

# Technical Compilation Guide for Pension Data in National Accounts

2011 edition



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# Technical Compilation Guide for Pension Data in National Accounts

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## Foreword

The Technical Compilation Guide for Pension Data in National Accounts is a handbook for compilers and users of data on pension schemes in social insurance. It has been produced by Eurostat and the European Central Bank based on a mandate given by the Committee on Monetary, Financial and Balance of Payments Statistics to a Eurostat/ECB Task Force on the statistical measurement of the assets and liabilities of pension schemes in general government in 2006.

The Compilation Guide aims at supporting the work of National Statistical Institutes, Central Banks and other compilers within the European Union to derive estimates for position and flow data for pension entitlements. Such entitlements of households are reflected by corresponding obligations of various pension schemes in social insurance - either privately managed or managed by general government. Data on pension obligations need to be included in the supplementary table on pension schemes in social insurance. Such a table is described in chapter 17 of the System of National Accounts, 2008 (2008 SNA) and also in Annex A (chapter 17) of the European System of Accounts (ESA 2010). As table 29, it is also part of the Transmission Programme of ESA 2010, Annex B.

Most of the government-managed pension schemes in Europe are based on the pay-as-you-go principle whereby current contributions finance current benefits. To examine and especially improve the recording of such schemes, the various steps on how to derive actuarial estimates are described in the Compilation Guide. Moreover, the required data sources are mentioned and the results are demonstrated in various case studies and worked examples.

In this regard, we thank Mr. Bernd Raffelhüschen and Mr. Christoph Müller, Forschungszentrum Generationenverträge of the University of Freiburg, for providing a first draft of the Compilation Guide and also the numerical examples. Mr. Peter Parlasca and Mr. Ismael Ahamdanech-Zarco, both from Eurostat, and Mr. Reimund Mink, from the ECB, have contributed to the preparation of this Compilation Guide.

We encourage all European Union countries to use this Compilation Guide for estimating the pension obligations of such schemes for which no actuarial estimates are made available from other data providers such as from business accountants or from supervisory agencies.



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## Abbreviations

ABO	Accumulated benefit obligations
ADL	Accrued-to-date liabilities
AWG	Ageing Working group — EPC Working group on ageing populations and sustainability
BHPS	British Household Panel Survey
COFOG	Classification of the functions of government
CWL	Current workers' and pensioners' liabilities
DB	Defined benefit
DC	Defined contribution
Destatis	German Federal Statistical office
DRV	Deutsche Rentenversicherung (German statutory pension insurance)
ESA	European System of Accounts
ESSPROS	European System of Social Protection Statistics
EU-SILC	European Union Statistics on Income and Living Conditions
EVS	Einkommens- und Verbrauchsstichprobe (German Income and Expenditure Survey)
GAAP	Generally accepted accounting principles
hetCC	Heterogeneous contribution careers
homCC	Homogeneous contribution careers
IAS	International accounting standards
IPSAS	International Public Sector Accounting Standards
NA	National Accounts
NDC	Notional defined contribution
OSGL	Open-system gross liabilities
OSL	Open-system liabilities
OSNL	Open-system net liabilities
PAYG	Pay-as-you-go
PBO	Projected benefit obligation
SHIW	Survey on Household Income and Wealth
SKK	Slovakian Koruna (Slovakian national currency before 1 January 2009)
SNA	System of National Accounts

SOEP  
ZUS

Sozio-oekonomisches Panel (German Socio-Economic Panel)  
Zakład Ubezpieczeń Społecznych (Polish social insurance institution)

# Introduction

1

# 1 Introduction

Demographic projections for the European Union (EU), as for many other industrialised countries, are characterised by an ageing of the population. This will have a substantial impact on general government spending. A declining European workforce combined with a rapidly expanding number of retirees will force up spending on pensions, health-care and long-term care, while populations will start to decrease in the coming years. The dynamics of general government-managed pension schemes in Europe are usually based on the pay-as-you-go principle whereby current contributions finance current benefits. To examine and improve the recording of these schemes in the System of National Accounts (SNA), the Committee on Monetary, Financial and Balance of Payments Statistics (CMFB) agreed, in 2006, to establish a Eurostat/ECB Task Force on the statistical measurement of the assets and liabilities of pension schemes in general government. This Task Force made significant input to the SNA update process for pensions, notably through the design and compilation of a *supplementary table on pension schemes* in social insurance in the 2008 SNA and also in the European System of Accounts (ESA 2010) as adopted by the Commission.

Pension entitlements were already partly recorded in the 1993 SNA. However, the 1993 SNA did not recognise pension entitlements of defined benefit (unfunded) pension schemes as assets of households and as liabilities of such schemes. The ESA 95 treated defined benefits pension schemes in the same way.<sup>1</sup> The 2008 SNA and the ESA 2010 as the new statistical standards provide detailed guidelines for compiling supplementary data on pension entitlements under defined benefit schemes. They cover schemes managed by non-general government units and schemes managed by the general government and also social security schemes.<sup>2</sup> According to these standards, pension entitlements of households (and pension obligations of the schemes) are recorded in national accounts (NA).<sup>3</sup> However, the new international standards define a set of rules which provide compilers with guidance on when to include pension schemes in the core system of accounts and when to

---

<sup>1</sup> According to ESA 95, 'provisions or similar funds constituted by employers to provide employees with pensions (non-autonomous pension funds) are only included in the category insurance technical reserves if they are calculated according to actuarial criteria similar to those used by insurance corporations and autonomous pension funds' (see ESA95, paragraph 5.101).

<sup>2</sup> For a description of the recent steps taken to reform the SNA, see Mink (2007), p. 203 et seq. For a short explanation of the reasons to change the SNA, see Mink and Rother (2007), Semeraro (2007) or Dippelsman (2010).

<sup>3</sup> According to the SNA 2008, paragraph 11.107: 'pension entitlements show the extent of financial claims both existing and future pensioners hold against either their employer or a fund designated by the employer to pay pensions earned as part of a compensation agreement between the employer and employee.'

include the outstanding amounts of pension entitlements only in the supplementary table on pension schemes in social insurance<sup>4</sup>.

The supplementary table records all positions and flows in pension obligations of all pension schemes in social insurance. This new table provides a complete and consistent coverage of all pension entitlements and obligations across countries.<sup>5</sup> It shows all positions and flows of pension obligations of pension schemes in an economy and (as a counterpart) the corresponding pension entitlements as held by households.

In the context of the ESA 2010, it may be mandatory in the coming years for EU countries to record a full set of position and flow data on pension obligations of all pension schemes including the schemes managed by general government for its own employers and social security pension schemes.

In 2007, the Eurostat/ECB Task Force on the statistical measurement of the assets and liabilities of pension schemes in general government had started to model and estimate position and flow data for defined benefit schemes for general government employees and for social security pension schemes. First benchmark estimations of pension entitlements were made based on harmonised assumptions for 19 EU countries. In March 2008, this work was taken over by the Eurostat/ECB Contact Group on Pensions.<sup>6</sup>

To compile position and flow data for government pension schemes source data may be made available from government entities and also from supervisory agencies. Such data are usually the basis to carry out actuarial estimates for defined benefit schemes for government employees and for social security pension schemes. Actuarial estimates are broadly applied in the insurance and pension fund business.

This Technical Compilation Guide for Pension Data in National Accounts (the Technical Compilation Guide) helps countries compile pension entitlements and obligations to be included in the supplementary table as described above. The Technical Compilation Guide covers:

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<sup>4</sup> The supplementary table on pensions in social insurance is described in Chapter 17 of the 2008 SNA and in Chapter 17 of the ESA 2010 (Annex A). It is also part of the ESA 2010 Transmission Programme (Annex B, Table 29).

<sup>5</sup> The data reported on pension entitlements based on the 1993 SNA and the ESA 93 show considerable differences in the accounts from country to country due to the institutional variety in pension schemes. While pension entitlements and obligations of government-managed defined benefit schemes for general government employees and of social security pension schemes (like in France, Germany or Italy) were not recorded as positions in the national accounts, pension entitlements and obligations in countries with mainly defined contribution schemes were covered as assets and liabilities in the national accounts.

<sup>6</sup> For an overview on the recent work of the Task Force and of the Contact Group see Task Force (2008) and Contact Group (2009).



- the main methodological concepts to be applied to estimate pension entitlements and obligations (Section 2);
- the definition and classification of pension schemes covered in the supplementary table (Section 3);
- the design and use of the supplementary table (Section 4);
- the core assumptions to estimate pension entitlements and obligations (Section 5);
- the data sources for compiling and estimating pension entitlements and obligations (Section 6);
- the approach to estimate defined benefit pension entitlements and obligations (Section 7); and
- examples illustrating how to fill in the supplementary table (Section 8).

**Estimating pension  
entitlements and obligations in  
national accounts**

2

## 2 Estimating pension entitlements and obligations in national accounts

### 2.1 Concepts of pension entitlements and obligations

Pension entitlements of households can be recorded either as financial assets in the national accounts or as contingent assets. Those treated as financial assets constitute financial claims that beneficiaries have vis-à-vis either their employer or a pension manager designated by the employer to pay pension benefits earned as part of a compensation agreement concluded between the employer and the employee. Those treated as contingent assets usually represent 'conditional claims' on defined benefit schemes managed by general government, including social security pension schemes. As counterparts, they are recorded as contingent liabilities of the government.

The aim of the supplementary table is to give an overview of pension obligations (of general government but also of other institutional sectors) vis-à-vis households covering all pension schemes in social insurance. The figures in the supplementary table present the perspective of the debtor (the pension scheme) indicating pension obligations (either liabilities or contingent liabilities) as well as that of the creditor (households) showing pension entitlements (either assets or contingent assets). In the supplementary table, the positions and flows of the pension obligations always correspond to the positions and flows of pension entitlements.<sup>7</sup>

**Table 1: Concepts of pension obligations**

Time horizon	Gross liabilities (incl. expenditures)	Net liabilities (incl. expenditures & revenues)
infinite	Accrued-to-date liabilities (ADL)  Current workers' and pensioner's liabilities (CWL)  Open-system gross liabilities (OSGL)	Open-system net liabilities (OSNL)

<sup>7</sup> When the text refers to positions or flows of pension obligations, it corresponds to positions or flows of pension entitlements and vice versa.

Pension obligations or pension entitlements in national accounts always refer to a gross concept. It means that these obligations or entitlements are not netted against expected revenue of government or expected social contributions of households. In the case of defined contribution pension schemes or social security pension schemes, no future revenue or future social contributions are taken into account to compile any type of net pension entitlements or pension obligations (see Box 1). Only pension entitlements or obligations are considered. They are based on (actual and future) pension benefits.

### Box 1

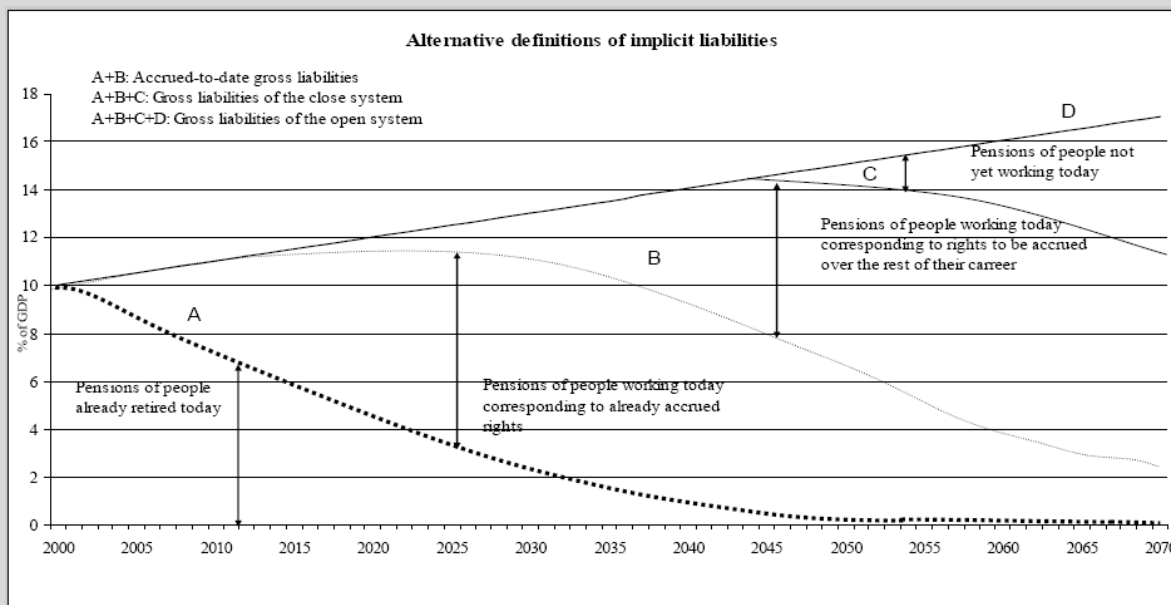
#### Three concepts of pension obligations

In recent literature (see Franco, 1995, pg. 2) three main concepts of pension obligations have been introduced: the concepts of (a) *accrued-to-date liabilities (ADL)*; (b) *current workers and pensioners liabilities*; and (c) *open-system liabilities*. Box 1 gives a detailed description of these concepts. All pension obligations of pension schemes or pension entitlements of households are assessed as part of extended balance sheets of pension schemes or households in the national accounts (showing assets and contingent assets or liabilities and contingent liabilities) at a certain point in time, usually at the year-end. The pension entitlements or obligations under defined benefit (unfunded) social insurance pension schemes are recorded in gross terms, meaning that no accrued-to-date obligations reflecting future social contributions to finance the pension entitlements are taken into account; instead only the accrued-to-date pension entitlements for current and future pension benefits (ADL) are covered, i.e. the pension entitlements accrued by current workers (including deferred pension entitlements) and the remaining pension entitlements of existing pensioners. As for all national accounts data, the data are measured ex post, as they include only the current values of the entitlements that arise from already accrued pension rights. The method is based on observable past events and transactions, such as membership of the pension scheme and contributions paid. However, these ex post measures also rely on some assumptions in the modelling process. The probability that current contributors may die or become disabled before reaching pensionable age needs to be estimated. The approach also covers future changes to the (defined) pension benefits owing to any legislation enacted prior to the year for which pension entitlements are calculated. Finally, the method requires assumptions about future developments, notably the development of the discount rate for future pension disbursements. As with all other assets, the pension entitlements are entered into the extended household balance sheet at their value on the balance sheet date. Since actuarial values for pension entitlements or obligations related to defined benefit (unfunded) pension schemes in social insurance in the EU countries are typically not made available by the manager of the pension scheme, compilers of national accounts have to estimate the actuarial value.

- a) *Accrued-to-date liabilities (ADL)*: These pension entitlements or obligations contain the present value of pensions to be paid in the future on the basis of accrued rights. Accrued pension rights are due to already paid social contributions by current workers and remaining pension entitlements of existing pensioners. No rights accrued after the current year — by present or by future workers — are considered. The time horizon of this concept is, therefore, somewhat limited. As shown in Figure 1 ADL covers only integral amounts below curve B (also taking a discount rate into consideration).
- b) *Current workers' and pensioners' liabilities (CWL)*: For CWL, allowance is made for the pension scheme to continue until the last current contributor dies. However, new entrants are not included. This concept covers ADL and the present value of pension entitlements that will be accrued by current contributors due to their future contributions. CWL corresponds to the integral amounts below curve C (considering additionally a discount rate) in Figure 1.

- c) *Open-system liabilities (OSL)*: In addition to CWL, this liability concept also includes the present value of pensions of new workers entering the respective pension scheme. It is assumed that the pension scheme will be continued under current rules for a relatively long time horizon. The present value of OSL may be compiled over an infinite time horizon. For practical reasons, however, a perspective, e.g. 200 years, is usually chosen.

**Figure 1**  
**Alternative definitions of implicit liabilities**



Source: European Commission Public Finance Report 2006.

Applying one of the three liability concepts depends on the specific purpose of the analysis. To assess the fiscal sustainability of a defined benefit (unfunded) pension scheme managed by government for its employees, for example, it is natural to apply the widest possible time horizon. This means using the OSL concept to examine long-term fiscal sustainability. By contrast, policy issues concerning the possible termination of an existing defined benefit pension scheme should be addressed on the basis of the ADL or the CWL concept, depending on the remaining time horizon of the scheme taking also into consideration that only the ADL concept complies fully with the methodology used in national accounts.

In line with some other valuation procedures used for financial instruments like unlisted shares or other equity, for which market values are not or not always available, the compilation of ADL is based on a net present value approach. In fact, estimating position and flow data for defined benefit pension schemes for government employees and for social security pension schemes to fill in the corresponding cells of the supplementary table involves projecting historical data into the future. For this purpose, actuarial estimates have to be carried out as described in further detail in Chapter 5 and Chapter 7. This method is commonly used in the insurance and pension fund sector, where actuarial figures are estimated on a frequent and standardised basis. Source data for the general government sector, however, are often limited to annual cash reporting. Moreover, actuarial estimations are not widely used there at present.

These actuarial calculations require a number of careful assumptions to be made. They include assumptions about future life expectancy, which determine the payout period of future pensions. In particular, assumptions on future wage growth and on an appropriate discount rate play a crucial role in projecting pension entitlements or obligations accrued-to-date.<sup>8</sup>

It is important to stress that pension entitlements (derived as accrued-to-date and applied in national accounts) do not allow any conclusions to be drawn as to the fiscal sustainability of a pension scheme. Large pension entitlements do not necessarily mean unsustainable pension schemes, and by the same token small pension entitlements do not mean that the respective pension schemes are fiscally stable in the long term (for a detailed discussion see Box 2).

### Box 2

#### Pension entitlements are not sustainability indicators

Measures of pension entitlements accrued-to-date are the appropriate data to be reported in the system of national accounts. In this respect, they are useful for economic and policy analyses. They provide an estimate of the cost of a hypothetical termination of a pension scheme without reneging on accrued entitlements. As measures of household wealth (assets and contingent assets), they are also valuable statistical information to understand positions and flows in household wealth also in relation to saving and consumption. Furthermore, ADL help in assessing pension reforms of various kinds, such as establishing a new system for new contributors or new contributors, while maintaining the current system for already accrued entitlements.

Pension entitlements accrued-to-date are not an appropriate indicator of fiscal sustainability. They can be interpreted as the amount of resources which has to be set aside today in order to finance all pension rights which have been earned up to a given year. Entitlements that will accrue after that year are not included. In contrast to other liability concepts such as OSL, therefore, the time horizon of ADL is somewhat limited. As illustrated in Figure 2 for the German statutory pension scheme, the ADL represent only one part of the OSL. Moreover, the ADL are compiled gross without including the net present value of future social contributions. To assess fiscal sustainability it is vital to compare (future) pension obligations with the corresponding future pension-related assets.

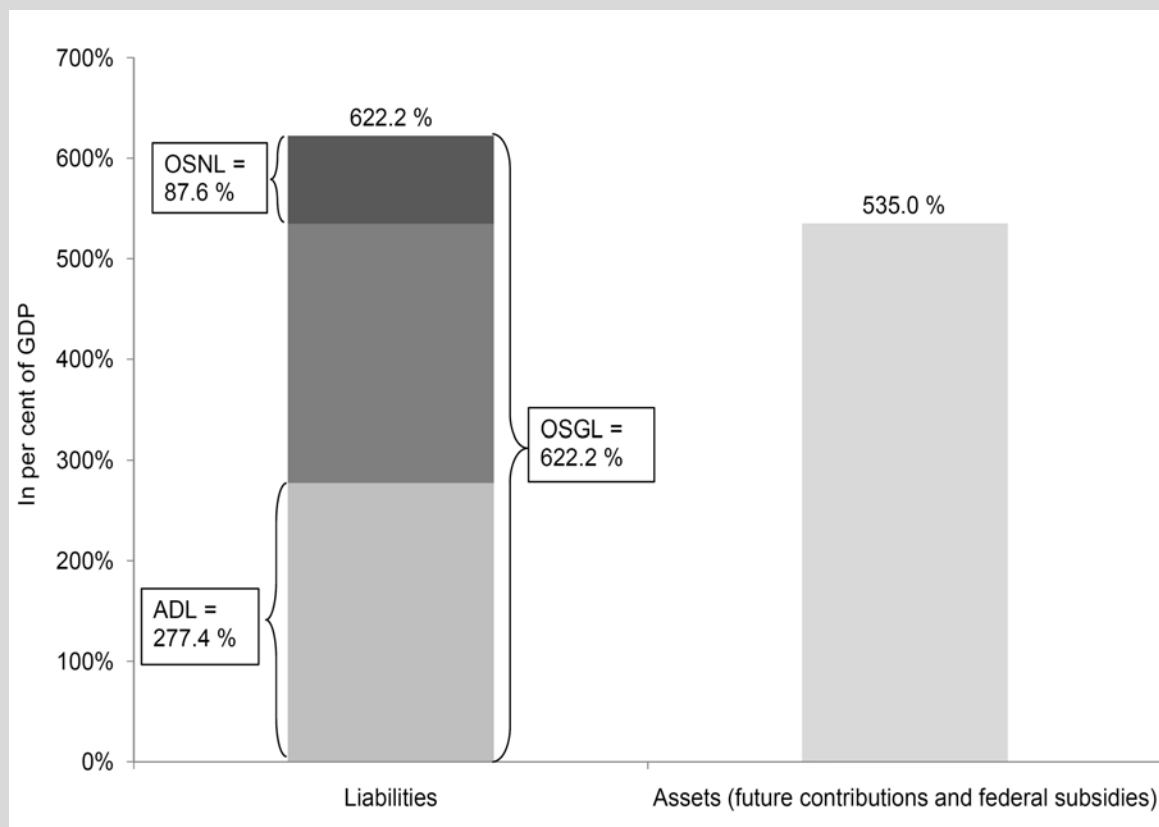
Figure 2 outlines the difference between ADL and sustainability indicators for the German statutory pension scheme. It shows that a considerable amount of ADL (equivalent to about 280% of GDP in 2006) is accumulated in this scheme. If future entitlements are also considered — applying the open system gross liability concept (OSGL) — pension obligations add up to more than 600 percent of GDP. However, it is only possible to draw conclusions about the sustainability of a pension scheme by comparing these pension obligations with the respective assets. The resulting residual amount of obligations and assets represents the open-system net liabilities (OSNL), also known as the sustainability or fiscal gap. In contrast to the ADL, it represents the stock which has to be set aside today to sustain the present pension system (in its legal status quo) in the long term. While the ADL only take into account a fraction of the future demographic development, namely the change in the number of retirees, the OSNL consider the long-term development of the overall population. Figure 2 also illustrates that the ADL estimates can indeed be extended to measure open system gross and net liabilities, provided that a longer time horizon

<sup>8</sup> The assumptions of the actuarial approach are outlined in detail in Section 5.

is used and the corresponding assets are included.<sup>9</sup>

**Figure 2**

**Accrued-to-date liabilities and related sustainability indicators**



Source: Müller et. al. (2010), p. 117.

## 2.2 Projected and accumulated benefit obligations

When estimating the ADL, one of the following two approaches may be applied: either the *projected benefit obligations approach (PBO)* or the *accumulated benefit obligations approach (ABO)*. The main difference between these two compilation methods refers to the treatment of future wage increases. In the case of the PBO approach, (expected) future increases in income — either through promotions or through a general increase of wages — are taken fully into account. The ABO approach, on the other hand, considers only the present value of benefits earned to date. Future wage increases are not taken into account.

The choice between the two concepts may have a significant impact on the level of pension entitlements. Results are usually by 10 to 20% higher when applying PBO instead of ABO.<sup>10</sup>

<sup>9</sup> For a description of extending the ADL approach, see Müller et al. (2010).

<sup>10</sup> Of course, this differential depends to a large degree on the promotions during working life, i.e. it depends on the progression of the age-specific wage profile — shown exemplarily in figure 8. The higher promotions are

Therefore, clear guidelines have to be applied which of the two approaches should be chosen to ensure comparability of results across pension schemes and also across EU countries.

Each method has its advantages and disadvantages. The probability of a termination or of a freezing of the respective pension scheme (before the end of a worker's career) should determine which method to apply. If the pension scheme is likely to exist until the end of a worker's career, his or her future wage growth needs to be taken into account, applying the PBO method. This approach is often recommended for pension schemes established for government employees.<sup>11</sup> The International Public Sector Accounting Standards (IPSAS25) also recommend applying the PBO approach to measure pension obligations of defined benefit plans.<sup>12</sup> Business accounting standards, in particular the International Accounting Standards 19 (IAS 19), also recommend the PBO approach. For social security pension schemes, the PBO approach seems the appropriate valuation method, since, in normal circumstances, an early termination of these schemes is not expected.

Furthermore, the PBO approach is a more suitable way of reflecting certain pension reforms. While an extension of the contribution periods relevant for the benefit formula (e.g. from best 25 income years to lifetime earnings), for example, may have no effect in the case of the ABO approach, it can change the entitlements when the PBO approach is applied. The PBO approach is also the most appropriate method to take into account the different indexation rules of pension schemes.

In conclusion, most arguments are in favour of the PBO approach rather than the ABO approach to estimate pension obligations of pension schemes managed by general government. This method has already been used in most countries which have already estimated corresponding pension obligations.<sup>13</sup>

To maintain consistency across pension schemes it is recommended to apply the ***PBO approach for the estimation of pension obligations of defined benefit schemes for government employees and of social security pension schemes. However, the ABO may be applied if there are good reasons to do so.***<sup>14</sup>

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expected, i.e. the steeper the wage profile the more significant is the difference between ABO and PBO outcomes.

<sup>11</sup> See Reinsdorf (2010), p. 190 et seq.

<sup>12</sup> In fact, the IPSAS25 requires an entity to use the Projected Unit Credit Method, which is equivalent to the PBO approach.

<sup>13</sup> See Contact Group (2009), p. 10f. Only Sweden applies the ABO approach for its calculations.

<sup>14</sup> Some actuarial estimates provided by external institutions may apply only an ABO approach. It is feasible to use such figures to compile pension entitlements if no PBO estimations are available.



In practice, various modifications of the PBO approach are applied, depending on how indexation effects are taken into account. These are the PBO approach with:

- 1) no future indexation of pensions;
- 2) price indexation;
- 3) wage indexation;
- 4) pensions indexed in accordance with indexation rules.<sup>15</sup>

To estimate defined benefit pension obligations, the PBO approach as described under 4) should be applied. This would allow country-specific differences in indexation policies to be reflected in the estimations.

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<sup>15</sup> For a description of indexation rules, see Chapter 7.3.

**Pension schemes in social insurance covered by the supplementary table**

**3**

## 3 Pension schemes in social insurance covered by the supplementary table

The supplementary table on pension schemes in social insurance as reflected in the 2008 SNA and in the ESA 2010 covers positions and flows of pension obligations in all pension schemes regarded as social insurance. In order to complete this table, the various types of pension schemes (in the columns of the table) must be distinguished and the positions and flows in pension obligations (in the rows of the table) defined. In addition the concepts of pension benefits and other social benefits, of social insurance social assistance and individual insurance policies have to be distinguished.<sup>16</sup>

### 3.1 Pension benefits and non-pension benefits

In the 2008 SNA and in the ESA 2010 social insurance benefits (and the corresponding contributions) are divided between those related to pensions (pension benefits) and those related to all other forms of benefit.<sup>17</sup> All other benefits are grouped together as non-pension benefits.

#### Box 3

##### Pension benefits

Pension benefits are predominantly old-age pensions. However, survivors' pensions — consisting of widows' and orphans' pension benefits — and disability and early retirement pensions also fall under the term pension benefits.

Pensions are generally disbursed in the form of a guaranteed annuity<sup>18</sup> and received under predetermined legal or contractual terms. It is important to stress that, in the supplementary table, pension benefits are recorded in gross terms, i.e. there are no deductions made for taxes, social contributions or any service charge associated with the respective pension scheme.

Only pension benefits (and the corresponding contributions) are covered by the supplementary table. A definition of the term pension is given in Box 3. The distinction between pension benefits and non-pension benefits is important since the 2008 SNA recognises liabilities for pensions whether there are actually assets set aside to meet the entitlements or not, but recognises reserves for non-pension benefits only when these actually exist.<sup>19</sup>

<sup>16</sup> This chapter follows closely Chapter 17 of the ESA 2010 and Chapter 17 of the 2008 SNA.

<sup>17</sup> See 2008 SNA, paragraph 17.98.

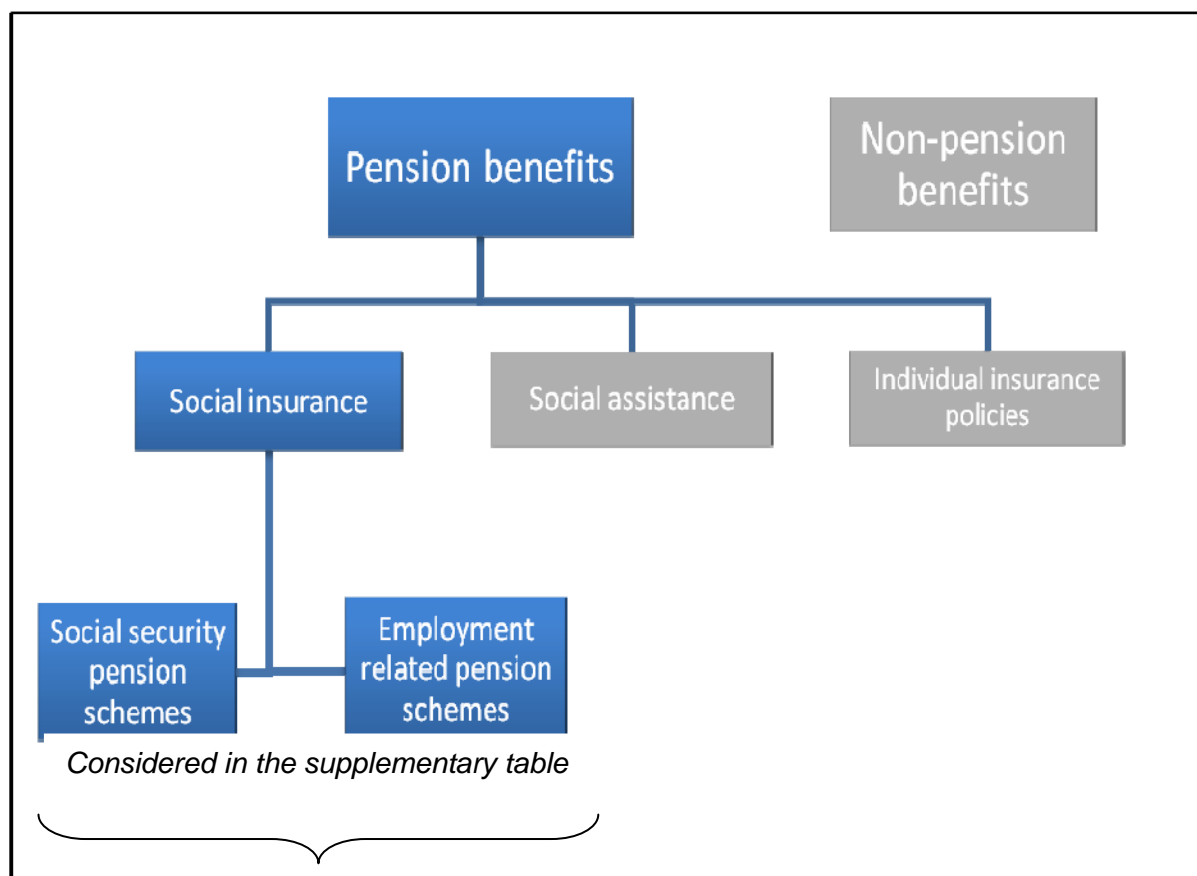
<sup>18</sup> For a definition of annuities, see 2008SNA, paragraphs 17.66-17.75.

