of the annuity amount by age and years for new pensioners:

\[
\text{Annuity} = \frac{\text{Purchase}}{\text{Present value of annuity for €1 a year with regard to the age of the insured person}}.
\]

- The overall pension paid out by age for the year \(Y+1\) was determined by multiplying the pension for the year \(Y\) by the survival factor (German tables 94) and adding to it the pension for new pensioners in the year \(Y+1\).

Number of pensioners
• The number of new pensioners by years and age equals the number of exits after 2011 and age beyond 55.
• The projection of the total number of pensioners by years and age was based on survival tables according to German tables 94.
• Equation for the number of pensioners by individual years

\[ \text{No. of pensioners (x, Y)} = \text{No. of pensioners (x - 1, Y - 1)} \times p_{x-1} + \text{No. of new pensioners (x, Y)}, \]

where x represents age, Y represents year and \( p_{x-1} \) probability of survival for age x-1.

Financial resources including mathematical provisions for pensions
• Mathematical provisions for a certain age group were obtained as the overall paid-out pension amount for this age group multiplied by the present value of annuities for €1 a year with regard to the insured person’s age.
• The projection of financial resources was made by adding up financial resources from the item “Financial resources of the insured persons“ and adding mathematical provisions for pensioners.
Slovakia

Description of the pension projection model and its base data

General Information: PROST - Pension Reform Options Simulation Toolkit - A toolkit to simulate the evolution of pension systems over time and the fiscal implications of reforming them. Model developed by World Bank and run by Financial Policy Institute (Ministry of Finance). Projection results are not subject to internal peer review within Slovakia.

General characteristics of the model

Programmed in Visual Basic, with input and output in EXCEL
- Input file is an Excel template enabling customization for individual cases.
- Output file is also an Excel file and can be saved or combined with other files.
- Permits an easy and quick approach for sensitivity analysis and scenario comparisons
- Automated procedures for some parametric reforms like retirement age increase.
- Forecast potential costs and benefits of alternative reform options.
- Universal model – this results however in some limitations and shortcomings as country specific model would better reflect some projection issues

Simplified sequence of modeling steps and input data used:

1) **population** projections of each age and gender group – because the model calculates population projections first, Eurostat was asked to sent cohort specific data on fertility and migration. Since the modeling technique requires year 2004 to be the projection base year, also Slovak statistical office was asked to send the same data for 2004-2007 period. Based on this data, the population projection for 2008 (and thus for the whole period) is slightly different compared to Eurostat population projections.

2) numbers of people in each cohort who are **contributors** and numbers who are **beneficiaries** – labour participation (AWG assumptions used), unemployment rate (AWG assumptions used),

3) **revenue** projection using the numbers of contributors in each cohort, the average wage of that cohort, and the contribution rate and other revenue sources - GDP and productivity growth (AWG assumptions used), age and earning profile of contributors (data from Slovak Statistical Office)

4) **expenditure** projection : benefits to new retirees; indexation of benefits to stock of retirees; benefits to widows and orphans; other expenditures - age and expenditure profiles of beneficiaries (data from Social Insurance Agency)

Input file
The input file is an Excel Workbook template with six embedded worksheets. The first of these worksheets contains general assumptions that are not age specific while the next three
contain age specific data. The fifth and sixth worksheets contain individual specific data and information on the reforms to be undertaken, respectively. Most of the data are entered for the base year, the final year, as well as any years in between if necessary.

*General* – Input information about the economy (inflation rate, interest rate, GDP growth etc.) as well as some non age-specific parameters of the pension system (retirement age, accumulated reserve fund, contribution rate, wage and pension brackets, etc.)

*Population* – Input base year population along with age specific fertility and mortality rates as well as immigration information

*Labour* – Input base year labour force participation rate, unemployment rate, distribution of earnings by age

*Pension* – Input base year pension system information including number of contributors, beneficiaries, coverage rates, etc.

*Profiles* – Information on representative individuals, such as gender, age of starting work, career path

*Reform* – Information on specific reforms to be simulated. Users can choose between any combination of conventional PAYG, notional account PAYG, and defined contribution pillars, and all the parameters relevant to each of these reforms. Users specify who will be permitted to join the new system, the rules of the transition, and how the acquired rights will be paid, through prorated pensions, through recognition bonds, or through initial notional capital.

**Output file**
There are 5 output modules generated by the program. The modules contain a graphical summary sheet along with Excel worksheets.

*Population Projection* - Population projections are made along with life tables and population pyramids, population dependency rate.

*Demographic Structure* - Labour force and employment projections, projections of contributors and beneficiaries, system dependency rate.

*Financial Flows* - Macroeconomic trends, wage projections, benefit projections, revenue and expenditures of the pension system, and the implicit pension debt, all projected for the base case assumptions. Pensioners at any time are divided into new and old pensioners. New pensioners get pensions based on existing formula (or proposed). Existing pensioners get last years’ benefits plus whatever indexation is assumed.

*Individual accounts* – Using the specifics in the Profiles input sheet, the program calculates the impact on up to 6 individuals who start work at each year of the simulation period, which allows both intragenerational and intergenerational analysis.

*Systemic transition* - Impact of reform on both the individual and system. Benefit payments and replacement rates are calculated under each of the three pillars. A hypothetical annuity is also calculated so that the replacement rates under each of the three pillars can be compared.
Financial flows are calculated for each pillar and an implicit pension debt is calculated for the reformed system. Finally, the model takes the average new pensioner in each future year and calculates this person’s replacement rate from each of the pillars and combined.

**Using PROST in the Slovak Republic**

- Model uses the common AWG data and assumptions
- Model works with age specific earnings profile which were not included in AWG base assumption (data from Statistical office and Social Insurance Agency)
- Pension benefits are divided into 4 schemes – old age, disabled, survivors and orphans.
- The base year for the model is 2004 – this is a shortcoming of the model which needs the base year to be before fundamental pension reform (introduction of the fully funded pillar in 2005)
- Number of pensions is defined as a stock (%) of population reflecting other variables (increasing retirement age, participation rates and unemployment rate)
- The average number of years of service is 40 years for males. For females, it is 37 in 2007 and it converges linearly to males until 2024, which reflects the increase in the statutory retirement age.
- Existing pension benefits are based on pension distribution, new pensions are defined with average replacement rate (% of average gross wage)
- Pensions are indexed according to law (50% wages + 50% prices)
- Due to change of the character of the second pillar from mandatory to voluntary, in the projections we assume that 95% of new labour market participants will join the funded scheme. The assumed 95% entry rate is based on the general preference of young people to participate in the fully funded pension scheme instead of relying solely on PAYG pillar. This can be proved by looking at the 2008 temporary opening of the fully funded pillar where out of 275 thousand participants aged 0-25, less than 1% decided to opt out.
ANNEX

Architecture of the pension system

<table>
<thead>
<tr>
<th>Component</th>
<th>Social assistance</th>
<th>I. (Mandatory)</th>
<th>II. (Voluntary)</th>
<th>III. (Voluntary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Way of financing</td>
<td>General taxation (state budget)</td>
<td>Pay-As-You-Go</td>
<td>Funded</td>
<td>Funded</td>
</tr>
<tr>
<td>Administration</td>
<td>Public (Ministry of Labour, Social affairs and Family)</td>
<td>Public (Social Insurance Agency)</td>
<td>Private (pension fund management companies)</td>
<td>Private (supplementary pension companies)</td>
</tr>
<tr>
<td>Tool</td>
<td>Redistribution</td>
<td>Redistribution</td>
<td>Savings accumulation</td>
<td>Savings accumulation</td>
</tr>
<tr>
<td>Pension amount</td>
<td>Means tested, dependent on insurance period, assessment base amount</td>
<td>Pension amount dependent on the amount saved in the personal pension account</td>
<td>Depending on the accumulated savings</td>
<td></td>
</tr>
<tr>
<td>Pension form</td>
<td>Social assistance benefit</td>
<td>Pension determined by a statutory formula</td>
<td>Annuity, or annuity and program withdrawal</td>
<td>Pension drawing forms, individual choice</td>
</tr>
</tbody>
</table>

Benefit formulas as stated in pension act

\[ OP = APP \times T \times CPV \]

Where:
- \( OP \) = old age pension benefit (monthly),
- \( APP \) = average personal wage point, calculated as a arithmetic average of PPs’ (personal wage points), maximum value of the APP is 3

\[ PP = \frac{\text{individual earnings}}{\text{average earnings}} = \frac{(\text{annual assessment base which was used to calculate contributions})}{(12 \times \text{average monthly wage in the economy})} \]

- \( T \) = number of years of the working career,
- \( CPV \) = current pension point value is a value in terms of money for one APP

Deferred old age pension in PAYG:
After reaching the retirement age, the economic activity affects the amount of pension.

\[ OP’ = (OP + OP_1) \times (1 + \%) \]

Where:
- \( OP’ \) = total sum of the pension,
- \( OP \) = the amount of pension acquired at the date of reaching the retirement age,
- \( OP_1 \) = the amount of pension acquired by the economic activity at the date of reaching the retirement age,
- \( \% = 0.5 \% \) for every 30 days of the economic activity after reaching the retirement age i.e. 6% per year.

\[ OP_1 = PP \times CPV \]
Early old age pension in PAYG:
The entitlement for early old-age pension arises to an insured person who:
- has been old-age insured for at least 15 years
- becomes eligible for early old-age pension that is higher than 1.2 x minimum level of subsistence for one adult

\[ EOP = OP \times (1 - \%) \]

Where:
\( EOB \) – early old-age pension,
\( OP \) = the amount of pension acquired at the date of reaching the retirement age,
\( \% \) = 0.5 % for every 30 days of the economic activity before reaching the retirement age i.e. 6% per year.

Disability pension in PAYG:
Calculation of the disability pension for a person with 41%-70% decline of work capability:

\[ DP = [APP \times (T + T_1) \times CPV] \times M \]

Calculation of the disability pension for a person with more than 70% decline of work capability:

\[ DP = APP \times (T + T_1) \times CPV \]

Where:
\( DP \) = disability pension,
\( APP \) = average personal wage point,
\( T \) = number of years of insurance as of the date of the rise of disability,
\( T_1 \) = number of years of insurance from the rise of disability until reaching the retirement age,
\( CPV \) = actual pension value,
\( M \) = percentage rate of reduction in the capacity to carry out gainful activity.