<sup>19</sup> See 2008 SNA, paragraph 17.99.

## 3.2 Social insurance, social assistance and individual insurance policies

Pensions can be provided to beneficiaries in the form of (i) social insurance pension schemes; (ii) social assistance; and (iii) individual insurance policies related to pensions (see Figure 3).

**Figure 3**  
**Social insurance, social assistance and individual insurance policies**



**Social insurance** is the predominant form of pension scheme in EU countries, covering social security pension schemes (classified as belonging to the general government sector) which, in many cases, are organized for major parts of the population, and employment-related pension schemes established by employers, including government, for their own employees. The distinction between social security schemes and employment-related schemes varies considerably from country to country, with the consequence that the coverage and, therefore, the national perception of what the term “social security” means also vary considerably, especially between European and non-European countries.

Figure 4

## Characteristics of social insurance

Characteristics	Social insurance			
	The beneficiary is obliged or encouraged to take out insurance against contingencies (old age, unemployment, illness, long-term care) by intervention of a third party.			
	Social security		Employment-related social insurance	
Form of organisation	Organised by general government via social security schemes		Organised by employers on behalf of their employees and their dependants or by others on behalf of a specified group	
Type of social insurance	Social security pension schemes	Other social security	Employment-related pension schemes	Other employment-related social insurance
Sector	Social security funds		Sector or sub-sector of employer, or pension funds	

In contrast to social insurance benefits, **social assistance benefits** are payable without qualifying contributions having been made to a social insurance scheme. Usually all resident households are entitled to apply for social assistance but the conditions under which it is granted are often restrictive. Generally, benefits are means-tested, including an assessment of available income and property. Only those households falling below a given income/property threshold may be granted this type of social assistance.

Sometimes it may not be feasible (or not sufficiently important) to separate elements of social assistance within pension schemes organised as social insurance. In these exceptional cases, social assistance benefits are included in the supplementary table.

**Individual insurance policies related to pensions** are policies that beneficiaries take out in their own names without being members of a scheme organized collectively for groups of employees, as in the case of social insurance. They are based on contracts which are (generally) made with individuals and which are not organised collectively. These individual insurance policies are not employment related and therefore are not recorded in the supplementary table.

Employment-related social insurance pension schemes may be managed by general government or by non-government entities, and they may be funded or unfunded. Funded

schemes finance pension benefits by drawing down segregated and earmarked assets. Their design requires them to hold assets equal to their liabilities. These schemes can be exactly funded, under-funded or over-funded, depending on the size of the accumulated assets in relation to the pension entitlements. Unfunded schemes finance current pension payments with the ongoing contributions paid by future pensioners and/or other ongoing revenue, such as taxes or transfers; unfunded schemes may nevertheless hold assets (for liquidity reasons, for example, or as buffer funds).

**The supplementary table covers social insurance-type pension schemes** but not schemes based on social assistance-type benefits and private savings benefits. To draw a clear line between these different types of schemes, the following definitions are essential:

(i) **Social insurance** refers to a contractual insurance scheme where the beneficiaries are obliged or encouraged to insure against certain contingencies by the intervention of a third party. According to 2008 SNA a **social insurance scheme must fulfil the following two conditions:**

- a) The benefits received are conditional on participation in the scheme and constitute social benefits as this term is used in the 2008 SNA.
- b) At least one of the three following conditions is met:
  - Participation in the scheme is obligatory either by law or under the terms and conditions of employment of an employee, or group of employees.
  - It is a collective scheme operated for the benefit of a designated group of workers, whether employed or non-employed, participation being restricted to members of that group.
  - An employer makes a contribution (actual or imputed) to the scheme on behalf of an employee, regardless of whether the employee contributes.

Social insurance pensions are broken down into benefits provided by general government — so-called social security pensions — and pensions provided by employers, namely employment-related pensions (other than social security pensions). This distinction is applied in the supplementary table for government-managed pension schemes.

- **Social security pension schemes** are contractual insurance schemes where the beneficiaries, as participants of a social insurance scheme, are obliged or encouraged by government to insure against old age, unemployment and so forth. Social security pensions are provided to beneficiaries by general government.

Contributions towards a social security pension scheme are often compulsory for a large part of the population. Furthermore, social security pension schemes are generally defined benefit schemes which means that they are unfunded and are financed on a pay-as-you-go basis.

The narrowest form of a social security pension is very basic. The level may be fixed independently of the size of contributions. Such flat-rate pension schemes are found in Ireland and the Netherlands. Most countries in Europe have earnings-related social security pension schemes, e.g. Germany and France. In these systems, the level of future pensions depends on the earnings history of contributors.

No pension entitlements for social security pension schemes are recognised in the core system of national accounts. They are only displayed in the supplementary table described in Section 4.

- ***Employment-related pension schemes***, other than the most basic form of social security pension schemes, are seen as part of the compensation package for employees. Negotiations between employees and employers may focus on pension entitlements as much as on current conditions of service and pay scales.

The relative importance of social security pension schemes relative to other social insurance schemes varies quite considerably across Europe. In some countries, such as Malta and France, almost all pension obligations accruing to employees of corporations and other legal entities may be rerouted through social security pension schemes. Other countries, such as the Netherlands and the United Kingdom, restrict their social security pension schemes mainly to the provision of basic pensions based on the dominant *employment-related pension schemes*. Social insurance contributions — paid by employees or by employers vis their employees — entitle designated beneficiaries to receive social benefits (covered by the respective scheme).

Most positions in pension obligations of employment-related pension schemes are recorded in the core system of national accounts and in the supplementary table. For government employee pension schemes, however, the classification is not so straightforward. Based on a convention, **positions in pension obligations of defined benefit pension schemes for government employees in EU countries are to be recorded in the supplementary table only**. See Section 3.4 for a detailed description of the division between core and non-core accounts.

### 3.3 Defined contribution, defined benefit and other pension schemes

The supplementary table distinguishes between two types of pension schemes:

- *defined contribution schemes* (columns A and D); and
- *defined benefit schemes* (columns B, E, F and G).

In a **defined contribution (DC)** scheme, the level of eventual pension benefits is exclusively determined by contributions over the employee's working life and the return on funds invested. Defined contribution schemes are always organised in the form of a pension fund.<sup>20</sup>

The risk that an adequate retirement income may not be forthcoming is borne solely by the employees. An underfunded defined contribution scheme is impossible by definition. Measuring pension obligations of defined contribution schemes is relatively straightforward; their development is determined by the development of the assets attributed to the fund.

**Defined benefit (DB)** schemes, on the contrary, are pension schemes in which the pension benefits are determined by the use of a formula, either independently or in combination with a guaranteed minimum amount payable. Generally, the factors considered to estimate the defined benefits are the years of service, the salary over a defined period of time, the age at retirement and the indexation rule.

Unlike in a defined contribution scheme, the manager<sup>21</sup> of the pension scheme bears the risk of providing an adequate pension in defined benefit schemes. Defined benefit schemes can be, but are not necessarily, based on a pension fund. Social security pension schemes are usually designed as defined benefit schemes which are unfunded and arranged as pay-as-you-go arrangements. Therefore, pension entitlements need to be estimated using actuarial methods, which are described in detail in Section 5 to Section 8.

**Other non-defined contribution schemes** are recorded together with defined benefit schemes in the supplementary table; they are often described as hybrid schemes in that they combine the characteristics of defined contribution schemes and defined benefit schemes. In these schemes, the risk of providing an adequate retirement income is shared between the pension manager and the beneficiary of the scheme. The most important forms of such hybrid schemes are notional defined contribution (NDC) schemes, which are similar to

<sup>20</sup> A pension fund can be defined as a pool of assets that is used to pay pension benefits. It can be contrasted with the term 'pension scheme' which represents a bundle of rules for paying out pensions.

<sup>21</sup> For a definition of the term *manager* see below.



defined contribution schemes but, usually, include a guaranteed minimum amount payable. In notional defined contribution schemes, contributions (from both, employees and employers) are credited to, and accumulated on, individual accounts. These individual accounts are notional in the sense that the contributions to the schemes are used to pay pension benefits to current pensioners.

### 3.4 Core and non-core accounts

The supplementary table on pensions in social insurance distinguishes between pension schemes whose positions are recorded in the core system of national accounts (and in the supplementary table) and those recorded only in the supplementary table. There is essentially one type of pension scheme, namely social security pension schemes, recorded only in the supplementary table. For EU countries however, by convention, all defined benefit schemes for general government employees are also recorded only in the supplementary table. Positions and flows of these two types of pension schemes are recorded in columns G and H of the supplementary table.

### 3.5 Pension manager, multi-employer pension scheme and pension administrator

The supplementary table classifies pension schemes according to the sector classification of the manager<sup>22</sup> of the pension scheme. A **pension manager** is mandated by the employer to manage the pension scheme. He is responsible for setting the terms of an employment-related pension scheme and bears the ultimate responsibility for pension entitlements. The pension manager also has a significant degree of responsibility for the long-term policy of investment in assets, including the selection of an investment strategy and the structure of administrative providers.

A single unit may often contract with several employers to manage their pension schemes. This unit is called a **multi-employer pension scheme**. As a pension manager, it bears the responsibility for any shortfall in the funds to meet the entitlements in return for the right to keep any excess funds. By pooling the risks of various employers, the multi-employer pension scheme expects to balance under- and over-funding and run a surplus in the schemes taken as a whole. This resembles the way in which an insurance corporation pools risk for many clients.

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<sup>22</sup> Please note that the term 'manager' is used synonymously for the word 'sponsor' which has been frequently used in recent years.

When general government takes responsibility for providing benefits to large sections of the society, the social security function fills the role of a multi-employer scheme. Like the insurance corporation, the government then takes on the responsibility for any shortfall in funds to meet the pension obligations, and may be entitled to retain any surplus generated. As social security pension schemes are financed on a pay-as-you-go basis there is usually no surplus or deficit; if there is a shortfall of the scheme, government may have the power to adjust pension obligations not only in relation to future employment but also to past employment.

Besides the pension manager, the employer may also appoint a **pension administrator** responsible for the day-to-day administration of the pension scheme. The pension administrator, however, does not take any responsibility for a shortfall of the scheme or the benefit of any surplus. The same unit may in practice carry out both functions of pension manager and pension administrator.

**Columns and rows in the  
supplementary table**

**4**

## 4 Columns and rows in the supplementary table

The supplementary table on pensions in social insurance (see overleaf) provides a complete and comparable overview of pension obligations from the debtor (pension scheme) perspective and also (as a counterpart) of pension entitlements from the creditor (household) perspective. In Europe, entitlements of defined benefit pension schemes represent a significant share of overall pension entitlements. Thus far figures on positions for specific government-managed pension schemes have not been compiled and included in the system of national accounts. The supplementary table (see Figure 5) bridges this information gap by showing all positions and flows of all pension schemes in social insurance including government-managed defined benefit schemes for government employees and social security pension schemes. This chapter describes in detail the columns (Section 4.1) and rows (Section 4.2) in the table. The outline follows closely Chapter 17 of the ESA 2010.

**Figure 5**  
**The supplementary table on pension schemes in social insurance**

Relations	Row No.	Core national accounts							Not in the core national accounts		Total pension schemes	Counterparts: Pension entitlements of non-resident households <sup>4)</sup>	
		Recording		Non-general government			General government						
		Pension manager		Defined contribution schemes	Defined benefit schemes and other <sup>1)</sup> non-defined contribution schemes	Total	Defined contribution schemes	Defined benefit schemes for general government employees <sup>2)</sup>					Social security pension schemes
								Classified in financial corporations	Classified in general govt 3)	Classified in general government			
Column number		A	B	C	D	E	F	G	H	I	J		
<b>Opening balance sheet</b>													
	1	Pension entitlements											
<b>Changes in pension entitlements due to transactions</b>													
$\Sigma$ 2.1 to 2.5	2	Increase in pension entitlements due to social contributions											
	2.1	Employer actual social contributions											
	2.2	Employer imputed social contributions											
	2.3	Household actual social contributions											
	2.4	Household social contribution supplements <sup>5)</sup>											
	2.5	Less: Pension scheme service charges											
	3	Other (actuarial) change of pension entitlements in social security pension schemes											
	4	Reduction in pension entitlements due to payment of pension benefits											
2 + 3 - 4	5	Changes in pension entitlements due to social contributions and pension benefits											
	6	Transfers of pension entitlements between schemes											
	7	Change in entitlements due to negotiated changes in scheme structure											
<b>Changes in pension entitlements due to other flows</b>													
	8	Changes in entitlements due to revaluations <sup>6)</sup>											
	9	Changes in entitlements due to other changes in volume <sup>6)</sup>											
<b>Closing balance sheet</b>													
1+ $\Sigma$ 5 to 9	10	Pension entitlements											
<b>Related indicators</b>													
	11	Output											

1) Such other non-defined contribution schemes, often described as hybrid schemes, have both a defined benefit and a defined contribution element. 2) Schemes organised by general government for its current and former employees. 3) These are non-autonomous defined benefit schemes whose pension entitlements are recorded in the core national accounts. 4) Counterpart data for non-resident households will only be shown separately when pension relationships with the rest of the world are significant. 5) These supplements represent the return on members' claims on pension schemes, both through investment income on defined contribution schemes' assets and for defined benefit schemes through the unwinding of the discount rate applied. 6) A more detailed split of these positions has to be provided for columns G and H based on the model calculations carried out for these schemes. The cells shown as ■ are not applicable; the cells in ■ will contain different data from the core national accounts.

## 4.1 Columns of the supplementary table

Relations	Row No.	Recording	Core national accounts						Not in the core national accounts		Total pension schemes	Counterparts: Pension entitlements of non-resident households <sup>4)</sup>
		Pension manager	Non-general government			General government						
			Defined contribution schemes	Defined benefit schemes and other <sup>1)</sup> non-defined contribution schemes	Total	Defined contribution schemes	Defined benefit schemes for general government employees <sup>2)</sup>		Classified in general government	Social security pension schemes		
Column number	A	B	C	D	E	F	G	H	I	J		
						Classified in financial corporations	Classified in general govt 3)					

Pension schemes are recorded in different categories as shown in the columns of the supplementary table. The table distinguishes pension schemes by four criteria:

- by type of recording: positions and flows of pension schemes recorded in the core accounts (pension schemes in columns A to F), and positions of pension schemes recorded only in the supplementary table (pension schemes in columns G and H);
- by type of pension manager: non-general government (columns A to C), and general government pension schemes (columns D to H);
- by institutional sector: pension schemes classified in non-government sectors (columns A to E), and pension schemes including social security pension schemes classified in the general government sector (columns F, G and H);
- by type of pension scheme: defined contribution schemes<sup>23</sup> (columns A and D), and defined benefit schemes including other non-defined contribution schemes (columns B and E to G).

For further explanations of the terms used above, see Chapter 3.

Column I sums up all pension entitlements acquired or held by resident households. Generally, the beneficiaries of pension schemes are predominantly resident households. In some countries, however, the number of non-resident households receiving pension benefits may be considerable. In this case, Column J should be filled in and added indicating the positions and flows of pension entitlements of non-resident households.

<sup>23</sup> In defined contribution schemes, assets should always be equal to equal to liabilities. The figures in Columns A and D are therefore always based on actual data and not on necessarily on actuarial estimations.

## 4.2 Rows in the supplementary table

The rows in the supplementary table contain a full reconciliation between the opening stock of pension obligations (entitlements) at the beginning of a period and the closing stock at the end of a period. Within this framework, all transactions and other economic flows which lead to changes in the opening and the closing stock within a given period are taken into account.

### i. *Pension obligations (entitlements)* — rows 1 and 10

**Row 1** illustrates the opening stock of pension obligations (entitlements), which is identical with the closing stock of the previous year. The corresponding closing stock of pension obligations (entitlements) at the end of the relevant period is given in **row 10**.

### ii. *Social contributions* — rows 2.1 to 2.4

Employer and employee actual social contributions are recorded in rows 2.1 and 2.3. Note that all actual social contributions are recorded in the core accounts. For some pension schemes (notably for social security pension schemes), actual social contributions related to pensions need to be separated from social contributions related to other social risks (such as unemployment).

In Columns H and G, the actual social contributions made by both employers (row 2.1) and employees (row 2.3) appear in the core accounts, while all other entries in these columns (G and H) are shown only in the supplementary table (except row 4); they are shaded grey in the table and are explained below.

For defined benefit pension schemes, employer-imputed social contributions are generally measured as the balancing item. Any changes in pension entitlements over the year not included in the other rows of the table are captured by **row 2.2**.

Row 2.2 also covers any ‘experience effects’ where the observed outcome of pension modelling assumptions (real wage growth rate, discount rate, etc.) differs from the levels assumed. It should be noted that, for social security pension schemes, such ‘experience effects’ are not recorded in row 2.2 but in row 3. By definition, there are no entries in this row for defined contribution schemes. Row 2.2 is therefore shaded black for these schemes.

The imputed social contributions by employers to government schemes (column G) require special consideration. In the non-core accounts, imputed contributions are to be estimated on the basis of actuarial calculations. Only in cases where the actuarial calculations are not sufficiently reliable may two other approaches be applied to estimate government employers' imputed pension contributions:

- i. on the basis of a reasonable percentage of wages and salaries paid to current employees; or
- ii. as the difference between current benefits payable and actual contributions payable (by both employees and government as employer).

Items for household social contribution supplements and the other changes in entitlements are shown in the same way as for non-government pension schemes.

**Row 2.4** relates to the property income earned, or imputed, on the schemes; it is routed via the household (or the rest of the world) sector. For all defined benefit pension schemes including social security schemes, property income is equivalent to the unwinding of the discount rate, meaning that its value is equal to the discount rate times the pension entitlements at the beginning of the accounting period. An illustrative example is given in Section 8.1. For defined contribution pension schemes, row 2.4 denotes interest earned on assets, i.e. the investment income during a period. Any loss in defined contribution funds is recorded in row 9.

**iii. *Other (actuarial) changes of pension entitlements in social security pension schemes — row 3***

Given that the supplementary table provides a complete overview of the changes in pension entitlements over the accounting period, a specific row is needed to show cases where actual social contributions to the social security pension scheme are not actuarially based. Such cases reflect an imputed contribution (which is not the responsibility of any employer). Row 3 shows these imputed transactions of social security pension schemes (as other (actuarial) increases to pension entitlements in social security pension schemes).

The entries in this row can be positive or negative. Negative cases arise in a social security pension scheme when the discount rate is higher than the scheme's internal rate of return<sup>24</sup>, e.g., where contributions have been increased above the actuarially

<sup>24</sup> The internal rate of return of a pension scheme is the discount rate that equalises the actual contributions paid and the discounted value of pension entitlements accrued through those contributions.



required level to finance a short-run cash shortfall. By contrast, positive values can occur when the discount rate is lower than the scheme's internal rate of return.

Row 3 does not show cash transfers from tax revenues, which are recorded in the core accounts as current transfers between government units, unless they affect pension entitlements. In some EU countries, however, governments make transfers to pension schemes that do increase pension entitlements (for example where transfers are made for specific social groups which are unable to contribute directly), which would indicate that the amounts should be implicitly included in this row calculated by difference.

'Experience effects' found in social security pension schemes in which the observed outcome of pension modelling assumptions (real wage growth rate, discount rate, etc.) differs from the levels assumed in the previous estimation are also recorded in Row 3. For other types of pension schemes, these experience effects are recorded in Row 2.2 (employer-imputed social contributions).

**iv. *Pension benefits — Row 4***

Row 4 comprises the pension benefits that are paid during the period of time. The payment of pension benefits has the effect of 'settling' some of the pension entitlements included in the opening stock in Row 1.

**v. *Change to pension entitlements — Row 5***

Row 5 shows the changes to pension entitlements due to contributions and benefits. It is equal to Row 2 + Row 3 – Row 4. This balancing item measured in the non-financial account is conceptually equivalent to that measured in the financial account.

**vi. *Transferring pension entitlements — Row 6***

With increasing work mobility, the portability of pension entitlements from one employer to another has significantly increased in recent years. A change of jobs does not usually lead to a change in pension entitlements for the household concerned. However, there are transactions between the two pension funds as one assumes the liability of the other. First, there is a transfer of pension entitlements from the original manager to the new manager. Second, there may be a transfer in cash or other financial assets to compensate the new manager. The value of the transfer of financial assets may not be exactly equal to the value of the pension entitlements transferred. In that case, a third entry is needed (in the core accounts) in transactions (capital transfers) to correctly reflect the changes in net worth of the two units concerned.

If a government assumes responsibility for pension obligations for the employees of a non-government unit through an explicit transaction, a pension liability should be recorded in the balance sheet of the government. If the government does not receive matching assets in return, the difference between the increase in the government's liability and the assets received is shown as a capital transfer to the non-government employer.

**vii. Pension reforms — Row 7**

Due to demographic and economic developments, employers may reform the pension schemes they manage. Such reforms often take the form of parametric changes, e.g. a change of the retirement age, the indexation rules or the benefit formula. In some cases, systemic reforms can be observed, e.g. a shift from a defined benefit scheme to a defined contribution scheme. It is important to underline that not all reforms lead to a change of pension entitlements in the supplementary table.

First, only enacted pension reforms are recorded in the national accounts. They affect the estimates of pension entitlements in the year in which the reform is enacted and subsequently. An announcement by an employer of an intention to undertake a pension reform is not a sufficient basis for introducing the effects of the reform into national accounts data.

Some reforms, although formally enacted, may not have an impact on current pension entitlements. This is the case when the employer chooses to leave the rights of existing members untouched, confining the reformed arrangements to new entrants to the pension scheme. The impact of such reforms would be seen in future measures of pension entitlements, in line with the accrued-to-date liabilities concept described in Section 2.

In many cases, reform measures affect not only future entrants into the pension scheme but also existing members. An example would be a general change to the pension indexation rules that has an impact on present pensioners as well as on present and future contributors. Such reforms change the stock of pension entitlements during the period in which they are enacted. They must be accounted for as a transaction in the supplementary table. The impact of a reform may be very high if it affects current and future pension benefits — i.e. present pensioners and present contributors — since this affects the entire stock of existing entitlements.

Pension reforms are treated differently in national accounts, depending on whether they have been negotiated or whether they are imposed without negotiation.

Negotiated reforms are recorded as transactions in the following manner:

(i) If the entitlements of a pension scheme are included in the core accounts, and the employer/manager agrees to change the terms of pension entitlements via negotiation with the employees concerned, this change should be recorded as a transaction in the supplementary table under row 7;

(ii) If the entitlements of a pension scheme are not recorded in the core accounts, and the employer/manager agrees to a change in the terms of pension entitlements via negotiation with the employees concerned, this change should be recorded as a transaction in Row 7 in the supplementary table;

(iii) Changes agreed in parliament to pension entitlements under social security schemes are recorded as if the changes had been negotiated.

Changes to pension entitlements that are imposed without negotiation are recorded as other changes in the volume of assets (row 9).

#### viii. **Other flows — rows 8 and 9**

Rows 8 and 9 show other flows as revaluations and other changes in volume associated with pension schemes in social insurance. Table 2 breaks down the other flows into revaluations and other changes in volume.

**Table 2**

#### **Other flows as revaluations and other changes in the volume of assets**

<b>Revaluations:</b>
<i>Changes in assumed discount rate</i>
<i>Changes in assumed wage developments</i>
<i>Changes in assumed price developments</i>
<b>Other changes in the volume of assets:</b>
<i>Changes in demographic assumptions</i>
<i>Other changes in the volume of assets</i>

Revaluations are due to changes to the key model assumptions in the actuarial calculations and are covered in **row 8**. These assumptions are the discount rate, the wage rate and, if used in the model, the inflation rate.<sup>25</sup> Other changes in prices such as write-downs are also covered in row 8.<sup>26</sup> Experience effects are not to be included here in principle, though in some circumstances it may not be possible to single them out.

When the demographic assumptions used in the actuarial calculations are changed, they are recorded as other changes to the volume of assets (**row 9**). Any other changes to assumptions which are not revaluations are covered in row 9. This includes presumptions on future retirement behaviour. If these retirement patterns are altered in the model, the resulting changes to the outcomes are recorded in row 9. However, such changes are only covered in row 9 if they are not derived from a legislative reform.<sup>27</sup>

Besides changes to the underlying assumptions, the general framework of the actuarial model applied may also change from one year to the next to improve the accuracy of the results. Row 9 records these changes to the estimation approach which are not due to altered assumptions but result from a change in the model framework.

Row 9 also covers a number of other changes in the volume of assets. This includes changes to pension entitlements that are imposed without negotiation and defined contribution pension schemes that hold losses of pension funds.

#### ix. **Financial services — row 11**

Financial services provided by all pension schemes are recorded as being paid by scheme members (thus the costs of pension schemes will never be recorded as intermediate consumption of the employer operating the scheme). Accordingly, Figure 6 shows financial services separately from social contributions. Presenting financial services in this way means that the figures shown as social contributions received by employees from their employers are exactly the same as the share of contributions paid by the employees to the pension fund. It is not necessary to show which element of social contributions covers the service fee. It is the household contribution supplement for a defined contribution scheme and either the employer or the household contribution for a defined benefit scheme.

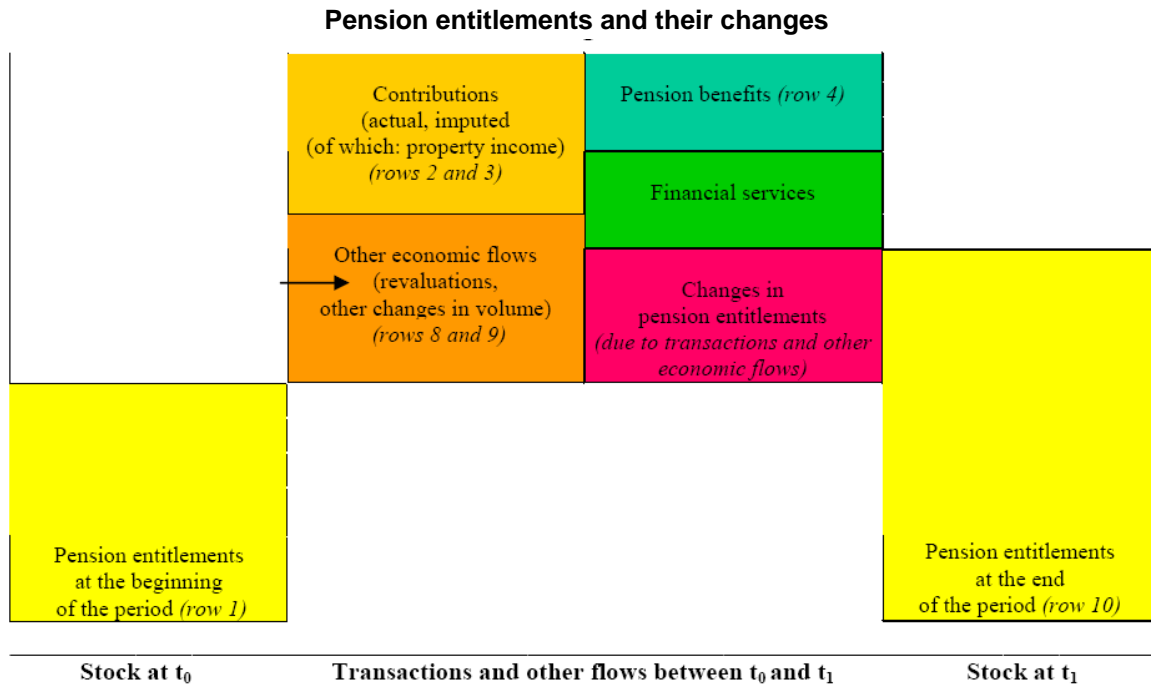
<sup>25</sup> For a further discussion on the use of the inflation rate, see Section 5.4.1.

<sup>26</sup> Note that, while write-downs are covered in row 8, write-offs are recorded in row 9.

<sup>27</sup> All changes due to enacted reforms are covered in row 7.

Output covers financial services. They are the costs of running the pension scheme for a given period. The output data provide additional information to be included in the supplementary table.

Figure 6



## **Key assumptions in measuring pension entitlements**

# 5

## 5 Key assumptions in measuring pension entitlements

Pension entitlements are recorded as positions in national accounts representing future payments of pension benefits. Moreover, the changes in positions between two points in time are also registered; these changes cover transactions, revaluations and other changes in the volume of assets as described in Section 4. Positions in pension entitlements are derived by applying actuarial estimation methods which are based on the net present value concept. Such actuarial estimation methods are used for all pension schemes. For pension schemes managed by non-government units, position data on pension entitlements are usually available based on business accounting or supervisory data sources (see Section 6).

For defined benefit schemes for general government employees and for social security pension schemes, such data are not available and need to be compiled based on data taken from government finance and population statistics. For such estimations various assumptions have to be made.

First of all, a suitable **discount rate** has to be chosen since pension entitlements are calculated in present value terms — i.e. they reflect the discounted sum of present and future flows compared to a certain base year. Another key assumption concerns future **wage growth**. Often, the development of future pension levels is highly dependent on wage assumptions, e.g. via pension indexation. Further, **demographic assumptions** — mainly concerning life expectancy — play a significant role in estimating pension entitlements. Following the appropriate choice of these three key assumptions, the estimation of pension entitlements is described for such government-managed pension schemes. In addition, some **other assumptions** such as assumed inflation rates are discussed.

### 5.1 Discount rate

#### a) The concept of the discount rate

The choice of the discount rate is one of the most crucial assumptions for estimating pension entitlements, since its accumulated impact over many decades is quite high.<sup>28</sup>

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<sup>28</sup> See e.g. ECB (2010), p. 95.