Indexation of benefits – Swiss formula
- in percent,
- pensions indexed on 1 July until 2008, since 2009 on 1 January
- taking into account the wage and price development.

\[ \% = \frac{(M + C)}{2} \times 100 \]

Where:
\( M \) = year-on-year wage growth index,
\( C \) = year-on-year price growth index.
**Initial determination of the pension point value in 2004:**

\[ PP_{2004} = \frac{RR\% \times AW_{2003}}{Years} \]

Where:
- \( PP_{2004} \) – pension point in 2004
- \( RR\% \) - replacement rate (gross pension over gross average wage)- set at 50%
- \( AW_{2003} \) - Average wage in the economy (estimated at the time of writing law)
- \( Years \) – years of service

1 EUR = 38.879 SKK
Description of the pension projection model and its base data

1. Structure of projection model

The results of the report have been calculated using the long-term planning model of the Finnish Centre for Pensions. The model is deterministic and replicates the functioning of the earnings-related pension scheme. With the help of the model it is possible to do projections to meet the planning and forecasting needs of the pension scheme. Unless otherwise stated, acts and other regulations governing the schemes will stay unchanged until the end of the projection period.

The model consists of several interconnected modules (figure 3.1.)

Figure 3.1. Modules of the projection model.

The earnings-related pension expenditure module. Earnings-related pension expenditure is projected separately for each earnings-related pension act. Pensions are paid out to pensioners on an annual basis, insured persons accrue future pensions, and persons move between different states (employed, unemployed, pensioner etc) according to given probabilities. The model’s states and transitions between these states are presented in figure 3.2. Unemployment pensions are scheduled to be eliminated by the middle of the next decade. In the future, the transition from unemployment will be made directly to old-age pension.

Those active in the model are in gainful employment, their earnings accrue a pension, and their contributions are levied on the basis of the earnings. The unemployed are divided into three different states in the model. Persons aged less than 57 who receive an earnings-related unemployment allowance are categorized as unemployed. Long-term unemployed persons aged over the age of 57 are entitled to an earnings-related unemployment allowance for additional days until their pension starts. These two groups of unemployed accrue an earnings-related pension during their periods of unemployment. Other unemployed persons do not accrue a pension (currently about half of the unemployed) and they are categorized as
inactive. Persons transferred to the category of inactive also include those who exit the labour force, and those who transfer from work covered by the act under observation to work covered by some other act. The inactive are those persons who have accrued a pension under the act under observation, but who no longer work in a job covered by this act, and who are not drawing a pension.

In addition to the transitions presented in figure 3.2, new employees are added, on an annual basis, to the active category in accordance with population and employment forecasts. Persons in each state also die over the course of a year, and some of these deaths result in the award of a survivor's pension to living family member(s).

Within the model's states, people are categorised into different classes within each age and gender. An average technique is applied in these classes. Averages are calculated for each age and gender and applied to all persons within in a particular class. For example, all 50-year-old men working in employment contracts covered by TyEL are assumed to be identical to each other. It is easier to use an average modelling technique as opposed to an individual-level projection, but at the same time it produces less information. For example, a distribution of pensions by size cannot be calculated.

The average technique used by the model does not prevent capturing the selectiveness of transitions between different states. The following phenomena have been included to the model:

1) Accrued pension and salary for projected pensionable service for those transferring to disability pension are typically lower than for those continuing in gainful employment.

2) The mortality for persons drawing a disability pension is higher than the average for the population in general, while the mortality for non-disabled persons is correspondingly lower.

3) Among old-age pensioners, a large pension is associated with low mortality when age and gender are standardised.

4) Pension accruals for those dying while still within the active age range are lower than average for the insured.

*Figure 3.2. States in the projection model.*
The TyEL financing module is used to calculate the development of TyEL's contribution rate, technical provisions and assets. It contains a detailed description of the legislation and the bases of calculation pertaining to TyEL financing. The financing module is joined to the TyEL expenditure module via a two-way connection: TyEL expenditure and wage sums affect the contribution level, and also affect the formation and dissolution of technical provisions. Conversely, the size of the employee's pension contribution affects pension accrual and therefore pension expenditure.

Premium income is composed of a pooled component, a funded component and a remaining component which contains operating expenses and client bonuses. The pooled component is used to finance pay-as-you-go pensions, and the funded premium income is accumulated into technical provisions for the pension providers. Technical provisions are also dissolved to finance annually paid pensions. Since the required amounts of technical provisions are calculated per age group for each calendar year, the age-specific allocation of old-age pension liability supplements can be investigated with the help of the model.

The number of earnings-related pension recipients and the average earnings-related pension are calculated once the pension expenditure of all earnings-related pension acts is known. The number of earnings-related pension recipients is calculated using the population and employment forecasts, and also using the transition probabilities from the pension expenditure module.

In the national pension module, the number and the size of national pensions is calculated. The earnings-related pension projection serves as a basis for determining the national pensions. However, the model does not provide information on the size distribution of earnings-related pensions. Therefore, in order to calculate national pensions, it is assumed that the shape of the commencing earnings-related pension distribution remains unchanged across time.

The model allows the national pension index to be a pure price index, a pure earnings level index or a weighted average of these indexes. Since the 2008 increase, no decisions have yet been made regarding the next general increase in the national pension scheme. Historically, however, the practice has been to occasionally increase the real value of national pensions. In the baseline projection, increases have been taken into account by assuming that the national pension index is equal to half of price growth plus half of average earnings growth. Chapter 5.5 analyses the impact of the national pension index on national pension expenditure and the benefit level.