Pension entitlements as positions are compiled based on the net present value method, i.e. they reflect the value of a future payment stream for a given base year. When calculating pension entitlements, the crucial question is: what are future payments of pension benefits worth today?

One tool for valuing a future stream of payments is the discount factor ( $DF$ ). The  $DF$  is compiled based on the following Equation 1:

$$(1) \quad DF_t = \frac{1}{(1+r)^{s-t}}$$

The discount rate  $r$  as part of the denominator determines the level of the  $DF$ . To calculate the present value in year  $t$  of a future pension benefit in year  $s$  this future payment needs to be multiplied by the  $DF_t$ .

Generally, there are two approaches of interpreting this factor. From the point of view of the creditor who earns the pension entitlements, the discount factor reflects the time value of money. It is the value of a future payment in terms of a present payment. Present payments are seen as worth more than future payments due to opportunity costs and possible risks associated with future payment streams. It means that the discount factor is generally smaller than one.

From the debtor's point of view the discount rate is used to calculate the pension reserves to be set aside today to finance future pension obligations. For a more detailed description of these two perspectives, see Box 4.

#### Box 4

##### The creditor's and the debtor's perspective: two interpretations of the discount rate

For pension entitlements (obligations), the discount rate can be interpreted from two perspectives, from the perspective of the creditor and from the perspective of the debtor.

From the perspective of the creditor, a future payment is influenced by the opportunity costs of 'waiting'. If a future pension benefit were available today, it could e.g. be saved and therefore could yield a return in the coming period. In such cases, the opportunity costs are reflected by the interest rate on the possible investment. Additionally, the discount rate of the creditor may be affected by the uncertainty of future payments. For example, there is the risk that the pension scheme may default. From the individual perspective of the creditor, therefore, the discount rate may be higher than the risk-free interest rate. Obviously, the discount rate from this viewpoint is difficult to measure and might vary considerably across individuals and time depending on individual preferences. However, for the estimation of pension entitlements in national accounts, such aspects of risk and preferences need to be taken into account.



The discount rate can also be interpreted from the debtor's perspective, representing a tool to measure the present capital costs of financing future payments. Due to gains through interest rates, the amount of money to be set aside today to finance a future payment can be smaller than the actual payment in the future. On the basis of these interest rates (discount rates), therefore, present pension reserves can be estimated to finance future pension payments. In the case of defined benefit schemes, notional reserves may be quantified. In practice, most accounting standards require debtors to calculate using relatively risk-free interest rates such as corporate bonds or central government bonds.

## b) The choice of the discount rate

The choice of the discount rate in business accounting standards differs. International accounting standards (IAS) aim for a discount rate that reflects market yields on the balance sheet of 'high-quality corporate bonds'. In this context, 'high quality' is generally defined by business accountants as bonds with a high rating. Where the markets for corporate bonds are thin, it is possible to use yields on central government bonds.

For **government-managed pension schemes**, it is generally agreed that central government debt securities provide a suitable basis for the discount rate.<sup>29</sup> Furthermore, the choice of the discount rate should be based on the following criteria:

- 1) In order to obtain a suitable proxy for a risk-free interest rate, it is advisable to base it not on central government debt securities of one single country but on a basket of e.g. European central government debt securities.
- 2) The maturity of these debt securities should be similar to that of pension entitlements, i.e. at least 10 years, but preferably longer.
- 3) In order to guarantee comparability across countries, the same discount rate should be applied to all EU countries and all government-managed pension schemes (including social security pension schemes) at whatever level of government.
- 4) A stable discount rate should be applied to avoid the *noise* resulting from frequent changes.

In line with the above criteria, **it is recommended to set the discount rate at three per cent in real terms and five per cent in nominal terms**. This will considerably improve the comparability of results across EU countries and will be in line with the assumptions made by the Ageing Working Group.

<sup>29</sup> E.g. IPSAS recommends (long-term) government bonds as a basis for the discount rate.

The appropriate choice of discount rate for pension obligations under unfunded public pension schemes is discussed in more detail in Box 5.

### Box 5

#### The appropriate choice of a discount rate for government pension obligations

In order to produce comparable estimates for pension entitlements (obligations) in national accounts across pension schemes, countries and time, the following criteria should be met with regard to the discount rate:

1) *To obtain a suitable proxy for a risk-free interest rate it is advisable to base it not on the central government debt securities of one single country but on a basket of e.g. European government long-term debt securities.*

The first argument for such a portfolio of bonds is based upon risk considerations. Government bonds are usually not absolutely risk-free and generally include the risk of default by the country concerned in the shape of a risk premium. This risk premium can vary across countries and over time.

Another argument in favour of a basket of European bonds is the issue of interdependence, or more specifically the interdependence between a country's pension entitlements and its government bonds. The following example illustrates this issue. Imagine a country increases future pension levels via new pension legislation. Such a reform may lead to a higher default risk for the country and thus to increased interest rates on government bonds. Despite the increase in pension levels, therefore, the pension entitlements recorded in national accounts may actually decrease due to a higher discount rate. To avoid such a possible interdependence between the pension policy and the discount rate, it is advisable to choose a basket of European government bonds as a basis for the discount rate — which is (almost) unaffected by national pension policies.

2) *The maturity of these bonds should be similar to that of pension entitlements, i.e. at least 10 years but preferably longer.*

When calculating the accrued-to-date liabilities (ADL) of government-managed defined benefit pension schemes and of social security pension schemes, one projects future pension benefits accrued to date into the future. These benefits will arise after a period of some several decades. The government bonds used should cover (at least) a similar period of time. Therefore, only government bonds with a maturity of at least 10 years should be considered as a basis for the discount rate. Preferably, duration of 30 years should be chosen, which reflects the average length of pension entitlement payments.

3) *To guarantee comparability across Europe, the same discount rate should be applied to all EU countries and all government-managed defined benefit pension schemes (including social security pension schemes) at whatever level of government.*

In theory, there is only one risk-free interest rate. This interest rate should be equal for all countries and all levels of general government. Therefore, only one value should be approximated for the corresponding discount rate and used for estimations across Europe. Furthermore, differing discount rates across European countries would make it difficult to compare cross-country pension entitlements since outcomes can differ widely. A discount rate lower by just 2 to 3 per cent (in real terms) may increase outcomes by about 20 per cent. Therefore, using a single discount rate also ensures the comparability of results across countries.

4) *A stable discount rate should be applied to avoid the noise resulting from frequent changes.*

Frequent changes in the discount rate can make it difficult to explain to the public and compare time series of pension entitlements since outcomes can differ widely. As stated above, variation in the discount rate may change outcomes considerably. Excessive changes to the discount rate

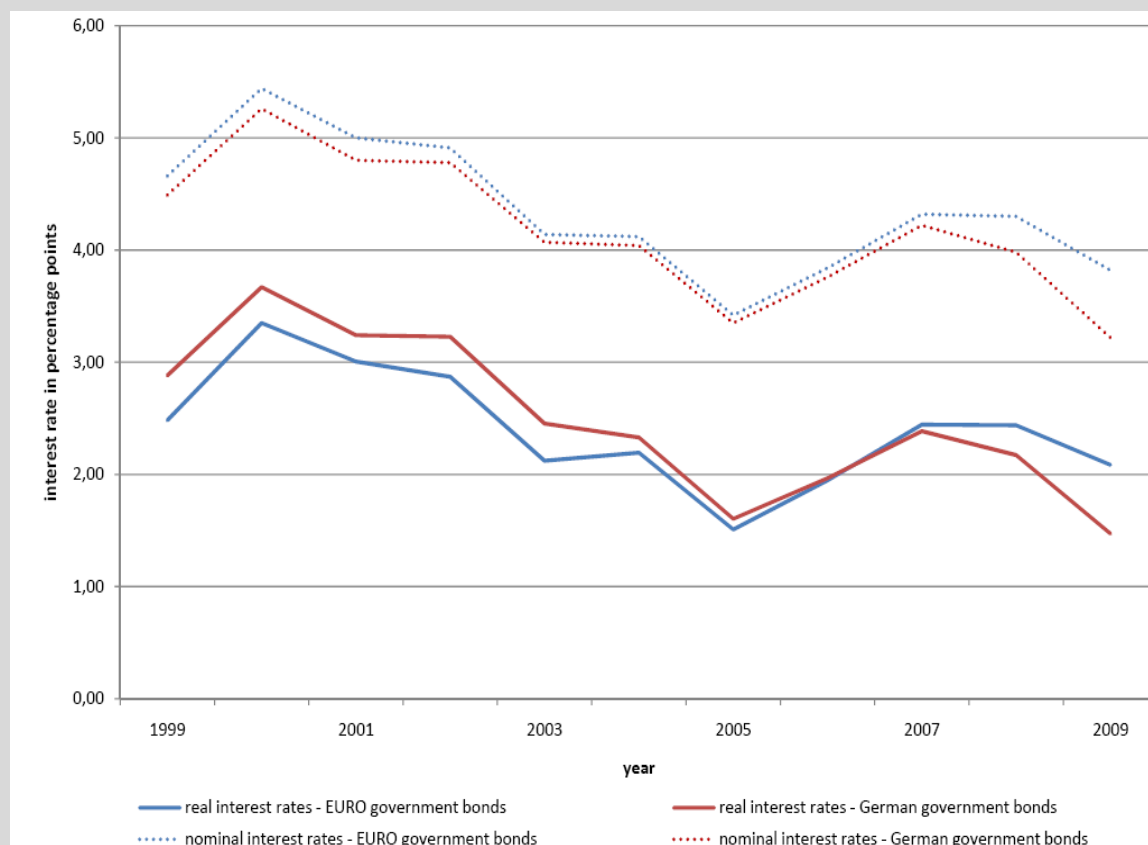
should therefore be avoided.

### Why to choose a discount rate of three per cent per annum?

Figure shows the average yield on government bonds (with 10-year duration) in euro countries compared to German central government bonds yields. The chosen discount rate of three per cent p.a. (in real terms) is close to the average interest rate over this time period.

A discount rate of three percent p.a. corresponds closely to the interest rates applied by European institutions and some national regulations. The Ageing Working Group agreed with Member States a constant real discount rate of three percent p.a. for its long-term projections. For estimating pension entitlements in the business sector, the reformed German Commercial Code also prescribes a long-term interest rate of about five percent p.a.<sup>30</sup> in nominal terms — corresponding to three percent p.a. in real terms. Of course, there remains some uncertainty about the future development of the real interest rate.<sup>31</sup> Therefore, the choice of discount rate should be reviewed regularly.

**Figure 7**  
**Interest rates of euro and German government bonds**  
**% p.a., 1999-2009**



Source: ECB and Eurostat.

<sup>30</sup> The discount factors to apply to pension liabilities under the German GAAP are published monthly by the Deutsche Bundesbank and based on the average yields over the period of the last 7 years. In accordance with the yield curve interest rates are published for different maturities. For pension liabilities with a duration of 30 years the interest rate in June 2010 was set at a level of 5.28 %.

## 5.2 Wage growth

To estimate the pension entitlements of defined contribution schemes, no assumptions regarding wage growth are required. In such systems, pension entitlements depend solely on the financial assets accumulated through contributions.

In contrast, in defined benefit schemes the level of pension entitlements depends also significantly on future wage growth.<sup>32</sup> These schemes usually apply a formula to the member's salary (final salary, an average over a period of years, or lifetime earnings) to determine the level of the initial pension. When using the PBO approach — described in Section 2.2 — the future wage development is taken into account. Therefore, assumptions have to be made regarding future wage growth, through promotion/career progression but also due to general economic growth.<sup>33</sup>

### a) The choice of wage growth

Assumptions as to the future development of wages have a significant impact on the level of pension entitlements when the PBO method is used. Therefore, guidelines for determining this essential parameter for actuarial estimations are given below.

Generally, two factors lead to future wage growth:

- 1) Promotions and the career progression; and
- 2) The general wage growth in the economy

The **career path** of individuals is usually relatively age-specific. Most countries show a hump-shaped wage development over the employment cycle — as illustrated in Figure 8. Younger cohorts (here aged around 20-30 years) generally earn less than their older counterparts in the workforce. With an increasing age, average earnings rise and reach their maximum usually around the age of 50. In many countries, the average earnings profile — shown in Figure 8 — decreases at ages close to retirement (here: 55-60 years). To approximate future career paths, it is useful to take the earnings profile for the base year as the basis (for an example see Figure 8). It is assumed that the present age- and gender-

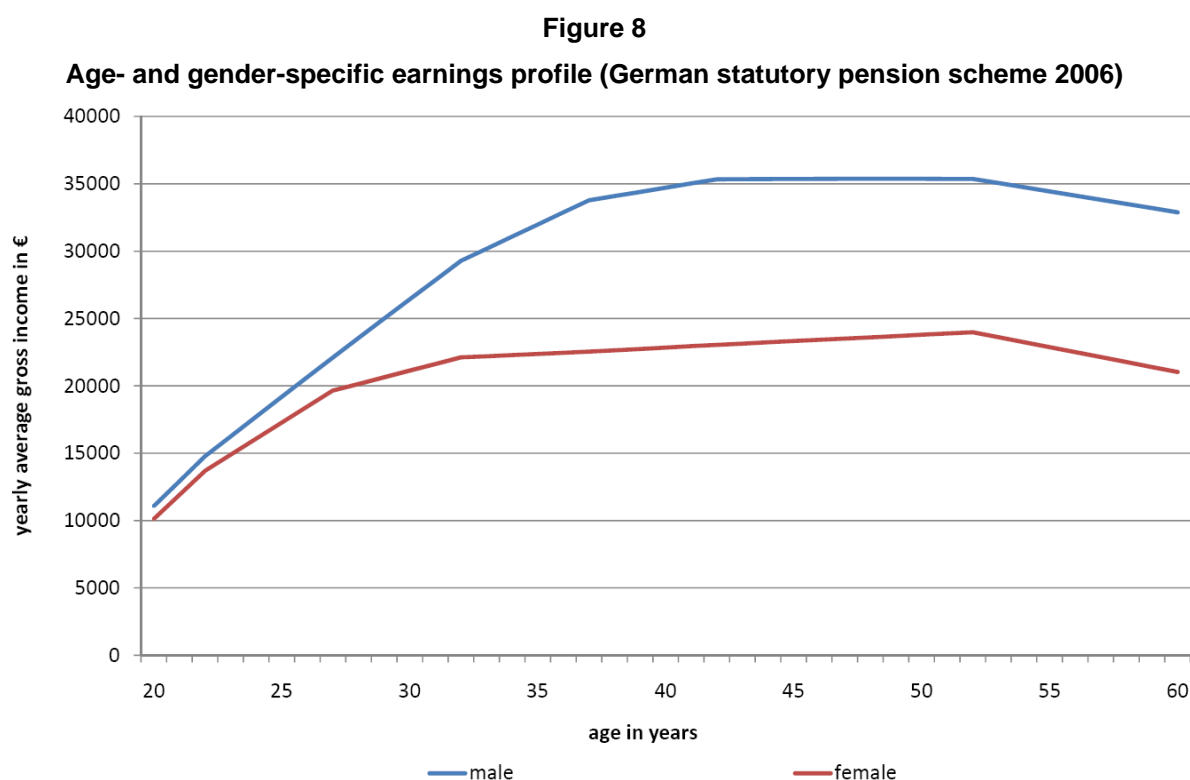
<sup>31</sup> Some authors (see. e.g. Börsch-Supan et al. (2004) or Canton et al. (2003)) assume that due to an ageing population and resulting changes in investment and saving behaviour real interest rates might drop in the coming two decades. However, it is not clear to which extent this is already anticipated in the current interest rates of long-term government bonds.

<sup>32</sup> In NDC systems, generally, future pension levels are determined by the wage growth or more precisely the wage bill growth in the economy.

<sup>33</sup> When applying the ABO method no assumptions have to be made about the future development of wages. With this approach the members' pensions are determined solely on the basis of their current salary in the base year.

specific salary structure will remain constant over time. In the example given, a male individual aged 25 in the base year 2006 can thus expect to earn 75 per cent more at the age of 40 (in 2021) due simply to career progression.

Career progression might differ between members of government-managed pension schemes for its employees and members of social security pension schemes. This is mainly due to differences in promotions in the private sector compared to the public sector. Therefore, earnings profiles should distinguish between private and public employees, if possible.



Source: Forschungszentrum Generationenverträge, University of Freiburg, based on data provided by the German statutory pension scheme.

**General wage growth** in the economy will also affect future pension levels, and therefore PBO pension entitlements. Since the development of future wages is uncertain, assumptions have to be made here as well. Generally, it is assumed that, over the long term, wages follow labour productivity growth per capita in the economy.

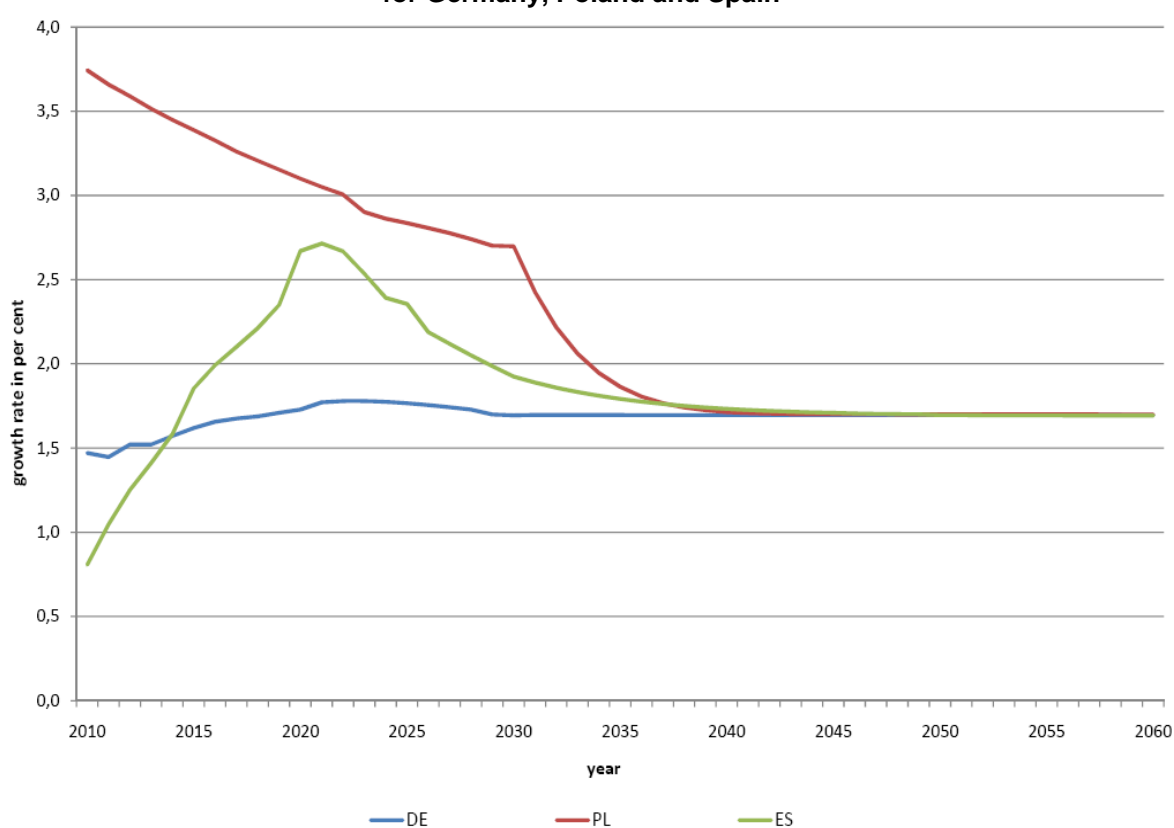
An overview of EU countries shows that this growth rate is relatively heterogeneous (see Figure 9). Specifically, countries with lower GDP per capita rates have seen higher productivity growth rates in recent years. According to the projections of the Ageing Working Group (AWG), this trend will continue in the coming decades. In particular, central eastern EU countries are expected to experience higher growth paths, catching up to the

productivity levels of the 'old' EU Member States (see e.g. the example of Poland in Figure 9).

**In order to reflect heterogeneous growth paths across the EU, the wage growth assumptions of the AWG — reflecting productivity growth per capita — should if possible be used for the estimation of pension entitlements.** This provides a basis for harmonised growth assumptions and at the same time allows for heterogeneous growth paths across EU Member States.

**Figure 9**

**Ageing Working Group productivity and wage growth paths for Germany, Poland and Spain**



Source: Ageing Working Group.

In most government-managed pension schemes of the EU countries, wage growth also plays a crucial role in the indexation of pension benefits. In the Netherlands, for example, pension benefits are adjusted twice a year in line with the average wage growth. To ensure consistency, the AWG assumptions for future wage and productivity growth should be used to estimate the future indexation of pensions.

## Changes in the wage growth assumptions

The assumptions for wage growth should be reviewed and updated on a regular basis. The latest productivity projections of the AWG should always be applied. These forecasts are revised generally every three years, and the last update has been made available in September 2011.<sup>34</sup> The AWG assumptions can be obtained from the national representatives in the AWG. If there are changes in the assumptions for future real wages, this will be recorded as other flows (revaluations).

## 5.3 Demographic assumptions

### 5.3.1 Life expectancy

The level of pension entitlements is also dependent on future demographic developments. Assumed future life expectancy plays a significant role. It determines the expected number of years the pension annuity is to be paid out. As a consequence, pension entitlements may vary if different life expectancies are applied. Life expectancies are calculated on the basis of mortality tables already established for the modelling of pension and life insurance schemes.

#### **Choice of life expectancy**

In the case of social security pension schemes covering a large part of the population, demographic data provided by Eurostat should generally be used. This ensures a comparable data set across EU countries. Eurostat provides age- and gender-specific mortality tables for all EU countries. Only if specific data on the mortality of social security members are available such data should be used. Since mortality rates differ widely between men and women, a gender-specific differentiation of mortality data is necessary.

An increase in life expectancy has been observed over recent decades. This trend is generally expected to continue in the coming years. **Assumptions provided by Eurostat regarding future life expectancy should thus be applied as well.** In doing so:

- Eurostat's most recent population projections must always be used. The most recent update of EUROPOP has been made available in spring 2011.
- There are several possible population change scenarios. In the case of EUROPOP, the convergence scenario must always be assumed.

<sup>34</sup> To contact the national representatives in the AWG see 'The 2012 Ageing Report: Underlying Assumptions and Projections Methodologies' (2011), p. 4-6 on the following link: [http://ec.europa.eu/economy\\_finance/publications/european\\_economy/2011/pdf/ee-2011-4\\_en.pdf](http://ec.europa.eu/economy_finance/publications/european_economy/2011/pdf/ee-2011-4_en.pdf).

- Furthermore, assumptions regarding future life expectancy must again be differentiated by gender.

Eurostat's mortality data are available at:

<http://epp.eurostat.ec.europa.eu/portal/page/portal/population/data/database>

If the mortality of pension scheme members is assumed to differ widely from the general population mortality, scheme-specific mortality data should be used if available. This might be the case for e.g. civil servants, who are generally assumed to have a higher life expectancy than the population average. In contrast, the beneficiaries of disability pensions might have significantly higher mortality rates than average members of the population.

### 5.3.2 Fertility rate

The modelling of some pension schemes may involve the use of other demographic assumptions such as future fertility rates. This may play a role in estimating entitlements for an orphan's pension. The right to these benefits is accrued today by present contributors to the pension scheme. When they die at some point in the future, however, their dependent children — whether born or unborn at present — will generally receive an orphan's pension. A higher future fertility rate will therefore lead to a higher number of children receiving an orphan's pension. However, this should play only a minor role since orphans' pensions account only for a small part of overall pension entitlements.

In addition, the future fertility rate may play a role in certain benefit formulas under European pension schemes, as e.g. in the German general pension scheme. Here, future pensions are linked — via a so-called sustainability factor — to demographic developments, which are partly determined by future fertility rates.

#### ***Choice of future fertility rate***

Here too, Eurostat provides a suitable harmonised basis for choosing future fertility levels. They are available at:

<http://epp.eurostat.ec.europa.eu/portal/page/portal/population/data/database>

### 5.3.3 Migration

Migration is another factor that might be relevant for the estimation of pension entitlements. In some countries, individual pension levels may differ if contributors migrate. Sometimes, as e.g. in the case of the United Kingdom, different pension rules apply to pensioners who choose to emigrate. Also, migration may play a role in the pension benefit formula — e.g. if



a sustainability factor is applied as in notional defined contribution schemes. Here, national modellers have to make assumptions about how migration will develop in future.

### **Choice of future migration rates**

Eurostat also provides a suitable basis for choosing future migration levels at: <http://epp.eurostat.ec.europa.eu/portal/page/portal/population/data/database>

## **5.4 Other assumptions**

### **5.4.1 Inflation**

For calculating pension entitlements, it has to be decided whether future flows are to be projected in nominal or in real terms. If nominal values are chosen, both the discount rate and the wage growth rate should include future inflation expectations. If the projection is based on real values, inflation expectations are not considered. The latter approach has the advantage of avoiding further assumptions regarding future price levels. Generally, for calculating present values both approaches (nominal and real values) should lead to similar results (see Box ). Therefore, both approaches can be used for the estimation of pension entitlements. However, it is essential to check which is being taken as the basis for the assumptions. Discount rates are usually quoted in real terms, but not always. Wage growth is sometimes presented in nominal terms. Hence, it is important to verify whether inflation is considered in the financial assumptions or not.<sup>35</sup>

### **Choice of future inflation**

For the future, an inflation rate of two per cent should be applied. This is in line with the ECB's inflation rate target of just under two per cent over the medium term.

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<sup>35</sup> For some examples how to apply inflation for the estimation of pension entitlements see also section 7.3, Box .

**Box 6****Projecting future flows — nominal terms versus real terms**

To estimate the present value (*PV*) in year *t* of a pension benefit *P* paid out in *t*+1, the following growth-discount factor (*GDF*) is applied:

$$(2) \quad GDF_{\text{real}} = \frac{(1+g)}{(1+r)}$$

The discount rate is denoted by *r* and the growth in the pension benefit, e.g. due to pension indexation, is denoted by *g*. The present value is then calculated by multiplying the pension level with the *GDF*:

$$(3) \quad PV_t = P_{t+1} \times GDF_{\text{real}}$$

If a nominal approach is adopted, expected inflation ( $\pi^e$ ) is considered for future wage growth and for the discount rate, leading to the following growth-discount factor:

$$(4) \quad GDF_{\text{nominal}} = \frac{(1+g)(1+\pi^e)}{(1+r)(1+\pi^e)}$$

Since expected inflation ( $\pi^e$ ) is in both the nominator and the denominator it ( $\pi^e$ ), it is almost cancelled out.  $GDF_{\text{real}}$  and  $GDF_{\text{nominal}}$  therefore have a similar value, with the consequence that the results calculated in nominal terms are rather close to the outcomes estimated in real terms.

**5.4.2 (Un)employment rates**

In some countries such as Poland and Germany the level of future pensions is directly linked to (un)employment rates in the economy. In Poland, for example, entitlements are (annually) recalculated in accordance with recent employment growth. Therefore, employment assumptions may be required for the estimation of pension entitlements.

***The choice of future (un-)employment rates***

For the choice of future (un-)employment rates, the AWG provides a basis comparable across EU countries. Therefore, these assumptions should be used if required for the estimation of pension entitlements.

**5.4.3 Future prevalence of disability**

The supplementary table covers all types of pensions, including disability and invalidity pensions. In order to estimate entitlements to disability and invalidity pensions, assumptions thus need to be made regarding the probability of becoming disabled in the future. This probability is reflected in the so-called *prevalence rate*, which is defined in this context as the total number of disabled persons divided by the total population.

Pension entitlements take into account the probability of receiving a pension in future. Therefore, they are generally higher — other things being equal — the higher the assumed

future prevalence rates for disability. Accordingly, the crucial question is whether the present health status will remain constant in the future.

### ***The choice of future prevalence rates for disability***

In recent decades, a rise in disability due to mental illness has been observed. Whether this trend will continue in the coming years is uncertain, and is not clearly evident from academic studies. Moreover, some countries have seen disability pension claims rise as a behavioural feedback loop in response to legal changes, e.g. an increase in legal retirement ages. Also, future behavioural responses of this kind are difficult to forecast. Due to this uncertainty, constant prevalence rates should be used for the estimation of pension entitlements.

**Data sources for compiling  
pension entitlements**

6

## 6 Data sources for compiling pension entitlements

Different data sources can be utilised to fill in the supplementary table on pension schemes. For the figures in columns A to F, accounting data (see Section 6.1) and regulatory data (see Section 6.2) generally provide a suitable basis. The information for columns G and H can be partly obtained from annual government finance data.<sup>36</sup> Some rows in columns G and H, however, have to be estimated on the basis of an actuarial model (see Section 6.3). The various data sources that can be used to complete the supplementary table are outlined in the following sections.

### 6.1 Accounting data (rows A to F)

The accounting statements of both private businesses and (for some countries) public bodies are guided by accounting principles for pension schemes. These principles may be based on one of the following international or national accounting standards:

- a) International Accounting Standard (IAS) for private businesses
- b) National accounting standards for private businesses
- c) International Public Sector Accounting Standard (IPSAS) for the employer pension schemes of public bodies

These standards are explained below to facilitate the interpretation and use of pension data from sources that apply these accounting standards<sup>37</sup>.

#### a. International Accounting Standard (IAS)

The accounting treatment of pension schemes in private businesses is set out in International Accounting Standard 19 (IAS19 – ‘Employee Benefits’). This standard is mandatory for the consolidated accounts of listed companies in Europe, with some countries extending its application (obligatory or voluntary) to individual accounts and unlisted companies.

IAS19 does not distinguish between funded and unfunded pension schemes. It is based on the principle that all schemes should be recorded in company accounts. However, IAS19 does distinguish between defined contribution (DC) and defined benefit (DB) schemes, and differentiates between the accounting treatment applied: (i) Defined contribution schemes entail a cost to the employer in the current period, but the only balance sheet obligations recorded are for employer contributions not paid by

<sup>36</sup> The figures of column F may also be estimated by an actuarial model depending on the accounting practices.

<sup>37</sup> In all cases, data from any source have to be adjusted according to National Accounts valuation and principles.

year-end; (ii) Defined benefit schemes entail costs to the employer in the current period along with balance sheet obligations representing the discounted value of future pension payments.

For defined benefit schemes, the balance sheet obligations for pension schemes under ISA19 are calculated using an actuarial model with the following characteristics:

- A discount rate equivalent to the market yield (on the balance sheet date) on high-quality corporate bonds (by convention with an AA ranking or better) should be used.
- The 'Projected Unit Credit Method' should be used; this method is equivalent to the Projected Benefit Obligation (PBO) approach described in Section 2.
- Valuations should be carried out regularly and assumptions should be mutually consistent.