The SOLITA module is a simple description of the development of SOLITA expenditure based on a population forecasts. The starting point for the projection is current SOLITA expenditure, by age and gender. For those of active age (18-62-year olds), SOLITA pensions grow at the same rate as the general wage level. For those who are 63 or older, SOLITA pensions grow at the same rate as the earnings-related pension index.

Total statutory pension expenditure and the average total pension are calculated as the joint result of different modules. The benefit level is calculated for Finnish residents receiving a pension in their own right, excluding part-time pension recipients. The average

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61 SOLITA-pensions refer to military accident and injury, traffic insurance and accident insurance laws.
pension is calculated for everyone included in the aforementioned group, and for 68-year-olds. The pension level of 68-year-olds depicts the size of old-age entry pensions based on year of birth classification.

The projection model requires the following data to describe the initial situation, specified by pension act as well as by the age and gender of the insured:

1) population distribution over different acts and different states under the acts
2) salaries of the insured
3) amounts of pension accrued
4) technical provisions and the amount of pension assets
5) amounts of the pensions payable
6) transition probabilities between different states.

Figures describing the initial values for the projection (31.12.2005) come from the Finnish Centre for Pension's employment and pensions registers, the joint statistics of the Social Insurance Institution and the Finnish Centre for Pensions, the the Local Government Pensions Institution and the State Treasury.

**Figure 3.3.** Accrued earnings-related pension and earnings-related pension in payment per capita in 2006.

The data on accrued pensions comes from the registers of the Finnish Centre for Pensions, the State Treasury and the Local Government Pensions Institution. This data is comprehensive, but nevertheless contains a few estimates. Therefore, the data is not final. Figure 3.3 presents the size of accrued pensions and pensions in payment in 2006.

Core assumptions for the projection period are:

1) demographic forecast
2) employment forecast
3) changes in retirement risk
4) growth in income level
5) return on pension assets

(source: Finnish Centre for Pension, Statutory pensions in Finland, Long-term projections 2007, Reports 2008:1)

2. The national pension system

National pensions are intended to provide a basic retirement income for those whose employment pensions are small or non-existent. All residents of Finland are eligible for the national pension. The old-age pension is payable to insured people over 65 years. The national pension is also payable as disability, unemployment and survivor’s pension. The supplementary means-tested pension components are: pensioners’ housing allowance, pensioners’ care allowance, front veterans’ supplements and increase for children. The pension benefits are adjusted yearly to changes in the price index. National pensions are financed by employers’ social security contributions and transfers from the state.

The employment pension reform, put into effect in 2005, had implications also for national pensions. The age-limit for early old-age pension increased by 2 years and unemployment pension will be discontinued by 2010.

The incentives to continue to work were increased for low-income workers with short employment history. Usually the national pension decreases as the persons’ earnings-related pension increases with the phasing-out rate of 50 %. The exception is made for earning related pension rights beyond 63 years.
The model covers about 90 per cent of all pension expenditure. Items such as pensioners’ housing and care allowances, which are paid within the pension system but are not by definition pensions, are excluded from the projections. Also, private voluntary and occupational pensions as well as pensions and life annuities related to the traffic and accident insurance system are excluded. The remaining pensions are defined as the social security pensions.

The difference in the social security pensions between the model calculations and actual statistics is about 200 million € on the total level, One reason for this difference is partly in statutory additional pensions.

### Social security pensions 2007, EUR million

<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>1. old age and early pensions</th>
<th>1.1 National pensions</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1560</td>
</tr>
<tr>
<td>1. old age and early pensions</td>
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<td>1.1.1. Old age</td>
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<td>1.1.2. Unemployment</td>
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<td>1.1.3. Veterans</td>
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<td>1.2. Earnings-related pensions</td>
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<td>1.2.1 Public sector</td>
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<td>1.2.1.1 Old age</td>
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<td>1.2.1.3. Unemployment</td>
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<td>1.2.2. Private sector</td>
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<td>1.2.2.3. Unemployment</td>
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<td>1.2.2.4. Agricultural</td>
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<td>2.1. National pensions</td>
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<td>2.1.2 Survivors</td>
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<tr>
<td>2.2. Earnings-related pensions</td>
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<td>2.2.1 Public sector</td>
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<td>2.2.1.2 Survivors</td>
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<td>2.2.2 Private sector</td>
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<tr>
<td>2.2.2.2 Survivors</td>
<td>965</td>
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</table>

Source: FCP, KELA
Sweden

Description of the pension projection model and its base data

1 Introduction

The AWG calculations have been done with the SESIM dynamic microsimulation model. The model is developed at the Swedish Ministry of Finance in close cooperation with researchers at Swedish universities. The work started in 1997 as a tool to evaluate the Swedish education financing system. Since year 2000 the focus has shifted from education to forecasts and analysis of the reformed Swedish old-age pension system and the effects of the ageing population on the public finances. This new focus has also implied that SESIM has been developed into a general microsimulation model that can be used for a broad set of analyses. SESIM has later been extended for other purposes, for example for analyses of health amongst elderly. More detailed documentation can be found in Flood et.al [2005], or at www.sesim.org.

All AWG calculations and model simulations has been done at the Ministry of Finance at the Economic Affairs Department. No peer review has been done nationally. The results has been validated e.g. against National accounts and calculations from The Swedish Social Insurance Administration.