Accounts should therefore record the following on the income (profit and loss) statement for a company pension scheme: (i) current service cost (the actuarial estimate of benefits earned by employee service in the period); (ii) interest cost (the increase in the present value of the obligation as a result of moving one period closer to settlement); (iii) expected return on the pension scheme's assets<sup>38</sup>; (iv) actuarial gains and losses<sup>39</sup>, to the extent recognised; (v) past service cost, to the extent recognised; (vi) the effect of any plan curtailments or settlements (e.g. pension reforms).

During the process of designing IAS19, there was a widespread fear that fully recognising actuarial gains and losses on the income statement would lead to excessive volatility. Therefore, a smoothing process was introduced, whereby actuarial gains and losses would be reflected only if they exceeded higher and lower bands (known as the 'corridor'). However, it should be noted that IAS19 is currently under review by the International Accounting Standards Board (IASB). According to the latest draft proposal published in April 2010,<sup>40</sup> the 'corridor' approach is to be abolished. In other words, it is planned to include all estimated changes in the cost of providing defined benefits and all changes in the value of plan assets. Furthermore, a

<sup>38</sup> This is the source of some controversy because the basis for calculating the expected return on assets is left to the discretion of the company.

<sup>39</sup> Representing the experience effect of outcomes compared to assumptions, and also changes in assumptions between one modelling exercise and the next.

<sup>40</sup> On the current revision of the IAS19 see <http://www.iasplus.com/standard/ias19.htm#0908ed>.

new presentation approach that clearly distinguishes between different types of gains and losses arising from defined benefit plans is envisaged.<sup>41</sup>

**b. National accounting standards for private businesses**

As regards companies that do not apply IAS, accounting practices differ across Europe. In some jurisdictions, e.g. the UK, there is a national standard for business accounting which is similar to IAS19, while in other countries a historical approach continues to be used, which can be quite different from IAS19. In Germany, for example, an ABO approach and a fixed interest rate were used for a long time. With recent reforms in 2009, however, the German GAAP is now closer to IAS19, requiring a PBO approach and a time-variant discount rate (which is regularly defined by the Deutsche Bundesbank).

It is important to stress that data reported by corporations for regulatory purposes may use a different basis than company accounting practices. Generally, it should be examined which approach is applied in accounting practices. Preferably, the approaches used for the columns of the supplementary table should be comparable. If e.g. both ABO and PBO data are available, the latter should be used to complete the supplementary table.

**c. International Public Sector Accounting Standard (IPSAS)**

The international accounting standard for the employer pension schemes of public bodies is set out in International Public Sector Accounting Standard (IPSAS25 – ‘Employee Benefits’). This standard is largely based on IAS19, including the use of the projected unit credit method<sup>42</sup>. Yet it diverges from IAS19 in one main respect: there is more leeway concerning the discount rate, as it can be based on the yields of either government or corporate bonds. In this context, the IPSAS Board has concluded that the required rate should reflect the ‘time value of money’ and that in some jurisdictions the yield on government bonds would be the most appropriate. The new standard will apply to reporting periods commencing on or after 1 January 2011. It should be noted that the IPSAS25 standard does not cover reporting by social security pension schemes.

Where IAS19 or IPSAS25 based accounts are available, they can often be readily used to complete the main parts of the supplementary table. In these accounts, the pension

<sup>41</sup> More specifically, the following changes in benefit costs should be presented separately: 1) service cost — in profit or loss, 2) finance cost (i.e. net interest on the net defined benefit liability) — as part of finance costs in profit or loss and 3) rereasurement — in other comprehensive income. .

<sup>42</sup> Similar to the current legal status of IAS 19, the IPSAS 25 recognises a corridor approach. Presently, there is no information that this approach will be eliminated. For further information on IPSAS 25 see website.

entitlements are measured on an actuarial basis and the assumptions made are usually readily available from the notes to the accounts.

Access to business accounts varies between countries. In some cases, the full data are available through central balance sheet offices or similar central data collections, while in other countries the collection might be based on the largest companies or some other sample-based approach. However, the data available might not be broken down by defined contribution schemes and defined benefit schemes — for this, regulatory data sources may need to be used (see below).

## 6.2 Regulatory data (rows A through F)

All European countries have a government agency (or possibly several agencies) responsible for the regulation of pension schemes (possibly life insurance, too). This agency will have laid down clear reporting requirements for pension schemes, usually on an annual basis, though in some cases with a limited collection of key quarterly data. National accountants are usually already in touch with this agency, but close cooperation is nevertheless recommended on this point.

While many pension regulators collect data based on business accounts (for example they require the annual accounts of the schemes to be provided), some data requirements relate to quite specific measurement and valuation standards. For example, pension requirements may be reported on an ABO basis while they are recorded on a PBO basis in the business accounts. It will be useful for national accountants to obtain the precise definitions used to compile the regulatory data, usually available as a technical manual. Comparable approaches should be chosen for the columns of the supplementary table. A PBO approach should thus be used if the necessary data are available.

Where regulatory data are published, they will be readily available to national accountants. It is usually helpful to agree on direct data transfer from the pension regulator, possibly subject to safeguards on confidentiality of individual returns.

Additionally, data on pension funds can be obtained from the European Structural Business Statistics. This database — which is collected by Eurostat — includes pension contributions (differentiated by defined contribution, defined benefit and hybrid schemes), pension payments, capital gains and losses as well as liabilities. However, it has to be underlined that the data are provided with a time lag of three years.



The European Structural Business Statistics are available at:<sup>43</sup>

[http://epp.eurostat.ec.europa.eu/portal/page/portal/european\\_business/data/database](http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database)

Practical examples of the use of regulatory and accounting pension data for completing the supplementary table are given in Section 8.2.

## 6.3 Other pension data (columns G and H)

While non-government employer pension schemes are usually recorded on a business accounting basis or subject to reporting requirements for regulatory purposes, this is often not the case for government-managed pension schemes. Especially for social security pension schemes, usually only cash data are available. In government employer schemes as well, regular 'long-term' accounting, e.g. of pension liabilities, is not widely used. Therefore, for these government-managed pension schemes the figures for the supplementary table (in columns H and G) can only be partly derived directly from statistics. Only some rows can be extracted from government finance data. Large parts of the rows in columns H and G need to be estimated with an actuarial model.

### 6.3.1 Pension data directly obtained from statistics (rows 2.1, 2.3 and 4)

Parts of columns G and H can be derived directly from the administrative data of general government, namely for:

- row 2.1 (employer actual social contributions);
- row 2.3 (household actual social contributions); and
- row 4 (reduction in pension entitlements due to payment of pension benefits).

The pension data should be recorded in gross terms and social assistance schemes should not be included. Table 3 illustrates, for example, the aggregated budget data for Spain's social security pension scheme required to complete rows 2.1, 2.3 and 4.

If pension data cannot be obtained from administrative entities, alternative sources may be used. They are described in Box 7.

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<sup>43</sup> Once the link to the European Structural Business Statistics has been opened pension funds data can be found under the following folder 'SBS — services/financial services statistics/ Statistics on pension funds'.

**Table 3**  
**Required aggregated budget data (social security in Spain)**

EUR billions

Aggregated budget data (in bn. EUR) - Social Security, Spain	
Year	2006
<b>Expenditures</b>	<b>73.72</b>
<b>Employer (actual) contributions</b>	<b>61.39</b>
<b>Household (actual) contributions</b>	<b>21.37</b>

Source: Müller et al. (2009).

### 6.3.2 Pension data to be estimated by an actuarial approach (all rows except 2.1, 2.3 and 4)

Most of the rows in columns G and H — namely all rows other than 2.1, 2.3 and 4 — need to be estimated by means of an actuarial model. Different actuarial tools already exist across European countries, ranging from simple dynamic simulation models to comprehensive stochastic micro-simulation models. At national level there are an increasing number of models for individual pension schemes, often developed by the ministries of finance or social security and/or government bodies responsible for pensions. Moreover, various research institutions use pension models for long-term projections of government-managed pension schemes. These models may be used and extended to estimate pension entitlements under social security and government employee pension schemes.

In the course of the AWG exercises, experience has been gained with a unified approach to long-term projections of government-managed pension schemes.<sup>44</sup> However, the concept used in these exercises is an OSL concept which differs from the concept of ADL with respect to the time horizon applied (for more details see Box ). Nevertheless, both approaches — the estimation of pension entitlements in national accounts and the projections carried out by the AWG — rest upon similar input data. Therefore, close cooperation and exchange of data sources and underlying assumptions (e.g. employment rates and productivity growth) between the Eurostat/ECB Contact Group dealing with estimations of ADL and the AWG is recommended.<sup>45</sup>

For some pension schemes whose pension entitlements are reflected in columns G and H, actuarial estimates may already exist. These actuarial estimates may be used to fill in the

<sup>44</sup> The AWG publishes an 'Ageing Report' including long term budgetary projections. The last report was published in 2009: [http://ec.europa.eu/economy\\_finance/publications/publication14992\\_en.pdf](http://ec.europa.eu/economy_finance/publications/publication14992_en.pdf).

<sup>45</sup> For an overview of the current national representatives in the AWG see the European Commission (2009), p. 4ff.

supplementary table. However, the concept and approach applied to estimate these figures should be cross-checked against other data in the supplementary table. In particular, it needs to be ascertained whether the ADL approach is always taken.

### a) Data inputs for the actuarial estimation of pension entitlements

Generally, pension data for actuarial estimations of social security and government employer pension schemes can be obtained from the institutions responsible for the pension schemes in question. The government entities responsible for a specific pension scheme usually collect (and publish) data on contributors and pensioners on a regular basis.

The necessary pension data include both macro data and micro data:

- Generally, the required **macro data** cover information on total pension expenditure and contributions (also required for rows 2.1, 2.3 and 4) as well as the total number of beneficiaries and contributors differentiated by age and gender in a given base year.
- The required **micro data** relate to individual contribution and benefit levels in a given base year — preferably broken down by age and gender. Additionally, individual accounts stating the contribution history of contributors should be obtained if available. Some countries provide their citizens with periodical information about their accrued pension entitlements. The pension schemes as observable in Sweden, Poland and Austria have introduced individual pension accounts that explicitly show the value of personal entitlements. Such information should be collected and applied in the actuarial calculations if obtainable. However, individual accounts might not always be available. Furthermore, the compilation of these data may turn out to be time-consuming and costly. In such cases, the pension entitlements of contributors can be approximated e.g. on the basis of present pensioners.<sup>46</sup>

The quality of data sources may vary across countries and schemes. For the actuarial estimation, ideally, processed data provided by the institutions responsible for the pension schemes in question should be used. The advantage of these data is that they cover (nearly) all members of the pension scheme and are already processed, e.g. average data per cohort are given. Therefore, they can be more easily used in the calculations.

<sup>46</sup> The PROST model of the Worldbank works on this basis but also the Freiburg model — used for the benchmark calculations of the Contact Group on pensions — uses data of present pensioners to estimate the pension level of future pensioners. For a detailed description see Heidler et al. (2009).

Apart from publicly available pension data, files provided by the pension scheme administrations may also be used. These data sets provide users with a broader and more detailed picture of the pension scheme. This is thus useful for modelling complex features of pension schemes such as e.g. the development of minimum pensions, which generally requires detailed information on the distribution of entitlements. The application of such data bases may demand knowledge of statistical software and can be relatively time-consuming.

If no pension data can be obtained from the institutions responsible for the pension schemes, alternative data sources may be used as described in Box 7.

### **Box 7**

#### **Additional data sources to compile pension entitlements**

##### **Macroeconomic data**

###### **ESSPROS**

One additional data source based on macroeconomic data is the European System of Social Protection Statistics (ESSPROS) maintained by Eurostat. It contains statistics on the financial flows of social security expenditure and receipts. ESSPROS is based on registers and other administrative sources, surveys, and estimates by EU Member States and is designed to provide a comparable data base for EU countries plus Iceland, Switzerland and Norway. Pension data are categorised by various types of pensions such as old age pension, disability pension or survivor's pension. ESSPROS data are generally available with a time lag of 2–3 years. Similar to the distinction made between social insurance and social assistance pension schemes — the latter are not to be included in the supplementary table (see Section 3) — ESSPROS divides benefits into means-tested benefits and those that are not means-tested. However, ESSPROS should only be used if no other data sources are available because it lacks precision on a number of issues. For example, it provides only limited information on the number of beneficiaries, which is differentiated by gender but not by age. Furthermore, it does not provide aggregated contribution data. Also, no distinction is made between government employee and social security pension schemes.

###### **COFOG**

Another macroeconomic data source refers to data based on the Classification of the Functions of Government (COFOG), which is compiled under the ESA transmission programme. It provides a breakdown of general government expenditure by economic function and by type of transaction. Pension data are divided into old age, survivor, and sickness/disability pensions. It should be noted that COFOG data provide only a very rough overview of pension expenditure aggregates. They cannot give a differentiated picture of pensions since they do not distinguish between social insurance and social assistance. Furthermore, no differentiation is made between government employee and social security pension schemes. Also, the category of sickness and disability benefits should ideally be split into two groups — sickness and disability — since only the latter is relevant for the supplementary table. Accordingly, COFOG data should only be used for the supplementary table if no other data source is available.

##### **Microeconomic data**

###### **National and EU household surveys**

Household surveys focus on the living conditions of representative households and generally cover pensioners too. Household surveys are usually available at national level but also at European level. Since national surveys generally cover a larger sample, it is recommended to use these data sources. If national household surveys are not available, European household surveys should be used.

One major European household survey is the European Union Statistics on Income and Living Conditions (**EU-SILC**), which was launched in 2003 and collects comparable multidimensional micro-data on income, poverty, social exclusion and living conditions on an annual basis. Every year, both cross-sectional data (covering a given time or a certain time period) and longitudinal data (relating to individual-level changes over time, observed periodically over — typically — a four-year period) are collected. EU-SILC covers all EU Member States as well as Iceland and Norway. It differentiates between various pension types, namely old age, survivors, disability and sickness benefits. Furthermore, benefits are distinguished by whether they are paid out by a pension scheme managed by general government or not. The same differentiation applies to contributions. However, EU-SILC does not differentiate between pensions paid out by government employee and social security pension schemes.

Before using household survey data, it has to be examined whether the individuals covered by the household survey are representative of the members of the pension scheme analysed. Generally, these surveys cover a sample characteristic of the overall population. Therefore, household surveys may be a particularly suitable alternative data source for social security pension schemes

## b) Further quality issues and benchmarking

While the estimation of pension entitlements should be based on a harmonised approach across Europe, this may not always be feasible in practice. Nonetheless, to ensure accurate estimations, the following general guidelines should be followed:

- Pension data and estimations should be divided by gender; this is necessary since men and women show differences not only in the level of contributions and pensions but also in expected life expectancy, and should therefore be modelled separately.
- Pension data and estimations should be differentiated by age; pension entitlements should ideally be calculated in one-year age groups (i.e. entitlements of a 20-year-old, 21-year-old etc. should be calculated), which can considerably improve the accuracy of results since e.g. pension reforms may affect a cohort born in the year  $x$  but not in the year  $x - 1$ .

It is furthermore recommended to divide participants of a pension scheme into present beneficiaries and future beneficiaries, i.e. present contributors. The latter have accrued pension rights but have not yet received any payment, while present beneficiaries have accrued 'full' entitlements and are receiving payments from the pension scheme. Both groups may also be differently treated due to pension reforms and indexation rules. It is thus reasonable to estimate the pension entitlements of these two groups independently.

Pension models are usually relatively complex — often considered even a 'black box'. Therefore, benchmarks are crucial in order to cross-check the plausibility of the outcomes. This is particularly the case when new pension models are introduced to estimate pension entitlements. Here, the probability of error is generally higher than in frequently used and well-established models. Different generic models can be used for benchmarking and quality assurance. These include the World Bank's pension reform modelling software PROST, although generational accounting models can be used for benchmark exercises too.<sup>47</sup>

<sup>47</sup> For an application of PROST to estimate pension entitlements see e.g. Holzmann et al. (2004) who examined public pension schemes of 35 low and middle income countries. For an application of generational accounting see e.g. Müller et al. (2009) who calculated ADL of government employee and social security pension schemes in 19 EU countries. This model is outlined as a worked example in section 8.1.

A high level of transparency in the compilation process should be ensured. Countries are therefore encouraged to publish a description of the compilation of the supplementary figures. This may include an outline of the actuarial model used to estimate pension liabilities as well as a description of the external actuarial valuations and data sources used.

**Description of the approach to  
estimating pension  
entitlements for government-  
managed pension schemes**

**7**



## 7 Description of the approach to estimating pension entitlements for government-managed pension schemes

### 7.1 Overview

The aim of the following section is to outline step-by-step the procedure to estimate pension entitlements of unfunded public pension schemes. The actuarial approach<sup>48</sup> to estimating these new figures in national accounts is presented in a general way to provide a description which can be applied for a variety of pension schemes. This chapter will address a broad audience, including actuaries, as well as non-actuaries (statisticians, data compilers, etc). Against this background, the calculation procedure is outlined using formal equations as well as various illustrative examples. Furthermore, this section is intended to assist countries which have not yet (fully) built up a model to calculate accrued-to-date pension liabilities.

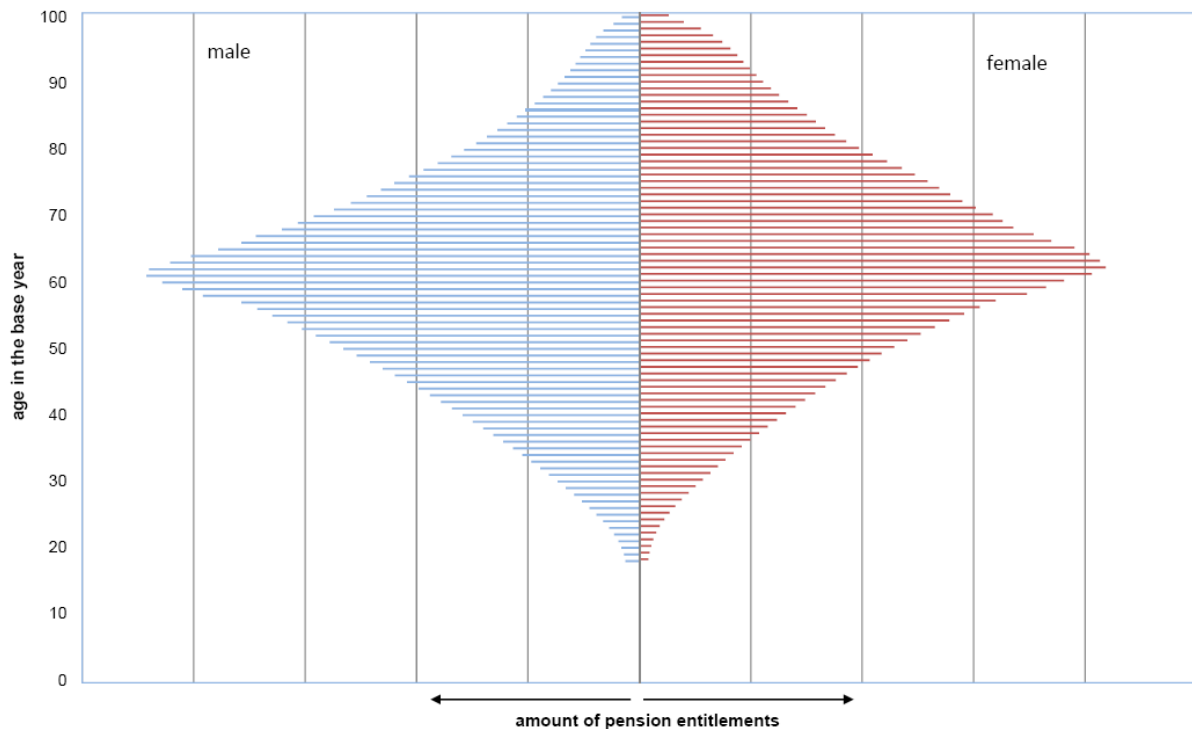
Before the calculation procedure is outlined, it is useful to state the aim: pension entitlements accrued-to-date of all public unfunded pension schemes in the country concerned. This figure represents the sum of entitlements of each participant in the relevant pension schemes. Of course, individual entitlements differ by age and gender. Figure illustrates the typical distribution of pension entitlements, by age groups as well as by gender. Cohorts at the age of retirement, i.e. around the age of 60, have usually, accrued-to-date comparably high pension entitlements. They have, generally, contributed to a pension scheme over a longer period than younger cohorts, and have therefore accrued higher pension entitlements. Furthermore, cohorts at the age of retirement usually show a higher value of pension rights than older age groups. This is mainly due to the fact that only future pension benefits are taken into account in the calculations. New retirees can look forward to a relatively longer remaining retirement period. Older retirees, on the other hand, have already received some of their pension benefits. Their entitlements are, therefore, accumulated over a shorter remaining pension period.

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<sup>48</sup> As outlined in section 2 an actuarial calculation bases on a forward looking approach. For the estimation of pension entitlements it is, simply speaking, applied to project pension benefits in the future and to accumulate and discount them finally to the present value of the base year. .

Figure 10

## Example showing distribution of pension entitlements by age and gender

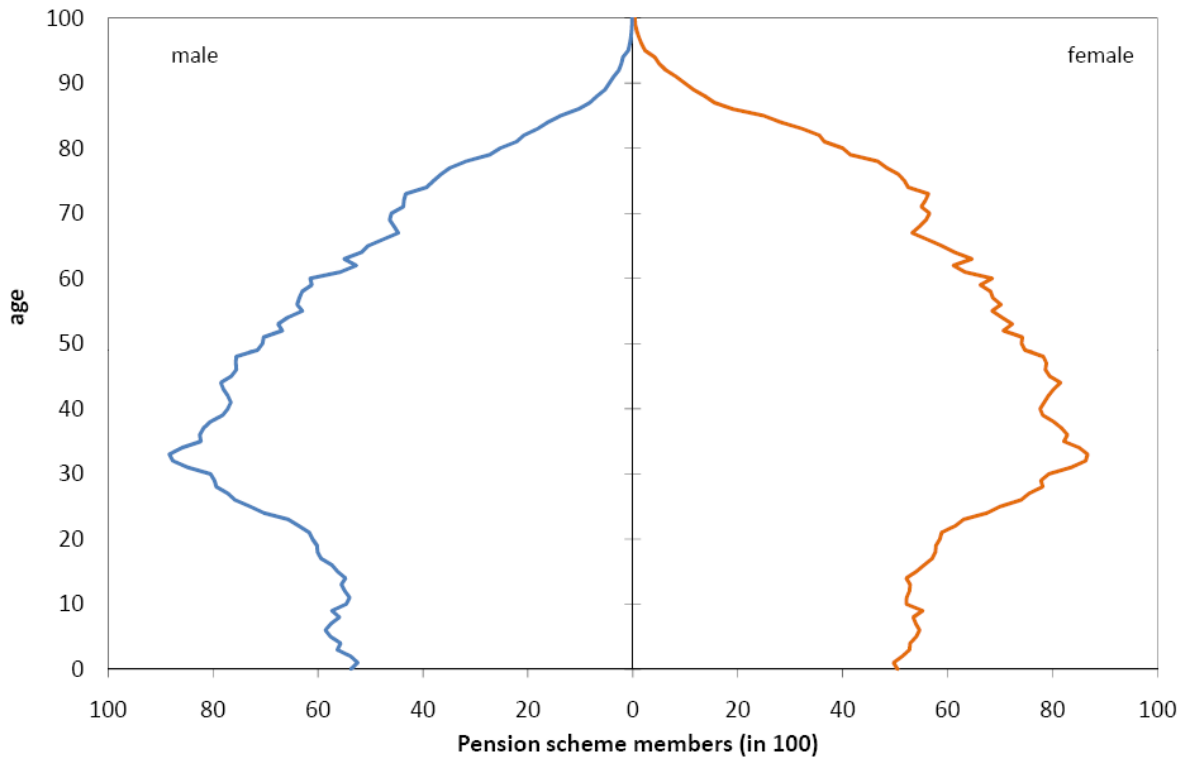


Source: Forschungszentrum Generationenverträge, University of Freiburg.

Besides age-specific differences, differences in pension rights between genders are also apparent. As displayed in Figure 10, women have usually accrued lower pension entitlements than men. Such gender differentials may be explained by, for instance, shorter contribution periods, as well as lower average wages for women, which result in comparably lower pension benefits and entitlements. To estimate accrued-to-data liabilities, these age- and gender-specific differences in pension entitlements should be taken into account.

Two major steps are required to estimate accrued-to-date pension liabilities. In the **first step**, average pension entitlements of different age and gender groups are estimated, as illustrated in Figure 10.

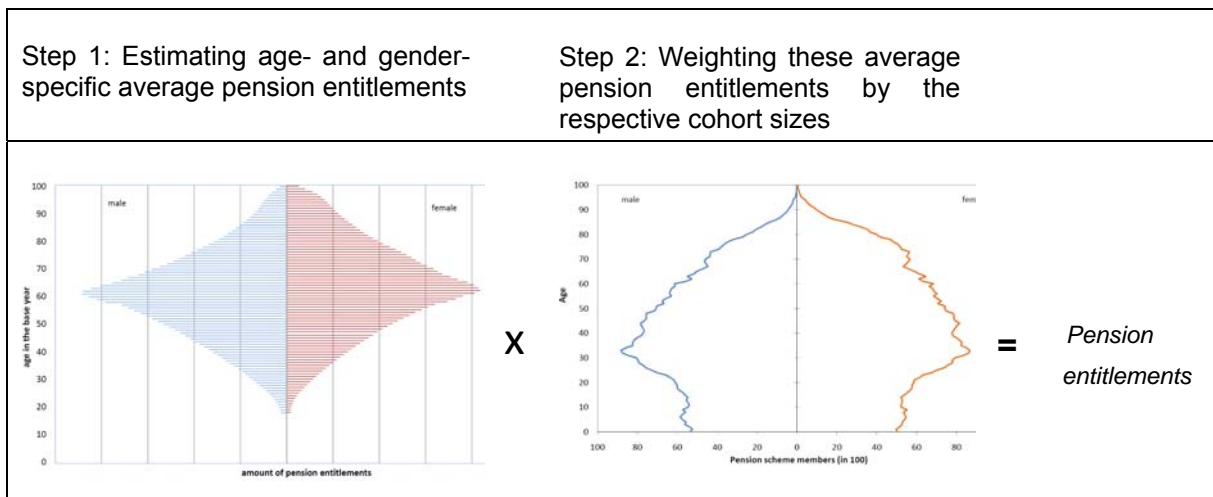
**Figure 11**  
**Exemplary cohort sizes by age and gender**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

In a **second step**, these group-specific pension rights (shown in Figure 10) are multiplied by the respective age- and gender-specific cohort sizes of the pension scheme members (displayed in Figure 11). Step 2 generates the final result: the total value of pension entitlements. To give a general overview, both major steps to calculate pension liabilities are displayed in Figure 12 below.

**Figure 12: Overview on the calculation of pension entitlements**



Step 1 (Chapter 7.2 – 7.4) considers the pension entitlements of a single participant. In step 2 (Chapter 7.5), these individual pension rights are aggregated.

## 7.2 Estimating individual pension entitlements

Pension entitlements represent the sum of all future pension benefits which are accrued-to-date in present-value terms of a base year. The approach to calculating this figure will be demonstrated below. A formal outline will be given first, to provide an introduction, especially for actuaries. Then the estimation approach will be illustrated through various examples.

### **Formal outline of the estimation approach**

Equation 5 presents the general approach to calculating pension entitlements.<sup>49</sup> In the following sections, further extensions of this formula are discussed.

$$(5) \quad E_{x,g,b} = \sum_{s=x+1}^D B_{s,g,f}^{accrued} * p_{s,g,f} * (1+r)^{x-s}$$

where

$E_{x,g,b}$  = the pension entitlements of a representative individual of age  $x$  and gender  $g$  in the base year  $b$ ,

$B_{s,g,f}^{accrued}$  = the annual pension benefits accrued-to-date of a representative individual at age  $s$  and gender  $g$  in a future year  $f$  ( $f = b + s - x$ ),

$p_{s,g,f}$  = the probability of a representative individual of gender  $g$  of surviving to age  $s$  in a future year  $f$  ( $f = b + s - x$ ),<sup>50</sup>

$D$  = the maximum life time,

$r$  = the discount rate.

The aim is to calculate pension entitlements  $E$  for an average representative of different age groups  $x$  and genders  $g$  in a given base year  $b$ . The variable  $B_{s,g,f}^{accrued}$  denotes the annual

<sup>49</sup> Please note that the following definitions may not be fully applicable for disability, survivors' and early retirement pensions. It should be e.g. taken into account that after the death of a retiree his/her surviving spouses/orphans (if existing) are entitled to a survivors' pension benefit. For a further description of the differentiation by pension type see section 7.4.4.

<sup>50</sup> These survival rates should reflect the expected increase of the life expectancy according to the newest EUROPOP projections. For a further discussion see section 5.3.

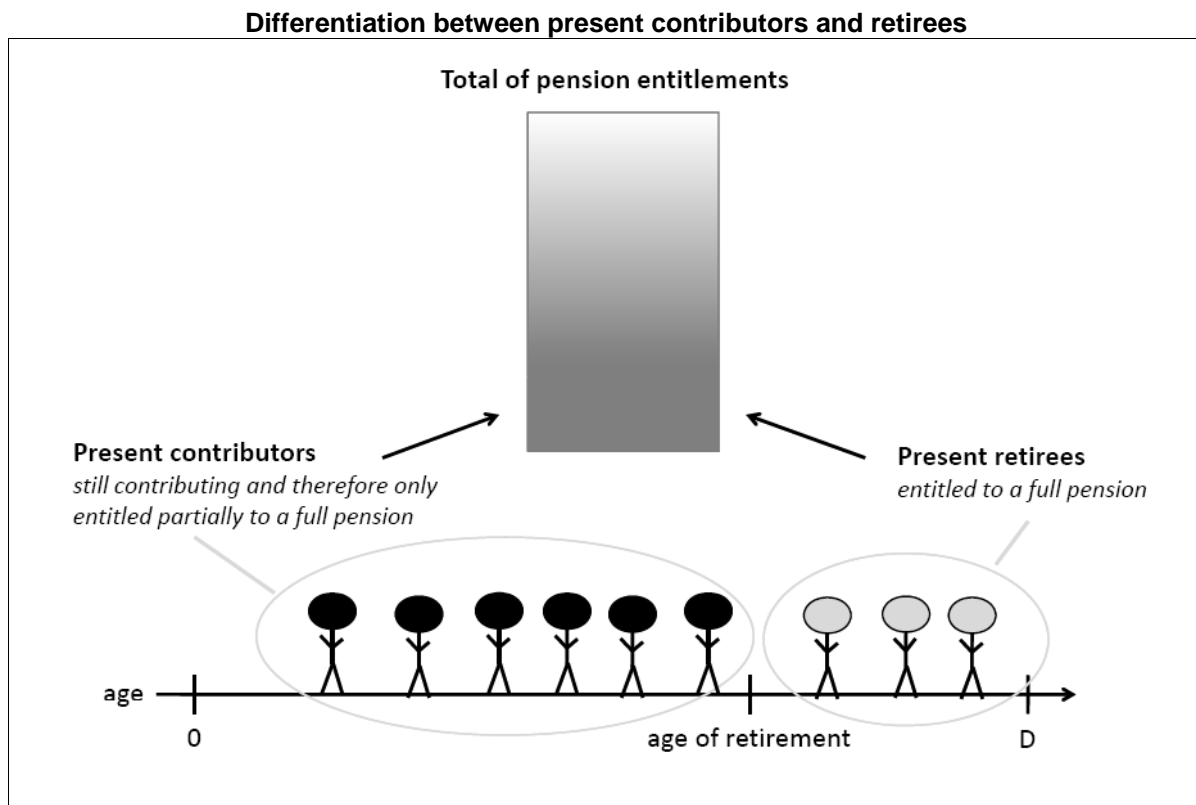
pension level accrued-to-date. How to derive this pension level accrued-to-date is then discussed in detail. It is important to note that only future pension payments are taken into account for the estimation of pension entitlements. All payments during or before the base year are disregarded. Therefore, the control variable  $s$  starts with the age  $x + 1$ , i.e. one year after the base year, and ends at the age  $D$ . In this context, the variable  $D$  denotes the highest maximum life time considered in the calculations. Usually, a level of 100 years is chosen for the variable  $D$ . Pension entitlements represent the expected amount of pension payments accrued-to-date. In line with this concept, future survival rates are taken into account for the calculation of entitlements. For this purpose, the variable  $p$  ( $0 \leq p \leq 1$ ) is introduced. It represents the probability of an individual of gender  $g$  surviving to a certain age  $s$  (in the year  $b + s - x$ ). In accordance with the applied present value concept, all future pension payments are discounted to the base year.

### ***Distinguishing between current retirees and current contributors***

For the estimation of pension liabilities, it is important to distinguish between pension entitlements accrued by present retirees, and pension entitlements accrued by current contributors. The former group has its working and contribution period behind it, and is therefore already entitled to full pension benefits.<sup>51</sup> For the estimation of accrued-to-date liabilities, it is important to take into account that current contributors have not yet accrued 100 per cent of their future (expected) full pension benefits upon retirement. They still have an (expected) contribution period ahead of them, whether this is one year (in case of a 59-year-old) or 40 years (in case of a 20-year-old, in our example). It is strongly recommended to distinguish between present retirees, who have already accrued full pension benefits, and present contributors, who have only partially accrued their future full pension benefits. Figure 13 illustrates this important distinction.

<sup>51</sup> Of course, in some pension systems — such as in Germany — it is possible to contribute and accrue further pension rights after receiving a pension benefit.

Figure 13



Pension entitlements reflect the present value of all future pension benefits which have been accrued-to-date. Contrary to other figures in national accounts, accrued-to-date liabilities are not calculated solely on the basis of historic data; rather a projection of future pension payments is required. This forward-looking approach will be discussed in further detail below. First, the actuarial method for estimating pension entitlements for current pensioners will be outlined (Chapter 7.3). Then an equivalent description will be provided for present contributors (Chapter 7.4). The following two sections always consider an average representative of a certain age group and gender.

### 7.3 Estimating individual pension entitlements for current retirees

Current pensioners are entitled to pension benefits on the basis of past accrued pension rights. As outlined above, this group is entitled to full pension benefits. In other words, the benefits they receive in the base year are fully accrued. It is important to note that current pensioners are entitled to pension benefits not just for one year but, in fact, to all future pension payments, usually until they die.<sup>52</sup> To illustrate the estimation approach for current retirees, see the example in Box 8.

<sup>52</sup> In fact, one may furthermore attribute future survivor's benefits — which accumulate after the death of present retirees — to the entitlements of current pensioners. For a further description see Box 18. .

**Box 8**

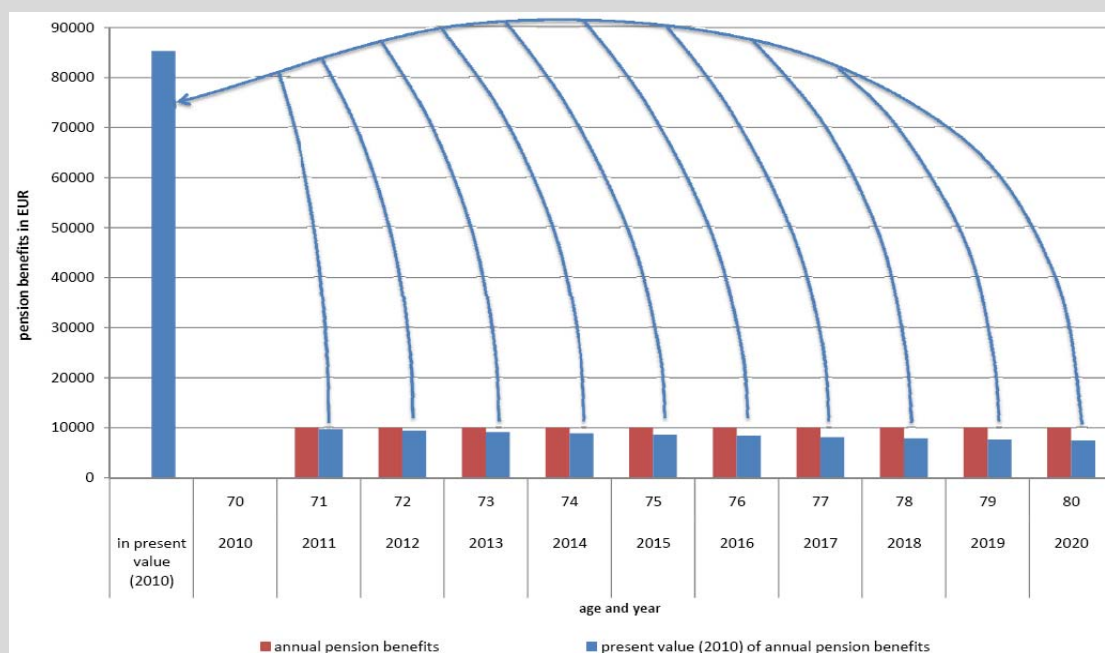
**Estimating pension entitlements for current retirees**

To outline the estimation approach applied for current retirees, take the example of an average male pensioner, aged 70. His pension entitlements are relatively straightforward to calculate. The current retiree’s pension benefit level is projected over his remaining (expected) life span. Generally, the pension data needed for this projection can be obtained from the respective pension scheme institutions, while assumptions on the (contingent) life expectancy should be obtained from Eurostat.<sup>53</sup> For the following example, the representative retiree will receive an annual pension payment of EUR 10,000 in the year 2010. His life expectancy at age 70 is 10 years. In other words, he can expect to receive EUR 10,000 per year over an (expected) period of 10 years, which adds up to EUR 100,000 over the rest of his retirement.

**Calculation of the present value of pension entitlements**

Pension entitlements represent the aggregated present value of future pension payments. In accordance with this present value concept, pension benefits in the far future are generally considered less valuable than present pension payments. To estimate entitlements, therefore, a discount factor is applied — described in Section 5.1 — to translate future pension benefits into present-value terms. As a consequence, a pension payment of EUR 10,000 in 10 years is, for instance, worth only EUR 7,440 in present-value terms at a discount rate of 3 per cent. The blue bars in Figure 14 represent the respective present values of the future pension payments.

**Figure 14**  
**Aggregating annual pension benefits in present value terms**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

In the final result, pension entitlements are calculated by summing up all future pension payments in present-value terms. In this example, the total pension entitlements of a 70-year-old pensioner would amount to about EUR 85,000 EUR. From the point of view of the government, this figure represents the accrued-to-date pension liability. In other words, the value of EUR 85,000 reflects the amount of money which has to be set aside today by the government to finance all accrued pension rights of the hypothetical 70-year-old average retiree.

<sup>53</sup> For a further description of the demographic data and assumptions see section 5.3.

### Choosing a base year for the calculations

Only future pension benefits over the remaining life cycle of an individual are considered in estimating pension entitlements. All pension benefits received in the past — or more precisely, before the end of a certain base year — are not taken into account. The pension payments considered, therefore, depend on the base year applied. If the base year is 2010, the aim is to estimate the stock of pension entitlements at the end of the year 2010 for inclusion in row 10 of the supplementary table of the base year 2010.<sup>54</sup>

### Consideration of pension indexation rules

For the calculation of entitlements, the indexation practice of the respective pension scheme should, possibly, be reflected. Most EU countries, including, for instance, France and Spain, adjust pension benefits annually in accordance with the change in the consumer price index (CPI). This is '*price indexation*'. Several EU countries, for instance, Slovenia or the Netherlands, base annual pension adjustments on general wage growth in the economy. This is referred to as '*wage indexation*'. Other countries have a *mixed indexation* system. In their annual pension indexation changes, they consider the CPI and, to some extent, wage growth.<sup>55</sup> In accordance with the respective pension indexation, an accrued pension benefit ( $B^{accrued}$ ) in year  $t + 1$  may differ from that in the previous year  $t$  (see Equation 6). The variable  $a$  denotes the annual adjustment factor, which reflects the indexation rules in the respective country.

$$(6) \quad B_{t+1}^{accrued} = (1 + a_{t+1}) * B_t^{accrued}$$

**Before implementing country-specific indexation rules, it is crucial to decide whether future payments will be calculated in nominal or in real terms. As outlined in Section 5.4.1, the difference between these two approaches concerns the way in which future inflation is considered. A nominal estimation approach takes into account assumptions on future inflation, while a real approach disregards such expectations.<sup>56</sup> The indexation of pensions with prices as well as with wages is illustrated in Box 9**

Box , which shows calculating pension entitlements both in nominal and in real terms.

<sup>54</sup> For an overview on the new supplementary table see chapter 4.

<sup>55</sup> For example Finland adjusts pension benefits annually with 80 per cent of CPI changes and with 20 per cent of the growth of the earnings level.

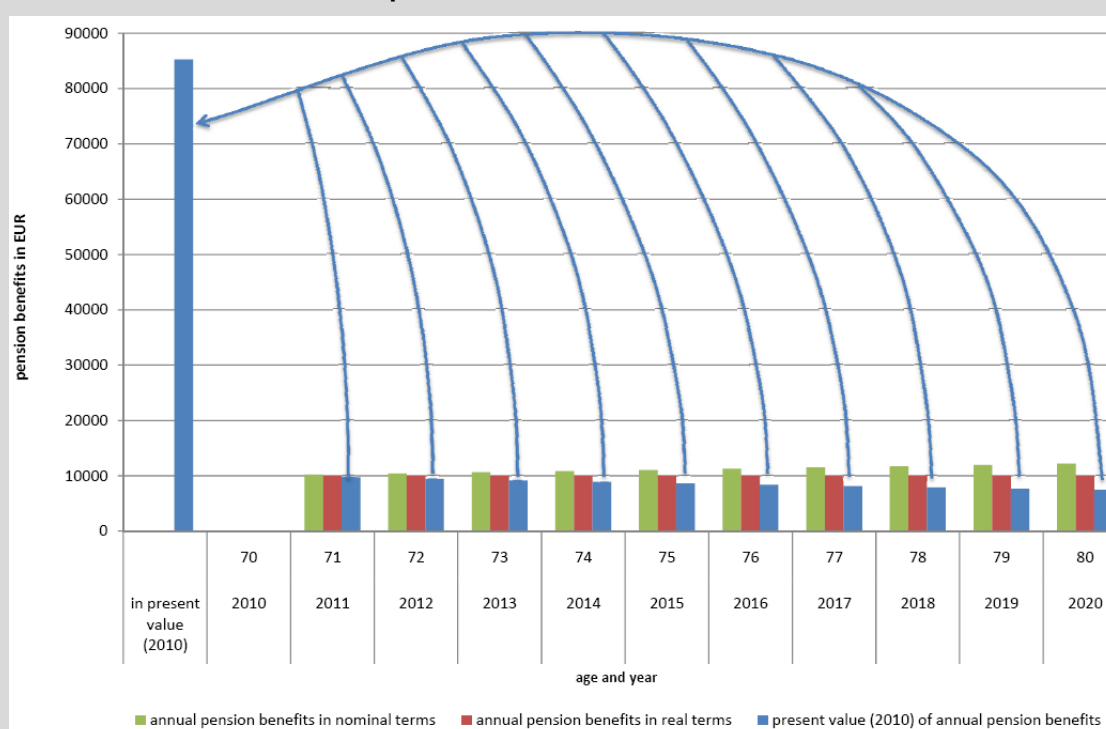
<sup>56</sup> For a further discussion on these two approaches see section 5.4.1.



### Box 9 Estimating pension entitlements for current retirees — considering pension indexation rules

Below are outlines of examples regarding pension indexation rules. The case again is a typical 70-year-old male pensioner, on the same assumptions as in Box 8. First, the application of a price indexation is described. Under these rules, an expected future price rise of e.g. two per cent would translate into annual pension increases of two per cent — see green bars in Figure 15. If future pensions are projected in real terms, an indexation of the pension in line with prices would imply that pensions stay constant in real terms — see red bars in Figure 15.

Figure 15  
Consideration of price indexation in real and in nominal terms



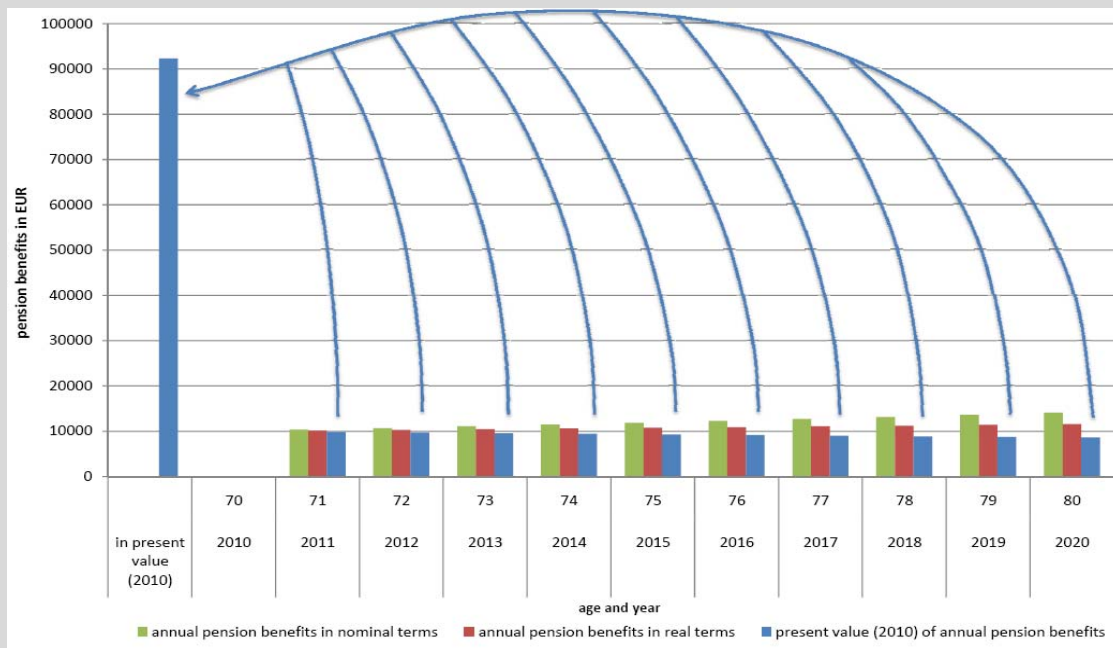
Source: Forschungszentrum Generationenverträge, University of Freiburg.

As outlined in Section 5.4.1, both approaches, a nominal and a real calculation approach, should lead to almost the same level of pension entitlements. It is, however, crucial that the approach used for the pension indexation is also applied to the discount rate. In other words, if the projection is undertaken in real terms, inflation expectations should not be considered in either the discount rate, or the pension indexation.

Further assumptions have to be taken in pension schemes which apply wage-growth indexation. To estimate pension entitlements for these schemes appropriately, assumptions on future growth of wages are required. For the sake of simplicity, constant wage growth of 1.5 per cent in real terms is assumed in the following example. This translates into nominal wage growth of 3.5 per cent.<sup>57</sup> Obviously, future pension levels differ if varying pension indexation rules are applied. To take the example of a current pensioner aged 70 again, if pensions are adjusted only according to the CPI, this retiree can expect an increase in his pension benefits from EUR 10,000 currently to EUR 12,200 (EUR 10,000) in nominal (real) terms until the age of 80. Under wage indexation, as observed in the Netherlands or Germany, his pension level would, on the other hand, rise to EUR 14,100 (EUR 11,600) in nominal (real) terms at the age of 80 — see Figure 16.

Indexation rules play an important role in the estimation of pension entitlements, since the effects of indexation accumulate over the entire retirement period. This is also apparent in our example. In the case of price indexation, the pension entitlements of the 70-year-old pensioner add up to about 85 000 EUR. However, they are considerably higher, by 7 000 EUR, if wage indexation is applied to the entitlement.

**Figure 16**  
**Consideration of wage indexation in real and in nominal terms**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

**Consideration of future adjustments in the benefit formula**

Besides indexation rules, future pension levels of current retirees might also be altered due to future adjustments in the benefit formula. For example, the German statutory pension scheme has a sustainability factor. With this new element in the benefit formula, pensions are adjusted annually in accordance with demographic and employment changes. Such

<sup>57</sup> The level of 1.5 per cent follows closely the forecasts of the AWG on the labour productivity in EU countries. As discussed in section 5.2, the AWG labour productivity predictions should, possibly, be applied as a basis for the future wage growth. Furthermore, as outlined in chapter 5.4.1 an inflation rate of two per cent should be used in the calculations. This value has also been chosen in the example above.

future alterations in the benefit formula should if possible be taken into account when projecting future pension benefits of current retirees. The variable  $b$  in Equation 7 denotes such changes in the benefit formula.

$$(7) \quad B_{t+1}^{accrued} = (1 + a_{t+1}) * (1 + b_{t+1}) * B_t^{accrued}$$

For the estimation of entitlements, it has to be taken into account that in most European countries, future adjustments in the benefit formula affect only future new pensioners, i.e. current (and future) contributors. For example, the future rise in the age of retirement in the United Kingdom, or the gradual change of accrual factors in Portugal, only play a role for future new pensioners. Such changes in the benefit formula will be discussed in Section 7.4 below, which outlines the estimation procedure for future new pensioners.

**The conclusion is that data on the annual pension level and life expectancy are required for the estimation of pension entitlements of current pensioners. Furthermore, pension indexation rules as well as future adjustments in the benefit formula of the respective pension scheme should be reflected in the calculation procedure. To obtain the present value of entitlements, a discount rate of, preferably, three (five) per cent in real (nominal) terms should be applied.**

## 7.4 Estimating individual pension entitlements for current contributors

### 7.4.1 A general overview

The estimation of pension entitlements for current contributors closely follows the approach described in the previous section. However, two further aspects need to be considered when calculating the accrued pension rights of this group. On the one hand, the fact should be taken into account that present contributors are not yet entitled to the full pension<sup>58</sup> they would receive after a complete contribution career. On the other hand, current contributors are not yet retired. Hence, their future pension payment needs to be newly estimated.

Current contributors are, generally, expected to accrue further pension rights in the future. This differentiates them from current retirees. To indicate the extent to which a future full

<sup>58</sup> A full pension is defined as the pension level one receives after the completion of the individual contribution career. The individual contribution career may vary considerably. Some individuals may retire already at the age of 40 due to a disability while others finish their contribution career not until the age of 65 or later. Consequently, also the full pension levels can differ. This aspect is discussed in further detail in the following sections.

pension  $B^{full}$  has been accrued-to-date, the so-called accrual factor  $\lambda$  is introduced (see Equation 8).<sup>59</sup>

$$(8) \quad E_{x,g,b} = \sum_{s=x+1}^D \underbrace{B_{s,g,f}^{full} * \lambda_{x,g,b}}_{B_{s,g,f}^{accrued}} * P_{s,g,f} * (1+r)^{x-s}$$

Equation 8 illustrates the link between the estimation of pension entitlements and other pension projections such as the AWG exercises. While the latter group, generally, takes into account only pensions after a full contribution career ( $B^{full}$ ), the ADL approach considers only a certain proportion ( $\lambda$ ) of such ‘full’ pensions (in the case of current contributors). In other words, only accrued-to-date pension benefits ( $B^{accrued}$ ) are considered in ADL calculations.

The value of  $\lambda$  ( $0 \leq \lambda \leq 1$ ) may differ by age and gender. For present pensioners, the accrual factors sum by definition to unity, i.e. they are fully entitled to their pensions paid in future years. For current contributors, who are still expected to earn further pension rights in future, the accrual factor, generally, amounts to less than unity.

For present pensioners, the level of pension benefits can be obtained from the institutions responsible for the respective pension scheme. For current contributors, on the contrary, this future retiree income has to be newly estimated. The following two sections describe how to estimate the initial annual pension benefit accrued-to-date ( $B^{accrued}$ ) at the point of retirement  $r$ .

Generally, there are two approaches for calculating the ‘starting pension’ to which a current contributor is entitled. On the one hand, the estimation may be based on the assumption that all contributors feature *homogeneous contribution careers (homCC)*. With this approach, future pension levels of current contributors are not estimated using past contribution data. In fact, future retirement benefits are approximated on the basis of current pension levels. This approach has the advantage of significantly limiting the input data required for estimations, so data on past contributions can be (partly) disregarded. The homCC approach is, therefore, recommended if no or only limited contribution data are available. Alternatively, *heterogeneous contribution careers (hetCC)* may be considered.

<sup>59</sup> Please note that Equation 8 follows the same notation as Equation 5.

This approach requires comprehensive data on past contributions. The hetCC approach has the advantage of reflecting cohort-specific employment careers. Its application may therefore lead to more accurate estimations than the homCC approach.

The following sections are structured as follows: first, the estimation of the initial annual pension benefit accrued-to-date ( $B_t^{\text{accrued}}$ ) is outlined, applying a homCC approach (Chapter 7.4.2) and a hetCC approach (Chapter 7.4.3); then (in Chapter 7.4.4), these annual pension benefits will be projected over the remaining retirement phase to calculate the final result, namely the pension entitlements of current contributors.

## 7.4.2 Estimating the initial pension by applying homogeneous contribution careers

With the homCC approach, future accrued-to-date pension benefits ( $B_t^{\text{accrued}}$ ) of current contributors are not directly calculated on the basis of past contribution data. In fact,  $B_t^{\text{accrued}}$  at the future point of retirement  $r$  is estimated from current pension levels. This small detour helps to limit the required data inputs for estimations, namely to limit the data on past contributions. This procedure, therefore, can be valuable for countries wishing to limit the data input for calculations. A worked example applying the homCC approach is provided in Chapter 8.1.

The estimation under the homCC approach proceeds as follows. In the first step, future full pensions<sup>60</sup>  $B^{\text{full}}$  of current contributors are estimated using the pension data of current retirees. The second step takes into account the fact that current contributors are only partially entitled to their expected full pension  $B^{\text{full}}$  which is accounted for with the so-called accrual factor  $\lambda$ . Equation 9 summarises formally the steps for the estimation of  $B^{\text{accrued}}$ .

$$(9) \quad B^{\text{accrued}} = \underbrace{B^{\text{full}}}_{\text{Step 1}} * \underbrace{\lambda}_{\text{Step 2}}$$

Both steps — 1) the approximation of future full pensions and 2) the estimation of the accrual factor — are outlined in detail below.

<sup>60</sup> As outlined before a full pension is defined as the pension level one receives after the completion of the individual contribution career.

## Step 1: Approximation of future full pensions

For the first step, the approximation of future full pensions  $B^{full}$  of current contributors, the basis can be the pension data of present retirees. It is assumed that future full pensions of current contributors are equivalent to pension benefits of current new pensioners.<sup>61</sup> All future new retirees are assumed to have the same contribution history as present new pensioners, i.e. using homCC as a basis.<sup>62</sup> As a consequence, future new retirees will receive (almost)<sup>63</sup> the same pension benefit as current pensioners.

In a flat-rate pension scheme, the homCC approach implies that all cohorts are assumed to have the same number of contribution years at the point of retirement as current new pensioners. In an earnings-related pension scheme, this assumption would mean that contributors show not only the same contribution periods but also (almost)<sup>64</sup> the same reference earnings over their contribution career as present pensioners. A formal outline of the procedure to estimate full pensions of future new pensioners is provided below. As a start, the pension benefit  $B^{full}$  of a new pensioner in the base year  $b$  would be equivalent to the pension of a new retiree in the following year  $b + 1$ , as outlined in Equation 10. Of course, Equation 10 ignores the impact of 1) pension reforms and 2) indexation effects.

$$(10) \quad B_{b+1}^{full} = B_b^{full}$$

Most European countries have implemented profound pension reforms in recent years. Usually, these reforms will lower the level of pensions for future new retirees. Therefore, a deduction factor  $\theta$  should be applied (defined by a reform or, for instance, inherent in the benefit formula, as in the notional defined contribution scheme).

<sup>61</sup> It is recommended to base on the contribution history of present new pensioners and not all current pensioners. The former group is temporally 'closer' to current contributors. Therefore, their contribution history can be assumed to be, generally, more similar to current contributors. This is e.g. the case when looking on female participation rates. While very old female retirees often show low participation rates, new female retirees feature, usually, a higher labour activity over their contribution history which is more comparable to current female contributors.

<sup>62</sup> It should be stated that such an assumption is only reasonable in pension schemes which are sufficiently matured.

<sup>63</sup> Of course, the pension level of future new retirees might differ from current retirees even if one assumes homogeneous contribution histories. For example pension reforms may lower pension levels of future new retirees. This aspect is considered later in the text.

<sup>64</sup> We will outline later that not exactly the same reference earnings should be assumed. In fact, one should take into account wage growth effects, i.e. one should consider (under the PBO approach) that reference earnings increase yearly with the general wage growth in the economy. .

$$(11) \quad B_{b+1}^{full} = B_b^{full} * \theta_{b+1} * (1+v)$$

Secondly, pre-retirement indexation effects need to be considered. The valorisation of pension rights of current contributors up to the point of retirement should be taken into account. In a number of countries, past entitlements are indexed annually to wage growth. These pre-retirement indexation effects are reflected with the valorisation factor  $v$ .<sup>65</sup>

In schemes where past pension rights are indexed only to prices, the valorisation factor also comes into play. Here future pensioners have, usually, earned higher reference earnings than present retirees, due to general wage growth in the economy. As a result, they should in earnings-related pension schemes benefit from higher pensions than their present counterparts.<sup>66</sup> This aspect is also taken into account with the valorisation factor  $v$  in Equation 11.

## Step 2: Estimating the proportion of the full pension entitlements accrued-to-date

The second step takes into account the fact that current contributors are not yet fully entitled to their future full pension  $B^{full}$  since they are, generally, expected to accrue further pension rights. In fact, current contributors are only entitled to a fraction of  $B^{full}$  which is denoted by the so-called accrual factor  $\lambda$ .

The crucial question is the extent to which current contributors are entitled to their future full pensions. The answer depends on the choice between the ABO and the PBO approach, as described in Section 2.2. Generally, the PBO approach should be applied for the estimation of government-managed defined benefit pension schemes.<sup>67</sup> Against this background, the following description of the accrual factor is based on the PBO method.<sup>68</sup> Generally, the

<sup>65</sup> Under the ABO approach  $v$  would equal to zero in schemes with a wage-indexation.

<sup>66</sup> For an illustration we want to imagine a final earnings scheme where the pension level depends on the last earnings in the year before retirement. We want to compare the initial pension benefit of a 60 year old new retiree in 2010 and a 60 year old new pensioner in 2020. Due to the future general wage growth the last earnings of the new retiree in 2020 are expected to be higher than the last salaries of its '2010-counterpart'. In accordance with the benefit formula, also the initial pension benefit of '2020-retiree' would be greater than the pension payment of the new retiree in 2010. This example outlines that even if past earnings are 'only' indexed to prices, wage increases need to be considered under the homCC approach.

<sup>67</sup> As stated in chapter 17 of the ESA 2010(paragraph 17.177) the PBO approach should be followed where the benefit formula 'includes implicitly or explicitly a factor for wage increases (before or after retirement)'. With the PBO approach reference earnings applied in the pension benefit formula are projected over the entire (remaining) contribution career. In this sense the PBO approach is similar to the projected unit credit method — widely used in the private sector accounting (e.g. in IAS).

<sup>68</sup> It should be noted, that the accrual factor can also be applied — after a few modifications — for the calculation of ABO entitlements.

accrued proportion of the full pension under the PBO approach depends on contribution periods (see Equation 12).

$$(12) \quad \lambda = \frac{c^{base\ year}}{c^{retirement}} \approx \frac{x - e}{l - e}$$

Where

$c^{base\ year}$  = the contribution periods of the participant until the base year,

$c^{retirement}$  = the total expected contribution periods of the participant until retirement,<sup>69</sup>

$x$  = the age of the participant in the base year,

$e$  = the age at which the participant entered the pension scheme,

$l$  = the expected retirement age of the pension scheme participant,<sup>70</sup>

As outlined in Equation 12, the level of the accrual factor depends on the ratio of contribution years accrued until the base year ( $c^{base\ year}$ ) to the (expected) total number of contribution years upon retirement ( $c^{retirement}$ ). A longer accrued contribution period automatically translates into higher pension entitlements.

In the absence of data on contribution years accrued until the base year ( $c^{base\ year}$ ), this figure can be approximated by subtracting the age at which the scheme member started paying contributions ( $e$ ) from the age in the base year ( $x$ ) — as outlined in Equation 12. The value of total contribution years upon retirement ( $c^{retirement}$ ) is then calculated in the same way. To illustrate the approach to estimating the accrual factor further, some illustrative examples are given in Box 10.

<sup>69</sup> In case of disability pensions  $c^{retirement}$  denotes the total contribution periods of the participant when he/she is expected to become disabled while in case of survivors' pensions  $c^{retirement}$  represents the total contribution periods at the expected age of death of the pension scheme participant.