2 Overview of the model

SESIM is a mainstream dynamic microsimulation model in the sense that the variables (events) are updated in a sequence, and the period between the updating processes is a year. The start year is 1999 and the initial sample of the Swedish population is approximately 110 000 individuals. All individuals are then subject to a large number of possible events, reflecting real life phenomena, such as education, marriage, parenthood, work or retirement.

SESIM has a recursive structure consisting of a set of modules executed in a predetermined order, see figure 5.1 below. The unit of simulation is the individual but the household also plays a significant role. Many of the simulated processes refer to household as well as individual properties. The simulation sequence starts with a set of demographic modules (mortality, adoption, migration, household formation and dissolution, disability pension, rehabilitation and regional mobility). After that follows modules for education and the labour market (unemployment, employment etc.) The date of retirement can be decided according to an endogenous retirement model, but in these calculations the retirement age is fixed at 65. Thus, no dynamic effects on the labour supply are taken into account in these calculations, although it’s realistic to assume a higher effective retirement age as an effect of the pension reform and a rise in the longevity.

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62 If necessary the sample can be extended.
Every year the individuals are assigned a status. Each individual can only have one out of nine different statuses during a specific year. Every status is related to a source of income. Working results in earnings; retirement brings pensions etc. For employed individuals an earnings equation is used to determine the income. For other kind of statuses, for example unemployment, different rules are applied to obtain the income. After the calculation of income, a module for wealth capital income and housing is entered. Four separate assets are considered in the household portfolio: financial wealth, owned home, other real wealth and private pension savings.

After the wealth/housing calculations follow a large module that contains all relevant tax, transfer and pension rules. The rules for all three pillars of pensions have been implemented in all relevant details (i.e. public, occupational and private pensions). This means that all components and parameters mentioned in the previous sections about the pension systems are implemented in the model calculations. All persons are assumed to be full time pensioners, since the model does not handle part time retirement (mixed statuses). Also the automatic balancing mechanism is implemented, but switched off in the AWG calculations. To ensure

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The different statuses are: Child (0-15 years old), Old-age pension, Student, Disability pension, Parental leave, Unemployed, Employed, Miscellaneous, Emigrated (individuals living abroad with Swedish pensions rights).
consistency, all calculations, including income and pensions, are made in the same model and with the same assumptions.

Given the information above the household disposable income can be defined. SESIM allows for an extensive definition of income since the value of various non-cash benefits can be included, e.g. education, childcare and health care. Only benefits that can be attributed to a specific individual are included.

3 Data Issues

The primary database for SESIM, concerning estimation of statistical models as well as construction of the base population, is the Statistics Sweden longitudinal database LINDA. This database is created from administrative registers and covers about 3.5 percent of the Swedish population. In 1999, the primary sample was, thus, 308,000 individuals, and including their household members the total sample size was 786,000 individuals. The selected individuals are followed over time and all relevant information is collected. Some information, for instance pension rights, can be traced back as far as to 1960. Selected individuals, who are omitted from the data due to death or emigration, are replaced by new individuals so as to maintain statistical representativity.

As LINDA is completely created from administrative registers, no interviews are needed and, therefore, a major advantage is that there are no problems of attrition bias. The database is created by merging a large number of registers, and includes data on income and wealth, earnings, pension rights, sickness- and unemployment benefit, schooling etc. The base population used in SESIM is formed by a random draw of individuals from LINDA. Considerable work has been done with the initial dataset to make it consistent with macro outcome data, e.g. when assigning the individuals’ initial statuses.

In the construction of the base population in SESIM two main adjustments have been made:

- **Adjustment of the household definition:** The households in LINDA are not defined in an economically optimal sense. E.g. adults living together without being married or having common children are considered as separate households. Therefore, other data sources are used to impute a more realistic family structure.

- **Adding emigrants with pension rights:** Individuals with Swedish pension rights will keep these entitlements even if they have emigrated. As LINDA does not include individuals living outside Sweden, information from the National Social Insurance Board regarding these individuals has been added.

Apart from the sources mentioned above, some additional data is used for estimation or imputation. The Statistics Sweden income distribution survey, HEK, which is based on interviews merged with register information is, apart from being used in the correction of the household composition, also used in the estimation of public consumptions and housing variables.\(^{64}\)

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\(^{64}\) Regional mobility and tenure choice is based on a database named GEOSWEDE. The Statistics Sweden household expenditure survey (Level of Living Survey) is used for calculation of indirect taxation. The health and care modules are based on the Kungsholmen study by Mårten Lagergren and Statistics Sweden.
4 Assumptions and simulations

The most important exogenous economic macro variables in SESIM are inflation, real income growth per capita, short- and long interest rates and return on stocks. All relevant macro numbers are implemented in line with the AWG assumptions. In the calculations the model is aligned in order to achieve exogenous average unemployment and participation rates. The age profiles for the labour supply, as well as the income, are endogenous and not aligned to the AWG-assumptions for different cohorts. Regardless of this the calculated numbers seem to replicate the AWG-assumptions closely. The “raw” model results are calibrated to NA levels 2007 where possible.

All calculations are made in current prices. In all calculations the exogenous retirement age is 65 years, although it’s very likely that the new pension system and the increasing life expectancy will lead to an increase in the retirement age. The indexation rules are implemented in detail in the model, normally in line with legislation. Exceptions are the housing allowance for pensioners and the guaranteed pension that by law should be price indexed, but is indexed with income growth from 2009 onwards. It is also assumed that the rate of return on the funded assets in the individual public DC funds and the individual occupational pension accounts will be the same for all individuals. Upon retirement it is assumed that all individuals choose to get their public DC pension benefits as a fixed annuity. The automatic balancing mechanism was switched off in the model simulations.

5 Additional Information

- SEK/Euro exchange rate = 92501 for all years, in line with the reporting framework.
- All figures are deflated with CPI, 2007=1.
- Some adjustments of the AWG assumptions have been made to make them fit into the SESIM model structure. Unemployment in SESIM is defined for the age group 16-64 years.
- The real interest rate, 3 percent, is used in the baseline calculations. No deduction for administrative costs for the funds is assumed.
- In the public pensions the housing allowance for pensioners (BTP) is included. The reported numbers are not calculated in SESIM but in the Ministry of Finance’s calculations for the convergence program.
- Funds and assets: The AP-fund and the funded DC premium pension funds (the notional funds in the income pension system not included) are calculated. Occupational pension funds only include funded DC-parts.
- Pension expenditures and public contributions adjusted to national account levels until 2007, but not occupation pension contributions and any assets. From 2008 on the growth rates from the model calculations are used.
- In SESIM, only occupational pensions to individuals with public pensions are calculated. Thus, different types of early retirement option programs in collective agreements, agreed disability pensions etc are not included. To adapt to the NA-level the reported numbers are adjusted with an additive factor for all years (income indexed).
- No contributions reported for pension systems that are financed by general tax income, i.e. disability pensions.
- Only DC contributions to occupational pensions are reported, but not DB contributions that are financed by the employers on actuarial ground.
References

Appendix 1: Indexation and Automatic balancing

Income indexation
The PAYG-pensions is on average indexed by wages. The system is front-loaded, though, and the pensioners receive a share of the real economic growth in advance. Technically this is achieved by calculating the annuity factor with a 1.6 per cent discount factor, resulting in a higher initial benefit than a straightforward application the actuarial principles imply. The indexation is then reduced during the pay-out time by subtracting 1.6 per cent from the yearly income indexation.

The development of income is measured by the income index, that measures the change in average income individuals active in the labour market. The income index is based on pensionable income for individuals between age 16 and 64, without any income ceiling. To avoid cyclical swings the index is calculated as a three year moving average.

![Income indexation diagram](image)

Automatic balancing
The Swedish PAYG NDC income pension system is equipped with an automatic balancing mechanism that will secure the financial stability of the system. Regardless of the demographic or economic development the system will be able to finance its obligations with a fixed contribution rate and fixed rules for calculation of benefits. This is achieved by reducing the rate of indexing, if necessary.

If the current liabilities of the system are greater than the calculated assets the balance ratio becomes below one (1) and the balancing is activated. The balance ratio is calculated by the Swedish Social Insurance Agency, and published in the pension system annual reports.

The balancing ratio is obtained by dividing the assets of the system by the pension liability. If the balance ratio exceeds one (1), the assets are greater than liabilities. If the balance ratio is less than one, liabilities exceed assets, and the balancing is activated. When balancing is activated, pension balances and pension benefits will be indexed by the so called balance index instead of the change in the income index.
An example: If the balance ratio falls from 1.0000 to 0.9900, while the income index rises from 100.00 to 104.00, the balance index is calculated to 102.96. The indexation of pension balances and benefits is then reduced to 2.96 instead of 4 percent.

If the balance ratio exceeds 1.0000 during a period when balancing is activated, pension balances and benefits will be indexed at a rate higher than the increase in the income index. When the level of the balance index reaches the level of the income index, the balancing is deactivated and the system returns to indexation by the normal the income index.

**Income and Balance indexation**

![Diagram showing income and balance indexation](image)

- **BT < 1, balancing activated**
- **BT > 1, higher rate of indexation**
- **Balance index = income index, balancing terminated**

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Appendix 2: Calculations of the premium pension in AWG05 and AWG08

There is a difference in the premium pension as a share of GDP between the AWG calculations in 2005 and 2008. In the 2005 calculations the premium pension was forecasted to 0.94 p.p to GDP in 2050, in 2008 the share was 1.3 p.p. in 2050.

The first payouts from the system were in 2003. As the system the growing very fast, small errors in the beginning accumulates to big numbers in the end. In AWG 2005 the calibration to NA-level was done as a multiplicative adjustment on the expenditure level 2004. This time the method of the adjustment is improved. Outcome and forecasts from the National Insurance Agency is used until 2011. Thereafter an additive factor, amounting to the difference in 2011 is added to the model forecast. As the system grows this factor becomes less and less important.

The numbers (Euros, fixed 2007 prices) is presented in diagram 1. The deviant series is obviously the adjusted numbers in 2005. There is also a small difference between the unadjusted AWG-05 numbers and AWG-08. This is explained by different demographic and economic assumptions. The difference between the adjusted and unadjusted AWG-08 numbers is hard to see in the diagram but still there. This difference is explained by the adjustment to outcome and short run budget forecasts until 2011.