<sup>70</sup> Please note that this definition holds for old age and early retirement pensions. In case of disability pensions  $l$  denotes the age when an individual is expected to become disabled while for the estimation of survivors' pensions  $l$  represents the expected age of death of the pension scheme participant. For a further discussion on a differentiation of the estimations by pension type see section 7.4.4.



### Box 10

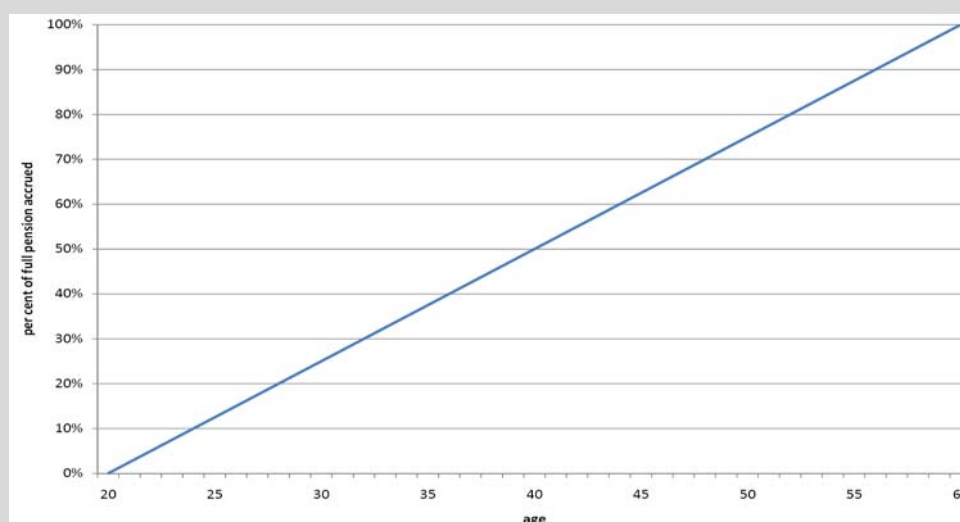
#### Estimating pension entitlements for current contributors — the accrual factor

The case of an average contributor, aged 40 in the base year 2010, will provide an example of how to estimate the accrual factor. Selection of a base year always refers to the situation at the end of that year. This case takes a 40-year-old at the end of 2010 with, for simplicity, a birthday at the beginning of 2011. The 40-year-old is assumed to have accrued 20 out of 40 contribution years in a final-earnings pension scheme, and is expected to retire at the age of 61. The accrual rates applied in the benefit formula are constant over the contribution career. Under the PBO approach, this individual is not yet entitled to a full pension. In fact, he/she has accrued 50 per cent of his/her full pension. This value is calculated on the basis of the relative contribution history. The 40-year-old can only look back on 20 contribution years out of 40 (expected) contribution years. For the calculation of entitlements, the accrual factor would, therefore, amount to 0.5.

A 21-year-old contributor who also started to contribute at the age of 21 and who likewise looks forward to retiring at 61 with 40 contribution years is, however, entitled to a considerably lower future pension benefit as of end-2010. At the end of the base year, this individual can look back on just one contribution year out of an expected 40. Due to this relatively short contribution record, this contributor has accrued pension rights amounting to only 2.5 per cent ( $=1/40$ ) of his/her (expected) full pension. Figure 17 illustrates the relationship between the proportion of the full pension accrued-to-date and the relative contribution history. It displays the accrual factor for each age group. To keep the example simple, it is assumed that one contribution year is accrued in each year of the contribution career.

Figure 17

#### Proportion of full pension accrued-to-date (PBO approach)



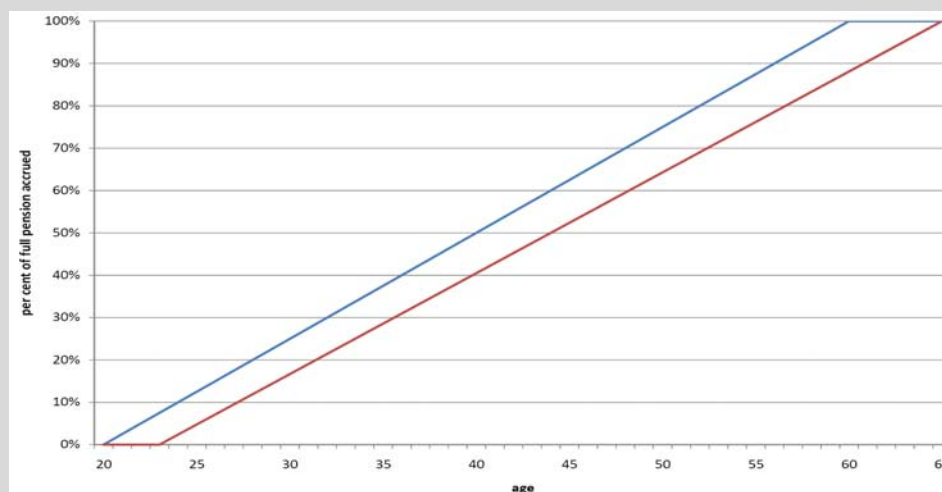
Source: Forschungszentrum Generationenverträge, University of Freiburg.

Of course, the proportion of the full pension accrued-to-date depends on the starting and finishing point of the individual contribution career. A further example is a 40-year-old contributor who started to contribute at the age of 24 and who can be expected to retire at 66. This 40-year-old would not be

entitled to 50 per cent of his/her full pension benefit, but only to roughly 38 per cent (=17/42) — see Figure 1.<sup>71</sup>

**Figure 18**

**Proportion of full pension accrued-to-date (PBO approach) — varying contribution behaviour**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

The examples outline that the starting point (the age at which contributions are first paid) as well as the finishing point of the contribution career (the expected retirement age) are significant for the estimation of the accrual factor. The choice of these parameters is outlined below.

### ***Choosing the age to pay first contributions***

For the estimation of the accrual factor, the number of contribution periods accrued until the base year are required. If such data is not available, one may approximate this figure on the basis of the average age at which contributions are first paid (see Equation 12). Generally, this starting point is usually at the age of 20 across European pension schemes. However, in government employee pension schemes, the age may vary due to specific employment policies in the government sector. The age at which contributions are first paid can be derived from contribution data which is usually obtainable from the institutions responsible for the respective pension scheme. It can differ by birth cohorts and gender.<sup>72</sup>

<sup>71</sup> Of course, it has to be considered that a relatively longer contribution period (in the example 42 instead of 40 years) may also lead to comparably higher full pension levels.

<sup>72</sup> To limit the data input one may base the estimations on one single average age to pay first contributions for all current contributors. For example, it may be assumed that all contributors started their contribution career on the age of 20 years — if this is reflected in the data. Nevertheless, it is recommended to apply a differentiation by birth cohorts and gender.

### **Choosing the expected retirement age**

For the choice of the end of the contribution career, one has to make assumptions regarding future retirement age. One option is to assume a constant retirement behaviour, but a change in retirement behaviour in future may be considered. For further discussion on the choice of retirement age, see Box 11 below.

#### **Box 11**

#### **Choosing the retirement age**

To estimate pension entitlements, various assumptions on future retirement age are possible. There is a choice between constant or changing retirement behaviour, as well as between homogeneous or heterogeneous retirement behaviour. Below, we discuss the appropriate choice of assumptions.

#### ***Constant vs. changing retirement behaviour***

One option is to assume constant retirement behaviour. We assume that future pensioners will retire at the same age as their current counterparts. Of course, such a scenario is only appropriate if the pension legislation allows current retirement behaviour to be prolonged into the future. In some countries, such as the UK or Malta, the age of retirement will gradually rise in the coming decades. For these countries, a constant retirement approach would not be suitable. The future expected retirement age should always be chosen in accordance with future legal retirement ages (it has to be underlined that only changes of the statutory retirement age which have been legislated until the base year are considered in the estimations).

Alternatively, one may assume changing retirement behaviour on the basis of behavioural forecasts. For some countries, there are authoritative predictions on future retirement choices. Berkel and Börsch-Supan (2004) provide such a forecast for Germany.

It should be noted that the choice between a constant and changing retirement behaviour should have no impact on the level of pension entitlements if the respective pension scheme can be considered actuarially neutral (actuarial neutrality in the context of pension systems means that the present value of accrued pension entitlements does not change due to an earlier or later pension start date. For a detailed description of this concept see Queisser and Whitehouse (2006). As these authors indicate numerous pension systems in the OECD cannot be considered actuarially neutral. A substantial number of countries do subsidise early retirement and penalise late retirement since pension decrements as well as increments are lower than an actuarial neutral rate. In these countries one would overestimate (underestimate) pension entitlements with the constant retirement behaviour assumption if future pensioners will decide to retire later (earlier) than today.

***Homogeneous vs. heterogeneous retirement behaviour***

When choosing the assumption on future retirement age, the question arises as to whether to consider retirement ages as homogeneous or heterogeneous. Should a single retirement age be assumed for all contributors, or not? As a starting point, it is sufficient to take one retirement age, preferably the average retirement age, as a basis (however, a differentiation between genders is highly recommended since retirement behaviour usually differs considerably between males and females). If possible, however, heterogeneous retirement ages should be taken into account. Box 1 provides a further description of how to include heterogeneous retirement behaviour in the calculation of pension entitlements, under the homCC approach.

***Considering pension increments and decrements***

For the estimation of pension entitlements, it is important to consider that the level of pension benefits depends on the choice of future retirement age. In most pension schemes, retirement after (before) the legal retirement age leads to an increase (decrease) in annual pension benefits. Such pension increments (decrements) should always be taken into account in the calculations.

**Box 12****Taking into account heterogeneous retirement behaviour**

Usually, retirement ages vary between males and females. Different retirement behaviour may also be observed within a cohort. Some individuals may choose to work until the age of 65, while others prefer to retire at 60. How should such heterogeneous retirement behaviour be taken into account? To give an illustration, let us return to the example of the average 40-year-old contributor (see). As stated, this contributor can look back on a contribution history of 20 years. For the example with heterogeneous retirement behaviour, let us assume that the probability of this person retiring at the age of 61 is 50 per cent. Furthermore, he/she might retire at 60 (with a probability of 25%), or at 62 (with a probability of 25%). Pension entitlements are calculated separately for each of these three retirement paths. In the first path, the 40-year-old individual is assumed to retire at 60, and has therefore accrued-to-date 51 per cent ( $=20/39$ ) of his/her full pension for that retirement age. According to the second path, he/she is expected to work until the age of 61, and has consequently accrued-to-date 50 per cent ( $=20/40$ ) of the full pension to which they will be entitled at the age of 61. The third path is calculated analogously, resulting in an accrual factor of 0.49. Of course, it has to be considered that in most pension schemes a later retirement age would result in a higher full pension level. This issue will be discussed below. Finally, the sum of these pension rights, weighted with the respective probabilities, represent the pension entitlements of the 40-year-old female contributor.

Equation 13 provides a formal outline of the procedure to calculate pension entitlements with heterogeneous retirement behaviour under the homCC approach (please note that Equation 13 can be applied for old age

and early retirement pensions). For the consideration of other pension types, such as e.g. disability pensions (see Box 18) In fact, this formula represents an extension of Equation 5. In Equation 13, the final entitlements  $E_{x,g,b}$  of a contributor are reflected by the probability-weighted sum of pension entitlements for each possible choice of the retirement age  $l$  ( $x < l \leq l^{max}$ ). Furthermore, the accrual factor  $\lambda_{x,g,l,b}$  as well as the annual pension benefit  $B_{s,g,l,b+s-x}$  depend on the respective choice of the retirement age  $l$ .

$$(13) \quad E_{x,g,b} = \sum_{l=x+1}^{l^{max}} [\lambda_{x,g,l,b} * q_{x,g,l,b} * (\sum_{s=l}^D B_{s,g,l,b+s-x}^{full} * p_{s,g,b+s-x} * (1+r)^{x-s})]$$

where

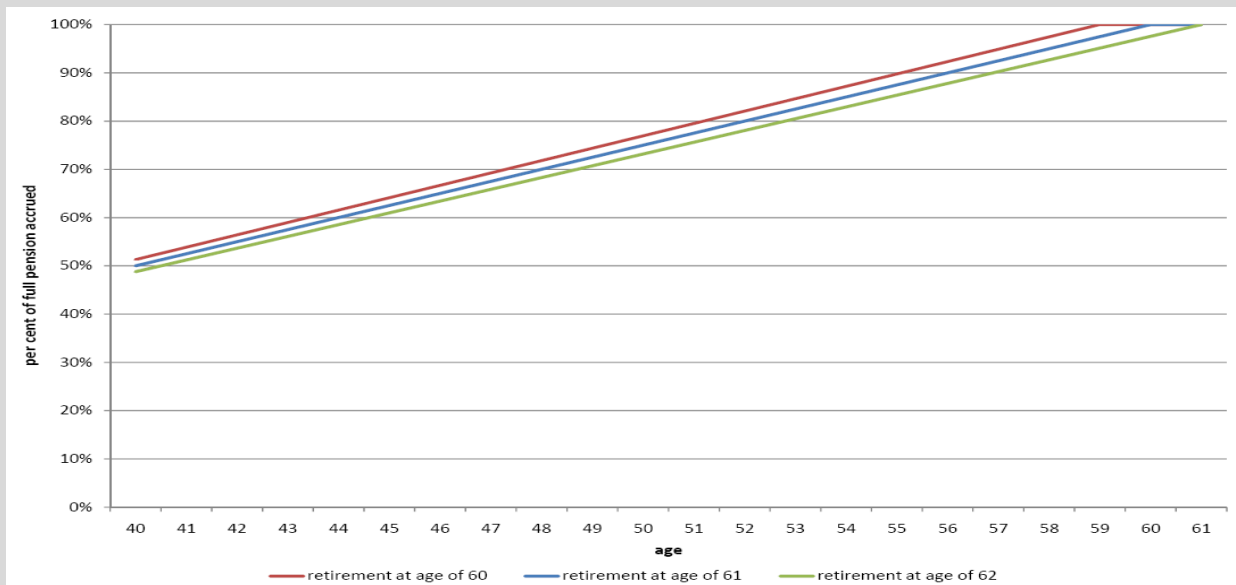
$l^{max}$  = the highest possible retirement age,

$\lambda_{x,g,l,b}$  = the accrual factor for a given retirement age  $l$ ,

$q_{x,g,l,b}$  = the probability of a  $x$  year old in the base year  $b$  to retire at age  $l$ ,

$B_{s,g,l,b+s-x}^{full}$  = the annual full pension benefit of a  $s$  year old in the year  $b+s-x$  after retirement at age  $l$ .

**Figure 19**  
**Accrual factors considering different retirement ages**



### 7.4.3 Estimating the initial pension by applying heterogeneous contribution careers

A more detailed approach to estimating pension entitlements represents the consideration of heterogeneous contribution careers (hetCC). This procedure allows the contribution career of a future new retiree to differ from those of current pensioners. For example, due to longer unemployment or education periods for younger age groups, contribution careers

may vary considerably between birth cohorts.<sup>73</sup> To consider such heterogeneity, comprehensive data on the contribution history of current contributors need to be collected. On this basis, the accrued-to-date pension benefit ( $B_{accrued}$ ) at the future point of retirement  $r$  is directly estimated, and later projected over the remaining retirement phase.

The way in which the past contribution career precisely translates into pension entitlements varies from pension scheme to pension scheme and is formulated in the respective benefit formula. Therefore, before describing the required steps to estimate  $B_{accrued}$  of current contributors, it is useful to classify government-managed employee pension schemes more closely with regard to the benefit formula applied. Across Europe, pension schemes may be distinguished as follows:

- 1) **flat-rate pension schemes**
- 2) **earnings-related pension schemes**
  - final earnings schemes*
  - pension account schemes*

In flat-rate pension schemes, the final pension level depends on the individual's number of contribution or residence years, as well as on a certain benchmark pension. In earnings-related pension schemes, on the other hand, the level of benefits depends not only on the number of years during which contributions were made, but also on the amount of reference earnings or contributions during the contribution career. Earnings-related pension schemes can be further differentiated into final earnings types and pension account types. A more detailed classification of pension schemes with respect to the benefit formula is provided in Box 13.

### Box 13

#### Classification of pension schemes with regard to the benefit formula

*In all government-managed defined benefit pension schemes covered in the supplementary table, the calculation of pension benefits is based on the past contribution career of scheme participants. How this past contribution career precisely translates into pension benefits and entitlements varies from one pension scheme to another and is formulated in the benefit formula. It is useful to classify these pension schemes with regard to the benefit formula applied. In this context, dividing pension schemes into flat-rate and earnings-related schemes.*

Flat-rate pension schemes can be found in the Netherlands or in the UK, for instance. They provide a basic flat-rate pension (in the UK also earnings-related public pension schemes can be found.<sup>74</sup> In these schemes, the final pension level depends on the individual's number of contribution or residence years ( $C$ ) as well as a certain benchmark pension ( $BP$ ), as outlined in Equation 14. The  $BP$  is, generally, the highest possible pension one can receive after a certain number of contribution

<sup>73</sup> Such differences are also referred to as *cohort effects*.

years.

$$(14) \quad B^{accrued} = \textit{benefit formula}(C, BP)$$

Most other European countries — such as France, Poland, Greece and Germany — feature **earnings-related** pension schemes. In these schemes, the level of benefits depends not only on the number of years of contribution, but also on the amount of reference earnings or contributions during the contribution career. All earnings-related pension schemes are based — at least to some extent — on the principle of equivalence. According to this notion, higher reference earnings should result in higher pension benefits. This aspect plays a role and should be reflected in estimates of pension entitlements.

Earnings-related pension schemes can be differentiated further with respect to their benefit formula. Traditionally, benefit formulas across Europe are designed as **final earnings schemes**. In such schemes, the pensions are calculated, as the name implies, on the basis of final earnings ( $FE$ ) before retirement. These  $FE$  may comprise the earnings over the entire contribution career, or over a shorter period, such as the last year or the last 10 years before retirement. Furthermore, benefit formulas of final earnings schemes explicitly take into account the number of past contribution years ( $C$ ) and generally also a so-called accrual rate ( $AR$ ).

A formal outline of the calculation for accrued-to-date pension benefits in final earnings benefit formulas is provided in Equation 15. The earnings-related part of social security pensions in the Czech Republic is an example of a final earnings scheme. In this scheme, future pension benefits are calculated by multiplying contribution years by the accrual rate (amounting to 0.015) and the respective reference earnings<sup>75</sup>.

$$(15) \quad B^{accrued} = \textit{benefit formula}(FE, C, AR)$$

In recent years, final earnings benefit formulas have been replaced in many countries by **pension account schemes**. The characteristic of such schemes is that individual contributions are directly converted and recorded in an individual pension account ( $PA$ ). In comparison to final earnings schemes, individual accounts are explicitly considered in the benefit formula — see Equation 16.

$$(16) \quad B^{accrued} = \textit{benefit formula}(PA)$$

Typical examples of such pension account schemes are notional defined contribution (NDC) accounts, as found in Poland, Latvia, Italy or Sweden. In these systems, the amount of yearly individual contributions is directly transformed into an equivalent increase in individual pension accounts. Pension point systems, found in Germany or Slovakia, are also examples of pension account benefit schemes. In these schemes, individual earnings translate into a certain level of pension points, recorded in individual accounts.<sup>76</sup>

The following description distinguishes between flat-rate pension schemes and two types of earnings-related pension schemes, namely final-earnings and pension accounts types.

<sup>74</sup> In the UK also earnings-related public pension schemes can be found.

<sup>75</sup> Currently reference earnings in this scheme cover all earnings since 1985.

<sup>76</sup> Generally, one pension point is accrued by contributors who earn in a certain year the average earnings in the economy. Higher or lower salaries result in increased or diminished pension point values per year.

### **Collection of data on the past contribution career**

In a first step, data on the contributions of current contributors need to be collected. The extent of data required depends on the benefit formula of the respective pension scheme.

In a flat-rate pension scheme like those found in the Netherlands, the accumulated number of contribution or residence years should be taken into account. It is useful to collect past contribution data broken down by one-year age groups and by gender. This are data for the accumulated contribution years for an average  $x$  year-old male, an average  $x$  year-old female, an average  $x + 1$  year-old male, an average  $x + 1$  year-old female and so forth.

In earnings-related pension schemes, additionally, past earnings or contributions of current contributors should be considered. This past contribution data depend on the type of earnings-related pension scheme. The following description, therefore, distinguishes further between final earnings and pension accounts schemes.

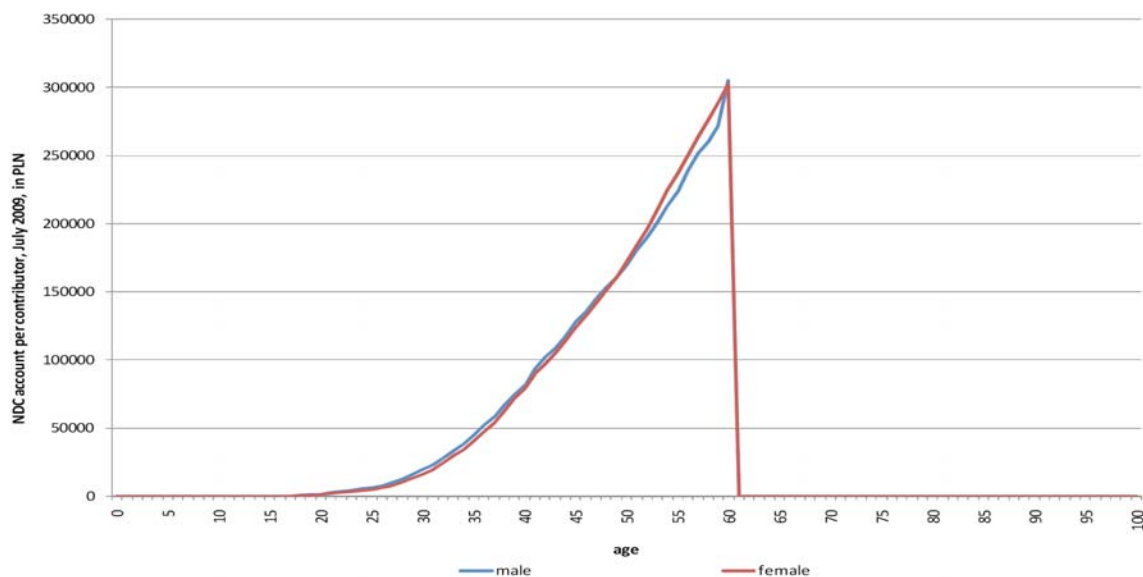
For pension accounts schemes, past earnings/contributions are, generally, already accumulated in individual pension accounts. These accounts facilitate the collection of contribution data since they also reflect (implicitly) the number of past contribution years. For pension schemes classified as pension accounts, the recommendation is to collect past contribution data broken down by one-year age groups and by gender. An example of such data is presented in Figure 20, which displays the required average notional defined contribution accounts, distinguished by age and gender, in the case of Poland.<sup>77</sup>

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<sup>77</sup> Contributors older than 60 years have no NDC account in the Polish general pension system. They are insured according to the old, pre-NCD pension rules. For a description of the pension system and the use of this data to project future pension levels see Jablonowski et al. (2010), p. 26-36.



**Figure 20**  
**Value of NDC accounts differentiated by age and gender**



Source: Forschungszentrum Generationenverträge, University of Freiburg, based on data provided by the Polish social insurance institution (Zakład Ubezpieczeń Społecznych, ZUS).

In pension schemes classified as final-earnings types, such as those in Bulgaria or Portugal, past reference earnings and the number of contribution years of current contributors need to be collected, preferably broken down by one-year age groups and by gender, that is, data for past reference earnings and the number of contribution years for an average  $x$  year-old male, an average  $x$  year-old female, an average  $x+1$  year-old male, an average  $x+1$  year-old female, and so forth.

On the basis of the contribution data, future initial pension levels accrued-to-date can be calculated. Below, this estimation procedure is outlined separately for 1) flat-rate, 2) final earnings and 3) pension account schemes.

### ***I. Estimation of accrued pensions in flat-rate pension schemes***

The aim is to estimate the annual accrued-to-date pension benefit  $B_{accrued}$  of current contributors at the point of their future (expected) retirement. For flat-rate pension schemes, this calculation is relatively simple. In a first step, the future retirement age of current contributors should be set. A discussion on the appropriate choice of future retirement ages is provided in Box .

As a second step, the information about accumulated contribution or residence years in the base year  $C_{base\ year}$  is applied in the respective benefit formula.

$$(17) \quad B_r^{accrued} = \text{benefit formula}(C_{base\ year}, BP_r)$$

Furthermore, it is necessary to project in a third step the benchmark pension  $BP$  from the base year  $b$  to the future year of retirement  $r$ . Here — in accordance with the PBO approach — the annual adjustments of  $BP$  starting from the year after the base year  $b$  until the year of retirement  $r$  should be considered (see Equation 18). In most flat-rate pension schemes, wage indexation is applied. But other indexation arrangements, such as an adjustment for prices, can also be found. In correspondence with the indexation rules, the level of the  $BP$  is adjusted annually by a factor  $v$  — as outlined in Equation 18.<sup>78</sup>

$$(18) \quad BP_r = \prod_{s=b+1}^r [1 + v_s] * BP_b$$

An example of the procedure to estimate  $B^{accrued}$  in flat-rate pension schemes on the basis of the hetCC approach is provided in Box 14.

#### Box 14

##### Estimation of accrued pensions in a flat-rate pension scheme

Below is a case study on how to estimate annual accrued-to-date pensions at retirement in a flat-rate pension scheme. The example is an average 50-year-old male contributor who participates in a flat-rate pension scheme, similar to the basic state pension scheme in the United Kingdom.

The final basic pension level received at the point of retirement depends solely on the number of contribution years the individual accumulates. A ‘full basic pension’<sup>79</sup> (FBP) — corresponding to the benchmark pension in the general description above — is granted if 30 or more contribution years have been earned. In the example given, the FBP would amount to EUR 5,000 in the base year. Furthermore, it is assumed that the FBP is adjusted annually for wage growth in the economy. The example assumes constant future wage growth of 1.5% (in real terms). Pensions are reduced if fewer than 30 qualifying years have been accrued. More precisely, the number of qualifying years is compared to the number of years needed for a FBP (30 years). This ‘contribution years ratio’ is then multiplied by the amount of a FBP (in the retirement year) to estimate the individual pension level at retirement. In the example, the representative 50-year-old male contributor has accumulated on average 23 contribution years. To keep the description simple, it is further assumed that all contributors retire at the age of 65. This representative 50-year-old contributor will retire 15 years after the base year.

The estimation of  $B^{accrued}$  of the 50-year-old contributor would be as follows: First, the ratio of contribution years accrued until the base year (23 years) to the number of years needed for a FBP (30 years) is calculated — amounting to about 76 percentage points. Thereafter, in accordance with the PBO approach, the FBP is projected to the year of retirement  $r$ . Finally, both the contribution years ratio and the projected

<sup>78</sup> Often a time lag of one or two years is set in the benefit formula. In other words pensions are indexed to the wage growth one or two years before the base year. The impact of indexation can be considerably. In the example given in Box 1 the level of a full basic state pension in 15 years — when the current 50 year old will retire — would increase by roughly 25 per cent (in real terms) with a wage indexation in comparison to an indexation with prices.

FBP are multiplied to estimate  $B^{accrued}$  at the point of retirement.

$$(19) \quad B_{50,male,r}^{accrued} = \frac{23}{30} * [(1.015)^{15} * 5000 \text{ €}] \approx 4800 \text{ €}$$

As outlined in Equation 19, the 50-year-old male contributor would be entitled to an annual pension benefit of roughly EUR 4,800 at his (expected) retirement age.

## II. Estimating accrued pensions in final earnings schemes

In final earnings schemes, pension levels depend not only on the number of contribution years accumulated until the base year ( $C_{base\ year}$ ), but also on final earnings before the retirement year  $r$  ( $FE_r$ ). Moreover, in most final earnings schemes, an accrual rate ( $AR$ ) is applied. For the estimation of  $B^{accrued}$  of current contributors, all the factors outlined above should be taken into account (see Equation 20).

$$(20) \quad B_r^{accrued} = \text{benefit formula}(FE_r, C_b, AR)$$

Most of the above-mentioned input factors can be relatively simply obtained from past contribution data. This includes information about  $C_b$  but also about past earnings until the base year  $b$ . Furthermore, the  $AR$  is defined in the respective benefit formula and can therefore be directly applied in the estimations.

For the estimation of ABO pension entitlements, the above-mentioned input data would be sufficient.<sup>79</sup> However, to estimate pension entitlements with the PBO approach — described in Chapter 2.2 — some further steps need to be taken: future wage increases have to be considered for the estimation of  $B^{accrued}$ . This involves a projection of future earnings periods. The framework and the assumptions of such a projection are outlined below.

### Defining the starting and finishing point of the projection

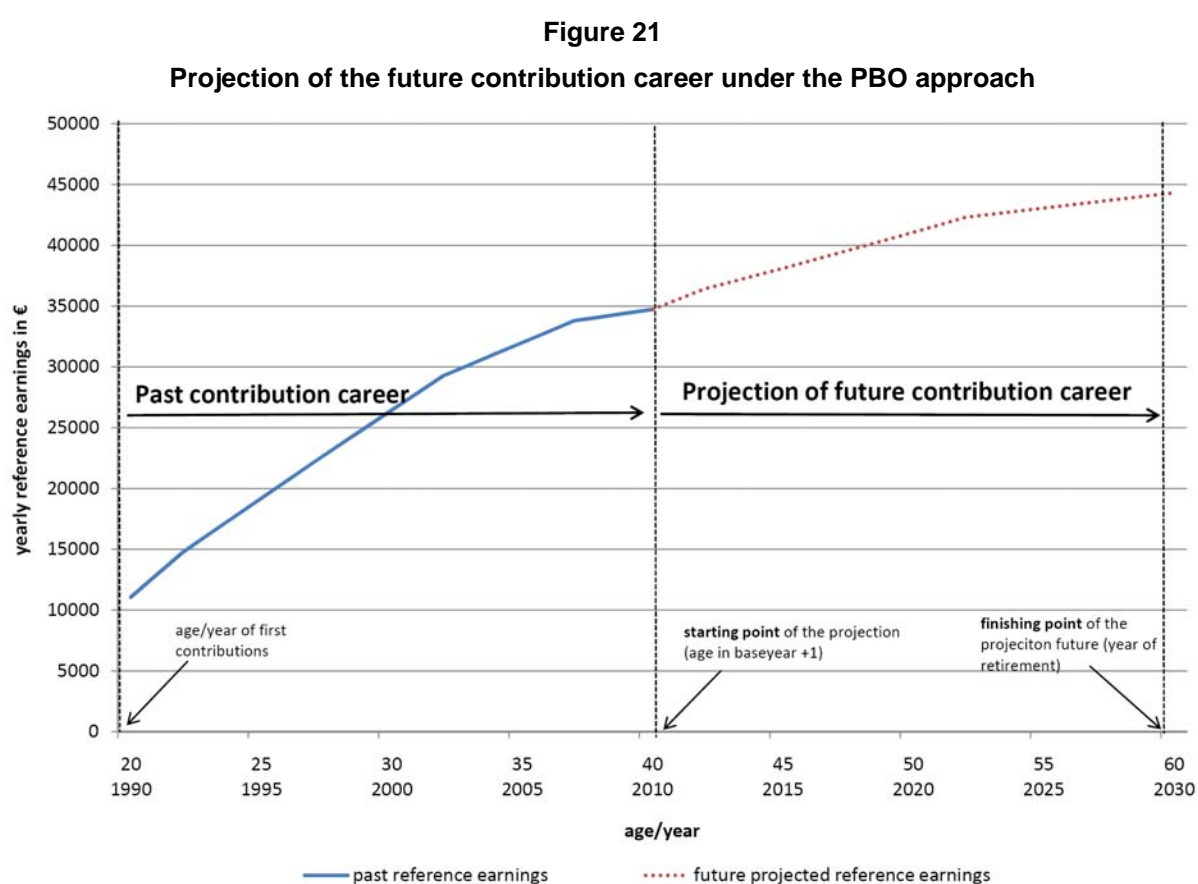
First, it is important to set the starting and finishing point of the required projection. Commonly, the projection of the future contribution career should start after the year for which the latest data on past earnings is available. Since the aim is to estimate pension

<sup>79</sup> A 'full basic pension' should not be mixed up with the term 'full pension'. The latter expression represents a pension benefit received after a full contribution career, while a 'full basic pension' is granted after 30 contribution years.