Diagram 1: The premium pension in AWG05 and AWG08
United Kingdom

Projection methodologies

Macroeconomic Assumptions

- Inflation in the long term is assumed to be in line with the Bank of England’s inflation target of 2 per cent. This is the best estimate for long-term inflation rates in the UK.
- The projections use an approximation of the employment rates provided by the European Commission. The difference amounts to less than 1% over the projection period and therefore has no significant effect on the overall projections.
- All other macroeconomic assumptions that were used are in line with the assumptions agreed by the EPC’s Ageing Working Group.
- The projections have been fully adjusted to Eurostat’s latest population projections.

Projection Models

Projections for Basic State Pension, Pension Credit and S2P (and SERPS) are modelled by DWP. Public Sector Pensions are based on projections provided by the Government Actuaries Department (GAD).

DWP estimates benefit expenditure separately for each of the benefits, and separately for the basic flat-rate (BSP) and the additional (SERPS and State Second Pension) elements.

Basic State Pension

Numbers are estimated from recent data on beneficiaries projected forward with allowance for awards and cessations in future years based on past experience and taking into account demographic factors. The average rate of benefit is projected based on past data and observed trends, making implicit allowance for changes to employment records and dependency.

The projection method assumes policy prior to the Pensions Act 2007 is in place, with the impact of those reforms being added to the projections as a second stage.

To project the basic retirement pension prior to reform, estimated expenditure was obtained by multiplying the projected number of recipients by the estimated average amounts of basic retirement pension. In doing this, the first stage is to calculate the future cost in respect of those already retired (allowing for future deaths), who are in receipt of known amounts of pension. Average amounts are assumed to remain constant for each cohort (apart from annual uprating of benefits), with allowance for higher rates payable to those who deferred receiving their pension and on award of widows' retirement pensions when a married male pensioner dies. To this estimate is then added the cost of pensions to future new awards based on the
projections of the numbers of pensioners and the estimated average amounts at award for future cohorts of pensioners.

For men resident in Great Britain, it has been assumed that 99 per cent of those in the population reaching age 65 in each future year will be eligible for retirement pension, including those who defer their pension beyond pension age. For men retiring now, excluding deferrers, the mean rate of pension is 97.3 per cent of the standard Category A pension. This percentage is assumed to fall slowly, reaching 96½ per cent in 2020 and stabilising at this level. This reduction reflects a continuation of past trends, which, in turn, reflects the fact that the advantageous effects of crediting entitlement prior to 1948 and in respect of contributions paid up to 1975 are becoming steadily less important.

The position prior to reform is more complicated for women since it is necessary to make allowance for changes resulting from the increasing number of women who are economically active, the introduction of Home Responsibilities Protection and the phasing out of the married women’s reduced rate contribution option. The result of this will be that increasing proportions of women will be entitled to retirement pension on their own contribution record rather than relying solely on that of their husband, and the average rate of pension will increase. As a result, increasing proportions of women are becoming eligible for some retirement pension based on their own contributions when they reach pension age (rather than having to wait until their husband retires).

In spite of the projected increase in the proportion of women who are entitled to basic pensions on their own contribution records, the number of male pensioners increases at a faster rate than for women. This is due chiefly to the increase in pension age for women, which is being phased in between 2010 and 2020.

Under pension reform, the main changes are modelled as follows:

- Earnings uprating by replacing price inflation assumptions with average earnings assumptions.
- Raising SPA by excluding from entitlement those of the relevant ages (see Annex A for detail) and allowing for an additional accrual as we assume that individuals pay more National Insurance Contributions as they work for longer.
- Changes to qualifying years and credits by applying the new rules to data on contributions and qualifying years. Informed judgements have had to be made where reforms extend beyond the realm of existing data, and for take-up of new entitlements, particularly for those residents overseas with relatively small entitlements.

Graduated Retirement pension, which ceased for accruals in 1975, is modelled in a similar fashion to Additional pension (see below). Graduated Retirement pension is around 3 per cent of Basic State Pension expenditure.

Whilst numbers in receipt of state pension who are resident in the UK are largely driven by population projections, an additional adjustment must be made to allow for retirement pensions paid to non-residents. It is assumed that, reflecting recent trends, the percentage of

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65 Only married women who were paying the reduced rate of contributions in 1977 retained the right, under certain conditions, to continue to pay such contributions.
the number of all new retirement pensions that are paid to non-residents will rise from around 8½ per cent at present to around 11 per cent by 2020 before stabilising at that level, with the average pension paid to overseas residents around half of that paid to those in Great Britain.

**Pension Credit**

**Pension Credit**

Pension Credit is modelled using Pensim2, a dynamic micro-simulation model that has been developed in DWP to inform analysis of likely future trends in pensioner incomes. Pensim2 builds up a picture of the future pensioner population by modelling future life events and work histories for a representative sample of individuals.

The model currently starts from a set of base data representative of the GB household population in 2001. This base data includes detailed information on the characteristics of individuals and their employment and pension histories to date. For each subsequent year, sets of equations are used to model, for each individual, the probability of certain events occurring, based on estimates from current data. The calculated probabilities are then used within the model to determine what happens to each individual in a given year.

The key elements that are simulated include:

- partnership formation and dissolution;
- mortality;
- fertility;
- education;
- labour market status and earnings; and
- accrual of occupational and personal pensions.

The individual labour market and pension histories generated by the model are used to calculate estimates of pensioner incomes in each year of the simulation. For contributory State Pensions, the rules of the state pension are used to calculate someone’s entitlement given the extent to which they work or participate in activities that are credited. Entitlement to Pension Credit is then calculated based on all relevant income sources.

The methodology and equations underlying Pensim2 were validated by the Institute for Fiscal Studies.

**State Second Pension (and SERPS)**

S2P (and SERPS) are projected based on projected earnings and mortality rates. At pension age, the earnings are converted into pension amounts using accrual rates (i.e. using the formula on which pension entitlement is based).

Employees who are members of a contracted-out pension arrangement forego all or part of their additional pension, which is deemed to be replaced by the pension from the contracted-out pension scheme. In order to quantify clearly the effects of contracting out, the projections
have first been carried out assuming no employees are contracted-out. A deduction is then applied ("the contracted-out deduction", COD\textsuperscript{66}) in respect of employees who are assumed to be contracted-out and this represents the part of the additional pension to which they are not entitled as a result of being contracted-out.

Contracting out of the State Second Pension is assumed to continue to decline in the future in the private sector defined benefit schemes, falling by two-thirds in 2050 compared with current levels. The majority of this reflects the feeding through of schemes that have already closed to new members, but there is a further decline as a result of assumed future closures. Defined contribution schemes (contracted-out money purchase and appropriate personal pension) have a further reduction assumed, resulting from the lowering of the cap on age related rebates in the recent contracted-out rebate review. It is assumed a fall in numbers contracting out of 8\% in 2007/08, followed by a further fall of 4\% a year in the following years. It is also assumed that there is no change in contracting out in the public sector (where virtually all employees are contracted out).

\textit{Public Sector Pensions}

The projections of unfunded public sector pensions are based on projections provided by the Government Actuaries Department. The projections are based on figures used for national projections, but have been adjusted to be consistent with the assumptions agreed by the EPC’s Ageing Working Group.

The projections cover all unfunded public service occupational pension schemes. The main schemes covered are those for the National Health Service, teachers, civil service, armed forces, police, fire fighters, judiciary and the atomic energy authority.

\textsuperscript{66} Strictly under legislation the COD only exists in respect of SERPS accruals up to April 1997.
Modelling changes in State Pension Age

To capture the possible labour market effects of the proposed increase in the State Pension age, two behavioural effects were considered. A ‘lower’ estimate is to assume that those cohorts affected by the reform only increase their labour supply at the age(s) for which they are no longer eligible for a state pension. In other words, for the increase in the State Pension age from 65 to 66 years between 2024 and 2026 it is assumed that the cohorts affected by this change (such as females born in 1965) only adjust their labour market behaviour at the age of 65. This is the minimum behavioural response that can reasonably be expected. This adjustment is made by extrapolating the participation rate profile so that the slope of the profile is constant from 63 years to 65 years. A similar assumption is used to adjust the participation rates of 65 and 66 year olds following the increase in the State Pension age to 67 (between 2034 and 2036) and the participation rates of 65, 66 and 67 year olds following the increase in the State Pension age to 68 (between 2044-46).

By contrast, the ‘upper’ estimate assumes that those cohorts affected by the increase in the State Pension age begin to increase their labour supply earlier in their lifetimes, from the age of 55 onwards. Specifically, for the increase in the State Pension age to 66 years it is assumed that the participation rate profiles of these cohorts are ‘shifted’ to the right by one year. This adjustment increases the participation rate at 65 years of females born in 1965 by around 15 percentage points (a similar approach is used for males). For the subsequent increases in the State Pension age to 67 and 68 years, the participation rate profiles of cohorts affected by these changes are shifted to the right from the age of 55 years by two and three years respectively.

The ‘middle’ variant represents an average of these two behavioural extremes, and therefore provides a reasonable estimate of the likely labour market effect of the proposed increase in the State Pension age.
Tax and pension systems are typically detailed and complex. Accordingly, there are substantial aggregation problems when calculating the total effect on government budgets of changes in tax or pension systems. To overcome these problems, microsimulation models represent a socioeconomic system by a sample of decision units (e.g., persons), and then model the behaviour of these primary units. Contrary to what is possible in aggregate models, inhabited by one or a few representative agents, the detailed and complicated tax and benefit rules may be exactly reproduced.

The dynamic microsimulation model MOSART is especially designed to analyse the mechanical effects on individual pension entitlements, benefits, and government pension expenditures of changes in the Norwegian public pension system. The model simulates the life courses of a representative cross-section equal to 1 percent of the Norwegian population, using a set of transition probabilities to determine the occurrence of socio-demographic events, emphasizing what is relevant for individuals’ accumulation of public pension entitlements. It captures the following events: migration, deaths, births, marriages, divorces, educational activities, retirement, and labour force participation. The model covers social security old age pensions and disability pensions.

Transitions between states over the life course depend on individual characteristics, and the transition probabilities have been estimated based on historical data. For retirement decisions, adjustments have been implemented in order to capture incentives for postponement of retirement in the reformed old age pension system (but the AWG- scenarios are based on participation rates in line with AWG-assumptions). The model includes an accurate description of the pension system and captures relevant details of the population dynamics, as well as the heterogeneity of individual age-earnings profiles and individual public pension entitlements.

Statistics Norway maintains the MOSART-model and runs the projections for the government. The model is well established as the central tool for evaluating development in pension expenditures in Norway, and is updated on a regularly basis in order to capture changes in demographic projections as well as changes in social security old age and disability pensions systems. Accordingly the reform of the old age pension system is implemented in the current version of the model.