<sup>80</sup> Under the ABO approach only reference earnings until the base year are applied for the estimation of  $B^{accrued}$ . This approach requires no projection of future wage increases.

benefits upon retirement, the natural finishing point of the projection is the year  $r$  in which the respective contributor is expected to retire. A discussion on the appropriate choice of future retirement ages is provided in Box 11.

The example is an average 40-year-old contributor in base year 2010. He is expected to retire at the age of 60. Data on his past contributions are assumed to be available until the base year 2010.<sup>81</sup> Figure 21 illustrates the required projection period for this example. Data on his past contribution career — reflected by past reference earnings — is obtainable until the base year. For all future years, starting from 2011, until the year 2030,<sup>82</sup> when he is expected to retire, his contribution career needs to be projected.



Source: Forschungszentrum Generationenverträge, University of Freiburg.

### **Required assumptions for the earnings projection**

Generally, the development of individual future earnings depends on two main factors:

<sup>81</sup> Sometimes data on the past contribution may only be available for years before the base year. Of course, in such a case the projection of the future contribution career may begin already in the base year or even in the years before.

<sup>82</sup> To be precise, the projection should finish already at the end of the year 2029 in this example. If the contributor is expected to retire in beginning of 2030 his contribution career finishes at the end of 2029.

### 1) future promotions and

### 2) future general wage growth in the economy

To project future earnings over the (expected) remaining contribution career, assumptions about these two factors need to be taken. The choice and application of these is described in detail below.

As outlined in Chapter 5.2, it is recommended to forecast future promotions on the basis of profiles reflecting the reference earnings or contributions for different age groups and genders. Figure 22 shows such an earnings profile for contributors to the German statutory pension scheme (DRV). The profile reflects a number of factors which might vary by age and gender, such as the average wage paid per hour, the number of hours worked per year, the part-time employment of older (55+) and younger cohorts (20 to 25) and so forth. For the following description, all these factors will be summed up by the term ‘promotions’. The picture makes clear that earnings vary over the working career. Generally, salaries increase with age and decline slightly before retirement. In this sense, the profile shown displays the usual hump shape which can be found in many European countries.

Figure 22



Source: Forschungszentrum Generationenverträge, University of Freiburg, based on data for 2006 provided by the Deutsche Rentenversicherung (DRV).

For the projection of the future contribution career, it is appropriate to base the calculation on a constant earnings or contribution profile over time. A current average contributor

'walks' along this profile over his/her remaining employment life cycle until retirement. Equation 21 provides a formal outline of how to calculate future earnings with this approach.

$$(21) \quad w_{x,y,m} = w_{y,b} * \prod_{i=b+1}^m [(1 + \pi_i) * (1 + g_i)]$$

where

$x$  = the age of a participant whose future earnings shall be projected,

$y$  = the future age of the participant ( $y > x$ ),

$w_{x,y,m}$  = the projected earnings of the current  $x$  year old participant than he/she reaches the age of  $y$  in the future year  $m$ .

$m$  = the future year for which the wage of a current participant is projected

$$(m = b + (y - x)),$$

$w_{y,b}$  = the earnings of a current  $y$  year old in the base year  $b$ ,

$\pi_i$  = the inflation rate in a future year  $i$  ( $b + 1 \leq i \leq m$ ),

$g_i$  = the general wage growth in a future year  $i$  ( $b + 1 \leq i \leq m$ ).

On the one hand, future earnings are determined by future promotions. According to the formula outlined above, a current pension scheme member aged  $x$  can expect to receive the same earnings at age  $y$  as a current member aged  $y$ . On the other hand, future salaries increase by inflation  $\pi$  and general wage growth in the economy  $g$ . Of course, inflation should only be considered if the calculation is carried out in nominal terms.<sup>83</sup>

Data used for earnings profiles can usually be obtained from the institution responsible for the pension scheme. Household surveys can be an alternative data source. For a further discussion on data sources, see Chapter 6.3.2. As outlined in Section 5.2, the AWG assumptions on future labour productivity growth provide a suitable basis for estimating general wage growth in the economy.<sup>84</sup>

With the application of the earnings profile and the assumption on general wage growth and inflation (if required), earnings can be estimated for each year of the individual's future contribution career. For an example showing how to project future earnings, see Box 15.

<sup>83</sup> For a further discussion see section 5.4.1.

<sup>84</sup> For a more detailed discussion on the future wage growth assumption see chapter 5.2.

**Box 15**

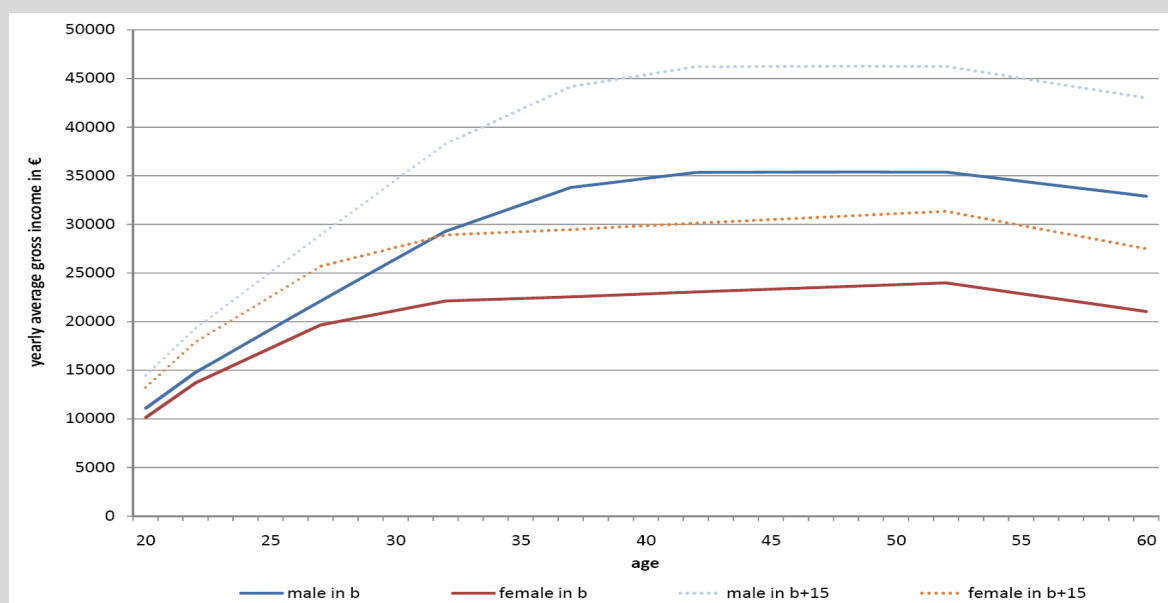
**Projection of future earnings**

The following case study illustrates a projection of future earnings. This example takes the case of a 25-year-old man, an average contributor who is expected to follow the earnings profile shown in Figure . The aim is to calculate his projected earnings at the age of 40. Of course, the same approach can also be applied to other periods of the individual's contribution career.

The projection is carried out in real terms, i.e. inflation is disregarded. In base year *b*, the contributor earns about EUR 20,000 (see Figure 23). Assuming a constant earnings profile over time, he can expect to earn a 75 per cent higher wage at the age of 40 (in 2021), due to career progression. However, there are factors other than promotions to consider for the projection of his future contribution career. The level of future contributions and reference earnings is also affected by general wage growth in the years until 2021. The assumption here is that annual real wage growth in the economy is 1.5 per cent, and that all employees benefit equally. Under these assumptions, the 25-year-old contributor can expect to improve his relative income position in the workforce due to promotions as well as from general wage growth in the economy. In quantitative terms, this implies that in 15 years' time, he will exceed the earnings of a current 40-year-old contributor, about EUR 35,000 annually. When the 25-year-old reaches the age of 40, he can expect future earnings of about EUR 45,000 due to general salary growth. The dotted lines in Figure 23 illustrate the increase in the earnings profile due to expected wage growth after 15 years.

**Figure 23**

**Age- and gender-specific earnings profile considering general wage growth (DRV 2006)**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

For the estimation of  $B_p$  a number of further aspects of the benefit formula need to be taken into account, such as the definition and valorisation of final earnings. The most important issues are discussed below.

### Defining final earnings

Generally, final earnings reflect the average of annual reference earnings ( $RE$ )<sup>85</sup> over the last  $n$  years before retirement (as outlined in Equation 22).

$$(22) \quad FE_r = \frac{\sum_{t=(r-1)-(n-1)}^{r-1} RE_{t,r}}{n}$$

The calculation of final earnings may differ widely from one pension scheme to another. In most pension schemes across Europe, not all contribution periods until retirement age are relevant for the pension calculation. In some schemes, only the earnings in the last three years before retirement matter (e.g. in the German civil servants pension scheme). In other pension schemes, the reference earnings of the best 25 years (e.g. in France) before retirement or even of the entire contribution career (e.g. in Slovakia) are taken into account. The length of the contribution career considered in the benefit formula can have a significant impact on future pension levels.<sup>86</sup> It is important to reflect this aspect in the estimation of ~~past earnings~~. The definition of final earnings should, therefore, always be chosen precisely in accordance with the benefit formula. Furthermore, it has to be considered that these past earnings are usually valorised to the point of retirement  $r$ . This aspect is described below.

### Indexation of past earnings

To estimate future pension levels, the indexation of reference earnings until the point of retirement should be reflected. These adjustments are also referred to as pre-retirement indexation. Most pension schemes across Europe apply indexation to past earnings according to wage growth in the economy.<sup>87</sup> Only a few pension schemes (e.g. in Portugal) choose a lower indexation of past contributions, using the CPI.<sup>88</sup> In accordance with the benefit formula, a past earning  $w$  in a year  $t$  is indexed by a factor  $v$  until the year of retirement  $r$  (see Equation 23). This valorised past salary represents the reference earning ( $RE$ ) of the year  $t$  applied in the benefit calculation (see Equation 22).

<sup>85</sup> Reference earnings are defined as the past earnings relevant in the benefit formula.

<sup>86</sup> Generally, an extension of the reference earnings translates into a decrease of pension levels — given the ceteris paribus condition.

<sup>87</sup> In these schemes the AWG assumptions on the future labour productivity growth provide a suitable proxy for the future wage growth. For a further discussion see section 5.2.

<sup>88</sup> In fact, in Portugal reference earnings are indexed to the growth of CPI from 2012 onwards. Before the year 2012 a slightly higher indexation is applied. .



$$(23) \quad RE_{t,r} = w_t * \prod_{i=t+1}^r [1 + v_i]$$

### Considering future adjustments to the benefit formula

Besides the contributions career, future changes to the benefit formula should also be taken into account. For example, alterations to accrual rates (e.g. in Austria or Hungary) as well as extensions of the periods relevant for reference earnings (e.g. in Portugal or Malta) should be considered. In some countries, moreover, demographic factors should be applied when estimating the final pension level upon retirement. These factors, often referred to as sustainability factors, link future pension levels to demographic trends and play a role in, for instance, Germany, Austria or Portugal. It is important to stress that only pension reforms which have already been enacted in the base year for calculations should be taken into account.

Once final earnings have been accurately defined and valorised,  $B_{accrued}$  at the point of retirement can be estimated. An example for the estimation of  $B_{accrued}$  at the point of retirement in final-earnings pension schemes (applying the hetCC approach) is provided in Box 16.

#### Box 16

##### Estimation of accrued pensions in a final-earnings pension scheme

The following case study illustrates how to estimate annual accrued-to-date pensions at retirement in a final-earnings pension scheme. Take the case of a 50-year-old male contributor who is a member of a final-earnings pension scheme. The individual pension received at the point of retirement ( $P$ ) will depend on the number of contribution years ( $C$ ), the valorised final earnings of the year before retirement ( $FE$ ) and on an accrual rate of two percentage points.

Equation 24 provides a formal outline of the applied benefit formula.

$$(24) \quad P = FE * C * 2\%$$

To keep the description simple, it is assumed that all contributors retire at the legal retirement age of 65. Moreover, it is assumed that reference earnings are wage-indexed up to the year of retirement. The example assumes constant future wage growth of 1.5% (in real terms). In the base year, the representative contributor earned a salary of EUR 20,000. In the case of the ABO approach, this would be applied as  $FE$ . However, as pension entitlements will be based on the PBO approach, future wage increases need to be taken into account, requiring an earnings projection. According to this projection the representative contributor will earn an (expected) annual salary of EUR 30,000 (in real terms) in the year before his retirement. Of course, in line with the benefit formula, these final earnings need to be valorised to the year of retirement. Here the valorised  $FE$  would amount to EUR 30,450 EUR (= EUR 30,000 \* 1.015) in real terms. Furthermore, this contributor has collected 30 contribution years until the base year.

$$(25) \quad B_{50,male,65}^{accrued} = 30,450 \text{ €} * 30 * 2\% = 18,270 \text{ €}$$

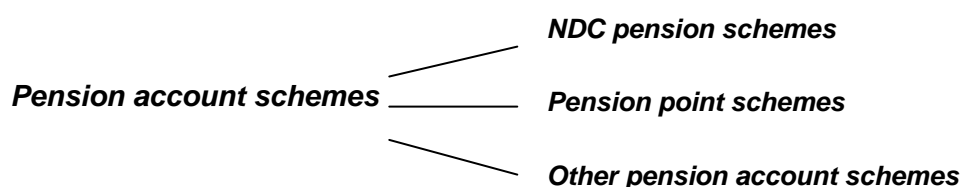
These inputs yield an estimate of the level of  $B_r^{accrued}$  at the future point of retirement  $r$  — as presented in Equation 25. In this example, the 50-year-old male contributor would be entitled to an annual pension benefit of EUR 18,270 at his (expected) retirement age of 65.

### III. Estimation of accrued pensions in pension account schemes

In recent years, final earnings benefit formulas have been replaced in many countries by a pension account scheme. The characteristic of these schemes is that individual contributions are directly converted and recorded in an individual pension account (PA). Individual accounts are explicitly taken into account in the benefit formula — see Equation 26. This aspect distinguishes them from final earnings schemes.

$$(26) \quad B_r^{accrued} = \text{benefit formula}(PA)$$

In pension account schemes, accrued pension rights are reflected by the value of the PA in the base year. In line with the ADL approach, pension rights accrued in future years are not taken into account. The degree to which the level of the pension accounts translates into future pension payments depends on the pension formula used. Pension account schemes can be divided into: NDC, pension point and other pension schemes (as outlined below).



The following description of the estimation of  $B_r^{accrued}$  distinguishes between these three types of pension account schemes.

#### NDC pension schemes

NDC schemes are typical examples of pension account schemes such as those in Poland, Latvia, Italy or Sweden. In these systems, the amount of yearly individual contributions is directly transformed into an equal increase in individual pension accounts.<sup>89</sup>

<sup>89</sup> Characteristic for NDC plans is that their benefit formula mimics the build-up of pension accounts in DC plans. Similarly to DC schemes, individual accounts in NDC schemes already reflect to a certain degree the value of individual pension entitlements — at least of old age pensions. Against this background, one may argue that an estimation of pension entitlements based on a projection of future pension payments is not required in case of NDC schemes because pension entitlements should correspond to the value of the NDC account. However, this

For the estimation of  $B_r^{accrued}$  of current contributors, one has to take into account mainly two factors: 1) the NDC account ( $PA_{b,r}$ ) of the base year  $b$  valorised to the future retirement age  $r$  and 2) the average remaining life expectancy  $LE_r$  at retirement age  $r$  (see Equation 27).

$$(27) \quad B_r^{accrued} = \frac{PA_{b,r}}{LE_r}$$

As a first step, appropriate assumptions about the future retirement age  $r$  of current contributors are needed.<sup>90</sup> As a second step, the base year NDC account ( $PA_b$ ) should be valorised until the future retirement age  $r$  to reflect future wage growth.

$$(28) \quad PA_{b,r} = PA_b * \prod_{i=b+1}^r (1 + v_i)$$

Usually, individual NDC accounts ( $PA$ ) are adjusted annually in accordance with wage bill growth or GDP growth. The indexation rules applied are reflected in the annual valorisation factor  $v$  (see Equation 28). On the basis of these two steps, the level of  $B_r^{accrued}$  may be estimated – as outlined in Equation 27 above.

### Pension point schemes

Pension point systems, such as those in Germany or Slovakia, are also examples of a pension account benefit formula. In these schemes, individual earnings translate into pension points which are recorded on individual accounts.<sup>91</sup> The level of  $B_r^{accrued}$  at the future point of retirement depends on 1) the total number of pension points accrued until the base year ( $TP_b$ ) and 2) the valorised point value in the retirement year ( $PV_{b,r}$ ).

$$(29) \quad B_r^{accrued} = TP_b * PV_{b,r}$$

'non-projection approach' has a number of shortcomings. First of all, the results would not be comparable to the estimations of other countries which apply a (PBO) projection approach based on harmonised assumptions. With the above described 'non-projection approach' also cases where contributors die before retirement cannot be appropriately reflected. Furthermore, a projection is in most NDC schemes required since survivor's pension benefits are usually linked to old age NDC pensions. Against this background, a projection approach as described in Equation 27 should be applied for the calculation of NDC pension schemes. Only if this approach is not yet realisable for a start a 'non-projection approach may be acceptable for the estimation of current contributors' entitlements. In other words under such circumstances the sum of individual pension accounts may serve as a proxy of total current contributors' (old age) pension entitlements.

<sup>90</sup> For a further discussion on the choice of future retirement ages see Box .

<sup>91</sup> Generally, one pension point is accrued by contributors who earn in a certain year the average earnings in the economy. Higher or lower salaries result in increased or diminished pension point values per year.

Generally, the level of  $PV$  is adjusted annually to the growth of average earnings in the economy. But other indexation rules are also possible. The valorisation factor  $v$  reflects the respective indexation rules for the annual adjustments of  $PV$ .

$$(30) \quad PV_{b,r} = PV_b * \prod_{i=b+1}^r (1 + v_i)$$

To take into account future wage growth, the  $PV$  of the base year is valorised until the future point of retirement  $r$  (see Equation 30).<sup>92</sup>  $B_{accrued}$  may then be estimated as outlined in Equation 29 above.

### Other pension account schemes

In all pension account schemes, accrued pension rights are directly reflected in individual accounts. These accounts are then explicitly considered in the benefit formula. Besides NDC and pension point schemes, there are also other forms of pension account schemes. One example is the UK civil service pension scheme, *Nuvos*. In this scheme, participants pay a certain percentage of pension earnings into a *PA* each year. In other words, the amount of yearly contributions is directly transformed into an equal increase in the individual *PA*. Finally, in the year of retirement  $r$  the initial annual pension payment equals the level of the *PA*.

$$(31) \quad B_r^{accrued} = PA_{b,r}$$

For the estimation of  $B_{accrued}$  it is necessary to valorise the base year pension account to the future point of retirement  $r$ . This procedure is outlined in Equation 32. In the case of the *Nuvos* pension scheme, the pension account value of a year  $t$  is increased in line with inflation to the following year  $t+1$ . In fact, under such price indexation, no future wage increases need to be taken into account. As a consequence, the results of the PBO estimation approach would equal the ABO outcomes. Of course, other annual adjustment rules, such as wage indexation, are possible. The valorisation factor  $v$  — in Equation 32 — reflects the indexation rule of the pension scheme analysed.

$$(32) \quad PA_{b,r} = PA_b * \prod_{i=b+1}^r (1 + v_i)$$

<sup>92</sup> For a discussion of the choice of the retirement age see Box 11Box .

#### 7.4.4 Estimating pension entitlements

In the sections above, the procedure to estimate the initial annual pension accrued-to-date  $B_{s,g,f}^{accrued}$  was outlined — applying both a homogeneous (Chapter 7.4.2) and a heterogeneous contribution careers approach (Chapter 7.4.3). In other words, the calculation of the ‘starting pension’ of current contributors was described. On this basis, it is relatively straightforward to estimate pension entitlements of present contributors. First, the initial pension level  $B_{s,g,f}^{accrued}$  at retirement year  $r$  is projected over the entire remaining retirement phase. This projection follows the same procedure described for current retirees. For the projection of current contributors’ benefits, (post-retirement) indexation rules also need to be taken into account. and future adjustments in the benefit formula have to be considered. A more detailed description of the projection of pension benefits over the remaining retirement phase is provided in Chapter 7.3.

On the basis of the benefit projection,  $f(f = b + s - x)$  the annual pension benefit received by a current contributor can be calculated for any future year. To estimate the expected entitlements, future pension payments are weighted in a further step by the respective survival probabilities  $p$ . Finally, all future pension payments are summed up and discounted to the base year (see Equation 33 below).<sup>93</sup>

$$(33) \quad E_{x,g,b} = \sum_{s=x+1}^D B_{s,g,f}^{accrued} * p_{s,g,f} * (1+r)^{x-s}$$

An example of the procedure to estimate pension entitlements for current contributors is provided in Box 17.

#### Box 17

##### Estimation of pension entitlements of current contributors

This case study outlines the estimation procedure to calculate pension entitlements of current contributors. This example is used to calculate the pension rights of a 40-year-old male contributor, base year 2010. This individual is expected to retire at the age of 61 (in 2031). At the beginning of his retirement he can look forward to receiving a full pension benefit of EUR 10,000 (see first green bar, Figure 24), representing a pension payment after a full contribution career.

For the estimation of pension entitlements, however, only accrued-to-date pension benefits are

taken into account. In the example given, the initial annual pension benefit accrued-to-date (B<sub>accrued</sub>) will amount to EUR 5,000 (see first red bar, Figure 24). In other words, the 40-year-old contributor would be entitled only to half of his future (expected) full pension. This proportion has been estimated on the basis of the homCC approach, described in Chapter 7.4.2.

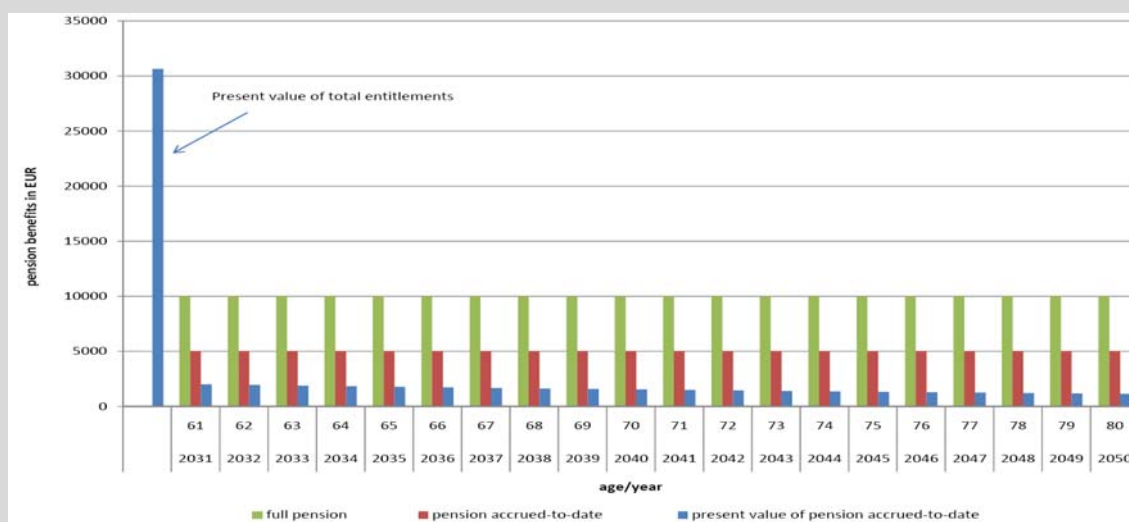
Pensions are paid until his expected death after the age of 80 (after 2050). To keep the case study simple, all values are calculated in real terms and price indexation is assumed. According to these assumptions, he can expect to receive the value of the initial pension over his entire retirement.

The aim is to calculate pension entitlements in the present value terms of the base year. All future accrued pension payments are therefore discounted. Since these future flows are paid out in the far future, in 20 to 40 years they are heavily discounted (see blue bars in Figure 20). At this stage of the estimation, an important aspect becomes apparent. Younger contributors especially have accrued only relatively little pension entitlement. This can be explained by two factors. First, their future pension payments are paid out in the far future, and are therefore heavily discounted. Secondly, they have accrued only a relatively small proportion of their full pension. Therefore, younger cohorts play only a minor role in the total of pension liabilities. This aspect should be kept in mind when setting up a pension model. It is important to focus especially on the estimation of pension entitlements of present pensioners and older contributors, since they have the largest impact on the total value of pension liabilities.

Finally, all discounted accrued-to-date pension payments are accumulated to obtain the stock of pension entitlements. For the example of the 40-year-old male contributor, these pension rights would amount to about EUR 30,000 in the base year (see blue bar to the far left). Analogously, for all other age groups, pension rights should be calculated and projected differentiated by gender.<sup>94</sup>

Figure 24

#### Estimating pension entitlements of current contributors



Source: Forschungszentrum Generationenverträge, University of Freiburg.

<sup>93</sup> Please note that Equation 33 equals Equation 5. For a description of the used parameters and variables see, therefore, Equation 5.

<sup>94</sup> In the given example it was so far assumed that current contributors reach with certainty the age of retirement. This is of course not a realistic presumption since a certain, though, small proportion of contributors is expected to die before they can receive any pension benefits. The aim of the estimations is to calculate the expected pay-out of pension benefits. Therefore, the mortality of current contributors should be taken into account by weighting the final pension with the probability to reach the respective retirement age. This aspect is considered in Box 18 with the probability to die before retirement.

### 7.4.5 Differentiation by type of pension

As outlined in Box 3, the supplementary table covers various types of pensions. The most significant category for the estimation of entitlements is old age pensions. Generally, the largest amount of pension expenditure and entitlements is determined by this type of pension. However, disability, early retirement, widows' pensions and orphans' pensions should also be considered in this new table of national accounts. As an example Table 4 displays the breakdown of aggregate payments by type of pension for the social security pension scheme in Slovakia.

**Table 4**

**Differentiation of aggregate payments by type of pension — the example of the Slovakian social security pension scheme**

Type of pension payments	Pension payments SKK billions, 2007
<b>Total of pension payments</b>	<b>126.519</b>
Old age pensions	96.148
Disability pensions	15.380
Survivor pensions	14.991

It is desirable to distinguish among pension types, for two main reasons: the benefit formula and the resulting pension levels may vary considerably between pension types; and the duration for which participants receive a specific benefit may vary significantly by pension type. While old age pensions, for instance, are granted until death, disability benefits are usually paid until the legal retirement age or the death of the beneficiary.<sup>95</sup> Box 18 outlines how to differentiate the calculation procedure by pension type.

In some countries, however, the data and resources to differentiate by pension types in making the calculations may not yet be available. In such cases, it is best to focus on the calculation of old age pension entitlements, due to their relative importance (see Table 4): a detailed estimation of disability and survivors' pension entitlements (for current contributors)<sup>96</sup> may initially be disregarded.<sup>97</sup> Under such circumstances, the final old age pension

<sup>95</sup> Also pension type specific survival rates may represent a reason to differentiate the calculation by pension type. E.g. survival rates of disabled individuals (persons) may deviate from the average survival rates applied for old age. If possible — as outlined already in section 5.3.1 — such pension type-specific survival rates should be taken into account.

<sup>96</sup> For present pensioners the estimation procedure is more straightforward. For this group a differentiation in the course of the calculations by pension type should, possibly, always be applied.

<sup>97</sup> For the development of a pension model it should always be taken into account which factors play the most decisive role for the final results. Generally, about half of pension entitlements are accrued by current

entitlements of a current contributor should be rescaled by a factor reflecting the ratio of the total aggregate pension payments and the aggregate of old age pension payments in the base year.<sup>98</sup>

**Box 18**

**Differentiation of estimations for current contributors by pension type**

The aim of the calculations is to estimate entitlements for different types of pension: old-age and early retirement, disability and survivors' pensions. The calculation procedure should distinguish between these pension categories. This approach is explained below. The description is provided for a homCC approach. But it is also applicable for a hetCC approach after the consideration of a few minor modifications.<sup>99</sup>

Pension entitlements of current contributors should reflect the fact that these individuals retire with a certain probability  $q_{x,g,d}^{old}$  at age  $d$ , but also that they may become disabled or may die with a certain probability at an age  $d$ . Their pension rights should represent the probability-weighted sum of entitlements for each of these pension types. Equation 34 provides a formal outline of the estimations differentiating by pension type. The formula reflects heterogeneous retirement ages  $d (x + 1 \leq d \leq D)$ .<sup>100</sup> For every  $d$  the accrual factor  $\lambda_{x,g,d,b}$  is calculated. Moreover, the present value of the expected payment stream  $PV$  is calculated for each type of pension considering the type-specific survival rates  $p$  and pension benefits  $B$ .

$$(34) \quad E_{x,g,b} = \sum_{d=x+1}^D [\lambda_{x,g,d,b} * [q_{x,g,d,f}^{old} * PV^{old} + q_{x,g,d,f}^{disab} * PV^{disab} + q_{x,g,d,f}^{surv} * PV^{surv}]]$$

$$PV_{x,g,d,f}^{old} = \sum_{s=d}^{D^{old}} (p_{s,g,m}^{old} * B_{s,g,d,m}^{full,old} * (1+r)^{x-s})$$

$$PV_{x,g,d,f}^{disab} = \sum_{s=d}^{D^{disab}} (p_{s,g,m}^{disab} * B_{s,g,d,m}^{full,disab} * (1+r)^{x-s})$$

$$PV_{x,g,d,f}^{surv} = \sum_{s=d}^{d+D^{surv}} p_{s+u}^{surv} * B_{s,g,d,m}^{full,surv} * (1+r)^{x-s}$$

where

$\lambda_{x,g,d,b}$  = the accrual factor of a participant of age  $x$  and gender  $g$  in the base year  $b$  who retires/becomes disabled or dies at age  $d$ ,

$q_{x,g,d,f}^{old}$  = the probability of a  $x$  year old to retire at an age  $d$  and to receive  $B_{s,g,d,m}^{old}$  in a future year  $f$  ( $f = b + d - x$ ).<sup>101</sup>

contributors. Of these half about 70 per cent are old age pension entitlements. Old age pensions are therefore rather significant for the final level of pension entitlements while disability and survivors' pensions play a less important role. One may conclude that 'only' about 15 per cent of overall pension entitlements are calculated not in depth when disregarding disability and survivors' pensions of current contributors.

<sup>98</sup> This rescaling approach has been applied e.g. by Holzmann et al. (2004), see p.34. In the Slovakian example shown in Table 4 the rescale factor would amount to about 1.3. In this example it is assumed that only old age pension have been calculated in detail by the actuarial model. Of course, it is also imaginable that further types of pensions (besides old age pensions) can be estimated in detail and fewer categories have to be disregarded. In this case the rescale factor would consequently decrease. .



$q_{x|g|d|f}^{dsab}$  = the probability of a  $x$  year old to become disabled at an age  $d$  and to receive  $B^{dsab}$  in a future year  $f$ ,

$q_{x|g|d|f}^{surv}$  = the probability of a  $x$  year old to die at an age  $d$  and to have a surviving spouse/orphan who receives  $B^{surv}$  in a future year  $f$ .

$PV_{x|g|d|f}^{old}$  = the present value of the expected payment stream of old age and early retirement pensions after retirement at age  $d$  in future year  $f$ ,

$PV_{x|g|d|f}^{dsab}$  = the present value of the expected payment stream of disability pensions,

$PV_{x|g|d|f}^{surv}$  = the present value of the expected payment stream of survivors pensions,

$B_{s|g|d|m}^{fullold}$  = the annual full old age or early retirement pension benefit at age  $s$  in year  $m$  after retirement at age  $d$ ,

$B_{s|g|d|m}^{fulldsab}$  = the annual full disability pension benefit at age  $s$  in year  $m$  after the participant became disabled at age  $d$ .

$B_{s|g|d|m}^{fullsurv}$  = the annual full survivor's pension benefit at age  $s$  in year  $m$  after a participant died at age  $d$ ,

$m$  = a future year after retirement/disability/death ( $m = b + s - x$ ),

$D^{old}$  = the highest possible age to receive  $B^{old}$ , i.e. the highest age considered in the calculations,

$D^{dsab}$  = the highest possible age to receive  $B^{dsab}$ ,

$D^{surv}$  = the number of years a spouse/orphan at age  $d + u^{surv}$  can at most receive  $B^{surv}$ ,

$p_{s|g|m}^{old}$  = the probability of an old age pension beneficiary of gender  $g$  to survive an age  $s$ ,

$p_{s|g|m}^{dsab}$  = the probability of a disability pension beneficiary of gender  $g$  to survive an age  $s$ ,

$p_{s+u^{surv}|g|m}^{surv}$  = the probability of a survivor's pension beneficiary of gender  $g^{surv}$  to survive an age  $s + u^{surv}$ ,

$u^{surv}$  = the number of years, positive or negative, that when added to the participant's age (in the year of his death) gives the age of the surviving spouse (in this year).

<sup>99</sup> In case a hetCC approach is applied accrued pension benefits are estimated directly. Therefore, the accrual factor  $A$  would be omitted. Furthermore, annual pension benefits  $B$  would reflect not a full pension but accrued-to-date pension payments estimated on the basis of past contribution data — as described in chapter 7.4.3.

<sup>100</sup> In case homogeneous retirement behaviour is assumed it is recommended to choose separately: 1) one average retirement age, 2) one average age to become disabled and 3) one average age to die during the time of contribution. For a further description on heterogeneous and homogeneous behaviour see Box .

<sup>101</sup> In various countries the entitlement of a pension is dependent on a minimum period of membership or contribution in the pension system. For example, in Italy 20 years (for people insured before the year 1996) of contribution are necessary to receive a pension entitlement while in Belgium no minimum period of membership in the pension system is required. The variable  $q^{old}$  should possibly reflect the probability to reach the minimum periods of contributions, i.e. to be eligible to a pension benefit.

The approach to calculating pension entitlements for average present pensioners (Section 7.3) and for average current contributors (Section 7.4) has been described). The distribution of pension entitlements for each age group and gender can then be estimated. The last step for estimating the total pension entitlements of a respective pension scheme is relatively simple. As outlined in Equation 35, all average pension entitlements calculated by age and gender in the previous steps need to be multiplied by the respective cohort sizes  $N$  in these groups. The sum represents the total of pension entitlements ( $TE$ ) in the respective scheme in present values of the respective base year  $b$ .

$$(35) \quad TE_b = \sum_{s=0}^D E_{s,b}^{male} * N_{s,b}^{male} + \sum_{s=0}^D E_{s,b}^{female} * N_{s,b}^{female}$$

## Worked examples

8

## 8 Worked examples

In this section worked examples are provided in order to complete the new supplementary table of national accounts. These case studies include the application of an actuarial model to estimate both the pension entitlements of social security pension systems (column H), and those of government employee pension schemes (column G) — see Section 8.1. Additionally, the use of business accounting data and regulatory data to compile the figures in columns A to C is described — see Section 8.2.

### 8.1 Using an actuarial approach to fill in columns G and H

The following section provides a worked example for the estimation of pension entitlements recorded in columns G and H. First, the so-called Freiburg model is outlined — which is applied to estimate these new figures in the national accounts. Thereafter, the outcomes of the actuarial approach will be presented using the example of the German supplementary table of 2007.

The Freiburg model has been developed to make benchmark calculations of pension entitlements on behalf of the Eurostat/ ECB Contact Group on Pensions.<sup>102</sup> The starting point for the Freiburg model is the method of generational accounting.<sup>103</sup> This method can be used for a wide variety of purposes. For this project, the method is applied to government-managed pension schemes<sup>104</sup> in isolation and to a group of existing retirees and current contributors (future retirees) only.<sup>105</sup> Additionally, the standard method is modified to account for the amount of benefits accrued to date, instead of considering future pension benefits in total. These calculations include old-age pensions, disability pensions and survivors' pensions. Any kind of means-tested social assistance is excluded wherever feasible. In order to estimate the entitlements of current contributors, the approach is based on the homCC approach described in Chapter 7.4.2. However, the Freiburg model may also be applied to a hetCC approach as outlined in Chapter 7.4.3.

<sup>102</sup> The model has been applied for 19 EU countries. For an outline of the results see Müller et al. (2009).

<sup>103</sup> This method was developed by Auerbach et al. (1991, 1992 and 1994). See Raffelhüschen (1999) and Bonin (2001) for a detailed depiction of theory and application as well as limitations of the method of generational accounting.

<sup>104</sup> The terms 'public pension scheme', 'government pension scheme' and 'pension scheme in general government' are used as synonyms. However, we differentiate between two different types of schemes. The government employer pension scheme indicates a pension scheme for civil servants, whereas a social security pension scheme describes a general pension scheme. For a discussion of the definition of government pension schemes see Eurostat/ ECB Task Force (2008), p. 20 et seq.

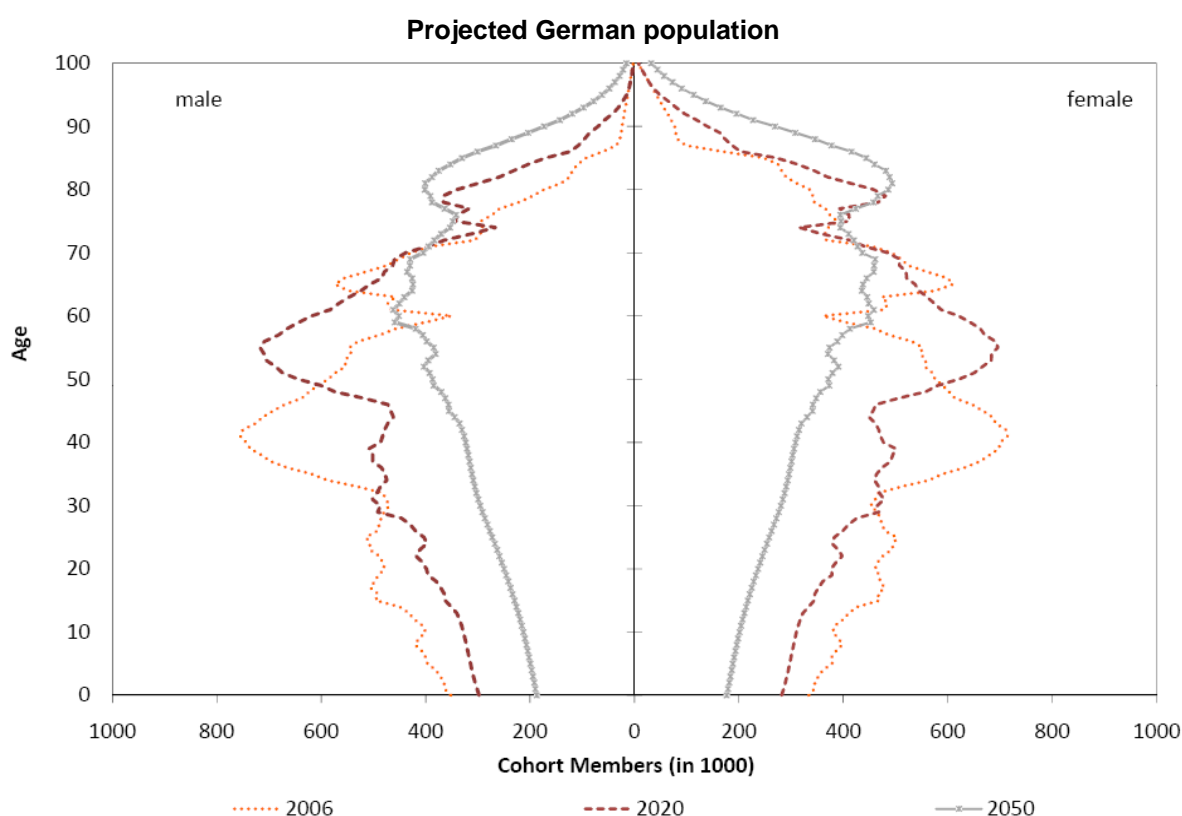
<sup>105</sup> For a closer look on the application of generational accounting to public pension schemes see Müller et al. (2010) or Jablonowski et al. (2010) who employed the concept of open-system net liabilities to investigate the sustainability of the German and the Polish statutory pension scheme respectively.

The core presumption is a projection of per capita future pension benefits based on those of today's existing retirees: the entire calculation procedure is set out in the five steps described below.

**Step 1 — Population projection:** Age-sex-specific projections of the base year's population need to be calculated. The demographic model used to generate these projections is based on a discrete and deterministic formulation of the cohort component method.<sup>106</sup>

In general, the three major determinants of future population changes are fertility, mortality and migration. Since ADL only take into account rights accrued by existing and former workers before the base year, the future migration of the base year population is irrelevant. The development of survival rates is examined by adjusting the initial set of survival rates using an exponential adjustment procedure.<sup>107</sup>

Figure 25



Source: Source: Forschungszentrum Generationenverträge, University of Freiburg, based on data provided by Eurostat.

The population data used for the calculation come from Eurostat. Also the assumptions on the future trend in life expectancy are based on data provided by Eurostat, i.e. the

<sup>106</sup> For a detailed description of the demographic model applied see Bonin (2001), p. 245 et seq.

<sup>107</sup> This procedure is suggested by Pflaumer (1988). See also Bonin (2001), p. 248.

Eurostat population projection (EUROPOP). Both declining fertility rates and the ongoing and fairly steep increase in life expectancy have led to a significant ageing process in Germany. As a result, the configuration of the German population pyramid will change considerably in the coming decades. Figure 25 illustrates the outcomes of the population projection for the years 2006, 2020 and 2050 as examples.<sup>108</sup>

**Step 2 — Projecting the pensions of existing retirees:** The projection starts by estimating the benefits of the average age-sex-specific existing retirees in the base year. As mentioned above, the projection of these pension benefits is the centrepiece of the calculations, the accrued pension benefits of the future new retirees are developed by changing the benefits of the existing retirees. Please note that *future new retirees* include all individuals who retire after the base year, while *existing retirees* are already in retirement in the base year.

It has to be emphasised that these calculations look only at average individuals within the respective age groups, i.e. they are not separated into different income groups. In fact, the calculation of age-sex-specific benefits is separated into existing and future new retirees, assuming that an average representative of an age group is to some extent an existing and a future new retiree in every year of his or her life-cycle.

The example of a 65 year old average representative may make this easier to understand. At this age this representative individual is to a large extent already retired, as he/she is an existing retiree. Nevertheless, with the concept of the representative individual, the fact is also taken into account that — although the probability is low — the 65 year old average representative may not retire until he/she is aged 66 or older. Hence, the average 65 year old taken as an example in the calculations is also to some extent a future new retiree.

### Generating age-specific pension profiles

Before going further into detail, the projection approach for the benefits of existing retirees is outlined here. First of all, the benefits are calculated by distributing the aggregated amount of today's pension expenditure to the different cohorts of retirement age. This procedure creates a cross-section profile of age-sex-specific benefits generated from the budget and micro data of the observed country, in this case Germany.

Figure 26 shows an average rescaled<sup>109</sup> profile of existing retirees' benefits for living male cohorts in the year 2006.<sup>110</sup> This profile reflects heterogeneous retirement behaviour.<sup>111</sup>

<sup>108</sup> In line with the ADL concept future migration is neglected.

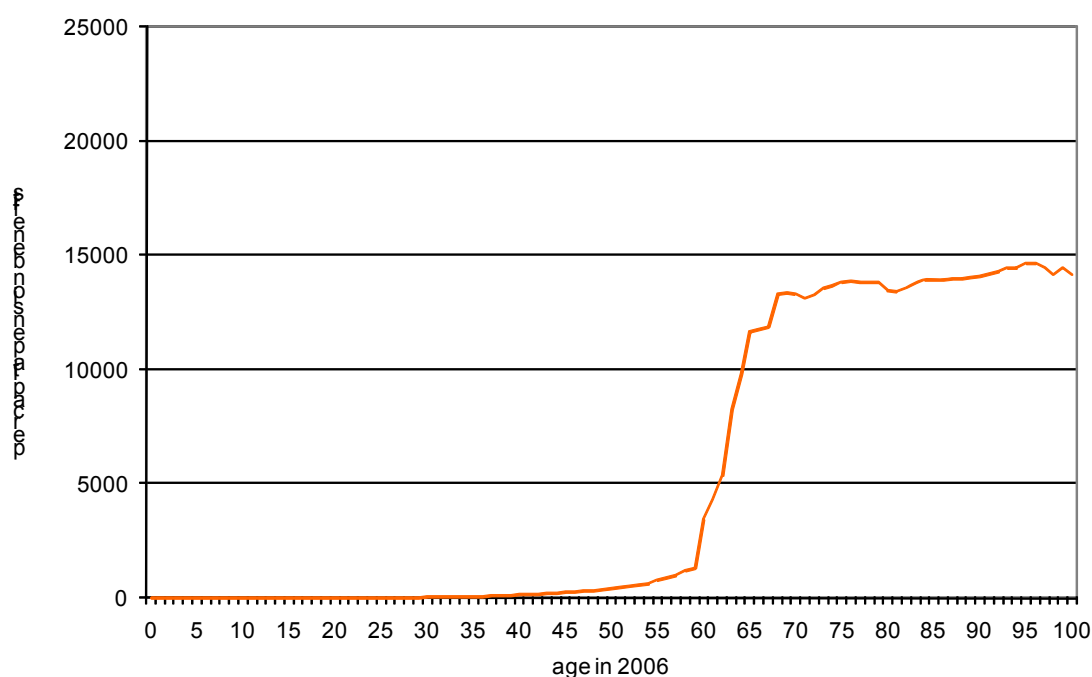
<sup>109</sup> The profiles are rescaled in a way that the aggregates based on micro-profiles and population data correspond to the respective government budget aggregates in the base year. This rescaling approach is described in further detail below.

Benefits are measured in per capita of the population units. In other words the pension benefits  $p_{b,k}$  (in the base year  $b$  of the cohort born in  $k$ ) of a  $x$  ( $x=b-k$ ) year old representative residing in the respective country in a given base year are quantified.<sup>112</sup> Formally (see Equation 35),  $p_{b,k}$  is derived by multiplying the average pension benefit of a scheme's retiree  $B_{b,k}$  of a certain age  $x$  by the number of scheme retirees at this age  $M_{b,k}$  and dividing this product by the cohort size of the overall population.

$$(35) \quad p_{b,k} = \frac{B_{b,k} * M_{b,k}}{C_{b,k}}$$

Figure 26

**Rescaled profile of average existing retirees' benefits in 2006  
(Social security in Germany, men, EUR)**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

Typical of most European pension schemes is the sharp increase in the pension profile around the age of 60. A steep rise of this type can also be observed in the German example (see Figure 26). It mainly reflects an increasing share of pension cases, because

<sup>110</sup> For illustrative reasons we only show here a male profile. For the calculations also a female profile was applied.

<sup>111</sup> For a description of heterogeneous retirement behaviour see Box . Most former surveys apply one constant average retirement age for their calculations instead of an age-sex-specific pension profile. From our point of view, this approach represents a simplification of retirement behaviour and leads to less accurate results.

<sup>112</sup> Since our projection method does not correct aggregates for business cycle effects, base year economic performance is perpetuated indefinitely. This may lead to a bias. Nonetheless this effect seems not as critical in case of considering pension expenditure only since they are for the most part dominated by demography.

the probabilities of retirement around the age of 60 are relatively high.<sup>113</sup> It should be noted that the profile also reveals other age-specific characteristics, namely the average rate of participation in the respective pension scheme (in per cent of the population) as well as the average pension benefits at a given age ( $B_{b,k}$ ).

The profiles applied include payments in respect of old-age pensions, disability pensions and survivors' pensions.<sup>114</sup>

### Rescaling the pension benefits of existing retirees

Formally, the estimation of the existing retirees' benefits is based on the following identity:

$$(36) \quad P_b = \sum_{k=b-D}^b p_{b,k} C_{b,k}$$

This identity states that the sum of age-specific individual pension benefits  $p_{b,k}$  (in the base year  $b$  of the cohort born in  $k$ ) weighted by the cohort size  $C_{b,k}$  must equal the corresponding overall aggregate pension expenditure, denoted by  $P_b$ .<sup>115</sup> The problem of Equation 36 is that it applies only in theory. While macroeconomic data – which are, typically taken from national accounting statistics - are relatively exact, micro data are generally difficult to gather and often inaccurate. To resolve this problem, re-scaled age-sex-specific benefit profiles are estimated in two stages. First, age-sex-specific information regarding per capita pension benefits has to be collected in order to calculate the relative fiscal position of different age groups as accurately as possible. The vector of relative pension benefits by age taken from the statistics,  $(\tau_{t,t-D}, \dots, \tau_{t,k}, \dots, \tau_{t,t})$ , is then denoted by  $\tau_{t,k}$ .<sup>116</sup> This vector is supposed to show only the relative pension position in period  $t$  of an individual born in the year  $k$ , and thus imposes a lesser restriction on the accuracy and availability of micro data at the absolute level. Second, the estimated relative age distribution is checked against the corresponding aggregate pension benefit  $P_b$  by the application of a proportional, non-age-specific benchmarking factor, denoted by  $\varphi$ . The relative distribution of pension payments is re-evaluated according to

$$(37) \quad p_{b,k}^{rescal} = \varphi \tau_{b,k}$$

for all living generations  $b-D \leq k \leq b$ , where  $\varphi$  is defined by

$$(38) \quad \varphi = \frac{P_b}{\sum_{k=b-D}^b \tau_{b,k} C_{b,k}}$$

<sup>113</sup> At this point it is worth mentioning that we employ age-sex-specific pension data which is broken down into one-year intervals. Most former surveys use five-year interval data which can lead to inaccuracies especially when looking at the cohorts retiring in.

<sup>114</sup> In doing so, we are able to take into account survivor pensions in a rather accurate way, compared to most other surveys dealing with the measurement of pension liabilities.

<sup>115</sup> Please note that  $D$  represents the maximum age of an individual which is 100 years by our assumption.

<sup>116</sup> For ease of notation we drop the sex-specific notation as from now on.



Equation 38 ensures that Equation 36 is finally satisfied. On the basis of the rescaling factor  $\varphi$ , it is ensured that the micro pension data match the given macro data.

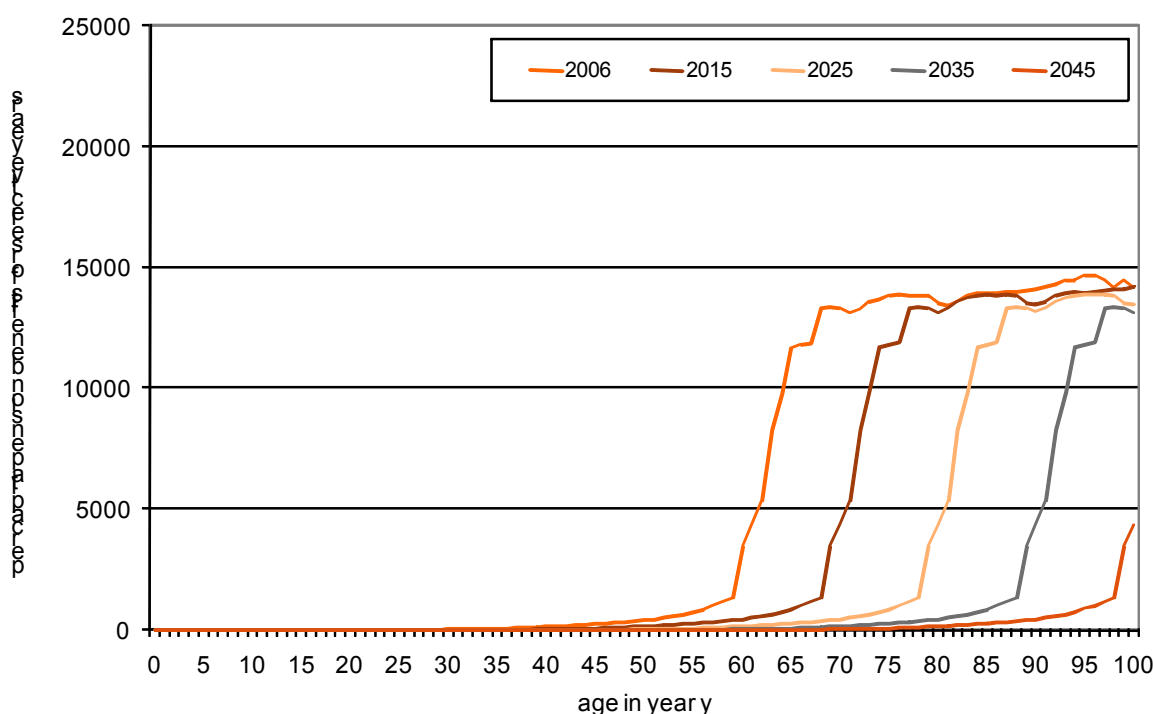
### Projecting the pension benefits of existing retirees

Lastly, the resulting rescaled average age-sex-specific benefits of existing retirees' are projected according to the indexation rules of the respective country:

$$(39) \quad p_{t,k}^{exis} = p_{b,k}^{rescal} (1 + g)^{t-b},$$

for all cohorts  $b-D \leq k \leq b$  living in the base year. This Equation 39 states that an individual already retired in base year  $b$  receives the same pension in a specific year  $t$  as in the base year  $b$ , only corrected by the indexation  $g$  of a pension in payment. In the case of the German statutory pension scheme, pensions are adjusted annually to wage growth. For the calculations, a real wage growth rate of 1.5 per cent is applied.

**Figure 27**  
**Phasing out the average profile of existing retirees' benefits from 2006 to 2045 (Social security in Germany, men, EUR)**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

Equation 39 also involves a 'phasing out' of the stock of existing pension benefits, since it applies only to all living generations. Thus, the pensions of all existing retirees for the base year will have disappeared at the latest when the youngest existing retiree of the base year is dead. To account for this future cohort-specific development of the pension benefits of existing retirees, the rescaled age-sex-specific existing retirees' profile is

phased out year-by-year and the pension benefits are indexed according to the benefit formula (see Figure 27). Consequently, the pension benefit of a 65 year old existing retiree in base year 2006, for example, would equal the pension benefit of an 84 year old existing retiree in 2025, disregarding indexation effects.<sup>117</sup> In year 2045 the 65 year old representative in the base year would be 104 years old. However, his benefits in that year would be disregarded, since the calculations do not take account of any payments after the age of 100.

**Step 3 — Projecting the pensions of future new retirees:** The age-sex-specific pension profile for future new retirees, which is the basis for the estimation of accrued-to-date entitlements, is calculated by manipulating existing retirees' benefits in the base year. This is done in five stages. First, the difference of the existing benefits for consecutive age groups (during the base year) provides the pension benefits for new retirees in the base year.<sup>118</sup> This provides the basis to estimate pension benefits for new retirees in future years. In a third step, pension benefits for new retirees are evaluated for a specific year  $t$ . Thereafter, if necessary, future new pension benefits are altered by a deduction factor defined, for example, by a pension reform. As a fifth and last step, the cumulated average benefits of future retirees are calculated by totalling year-by-year the benefits of new retirees, which explains why an individual can receive a new retiree benefit on average for any future year  $t$ .<sup>119</sup> All of these four steps will be described in greater detail below.

### Estimation of pension benefits for new retirees in the base year

First, the pension benefits for new retirees in the base year are estimated. Formally (see Equation 40), the new retirees' benefit  $p_{b,k}^{new}$  in the base year  $b$  for a cohort  $k$  is generated by calculating the absolute change in existing retirees' benefit  $p_{b,k}^{exist}$  of the cohort  $k$  to the cohort one year younger in the base year, namely  $k+1$ .<sup>120</sup>

$$(40) \quad p_{b,k}^{new} = \left[ p_{b,k}^{exist} - p_{b,k+1}^{exist} \right]$$

This example estimates the average pension benefit of a 60 year-old new retiree in the base year 2006, that is a representative of the cohort born in 1946 ( $k=1946$ ). From the pension data of existing retirees we know that an average male individual of the population

<sup>117</sup> Please note that for illustrative reasons in all figures wage growth rates have been set to zero. Correspondingly, no pension indexation effects can be observed in the figures.

<sup>118</sup> Note that new retirees' benefits represent those benefits that are paid for the first time upon retirement in a specific year  $t > b$ .

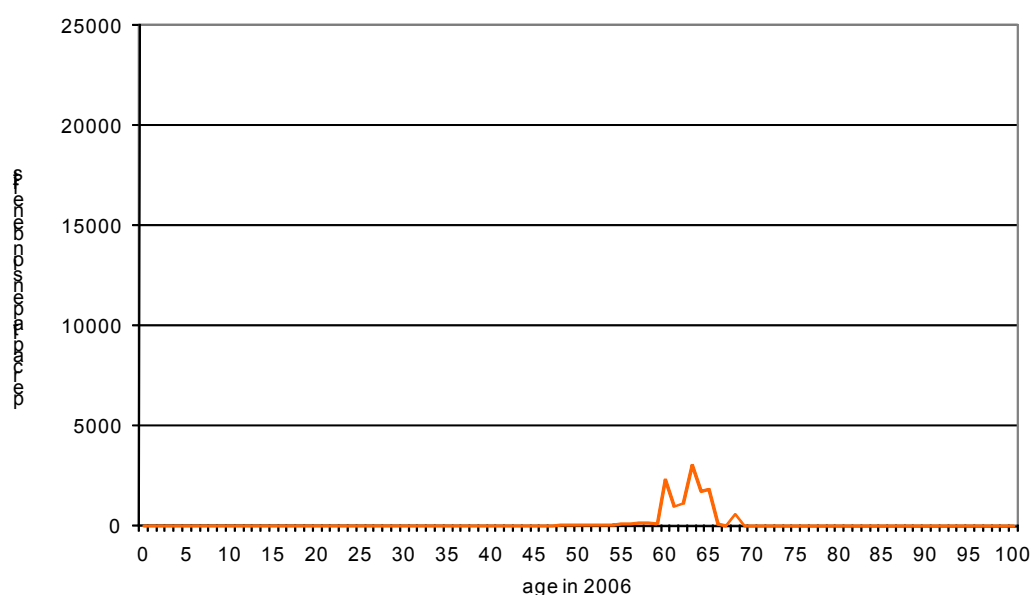
<sup>119</sup> The separation of existing pensions and future new pensions (pensions paid out for the first time after the base year) bears one big advantage: In case of a pension reform which affects only future pensions, only these pensions are changed while existing pensions are held constant.

<sup>120</sup> Changes after the age of 67 years are generally set to zero since new retirees' old-age benefits after the age of 67 are negligible. The only exception from this rule is widow's pensions.

at the age of 59 (i.e. of the cohort  $k+1=1947$ ) received a pension benefit of EUR 1,300<sup>121</sup> in 2006. This figure reflects all pensioners who retired at the age of 59 or earlier. The male cohort that is one year older, i.e. born in 1946 and aged 60, received an average pension of EUR 3,500 per capita. This pensioner aged 60 is assumed to have been to some extent a new pensioner in 2006 and to some extent an existing pensioner — who already retired before the age of 60. So the pension benefit of EUR 1,300 — which reflects pension benefits of pensioners who retired at the age of 59 or earlier — is allocated to existing pensioners. The remaining increase of the average pension from the age of 59 (EUR 1,300) to 60 (EUR 3,500) is accorded to new retirees entering at the age of 60. In line with Equation 40, the benefit received by new retirees at the age of 60 in base year 2006 would amount to EUR 2,200.

Figure 28

**Rescaled profile of average new retirees' benefits for 2006  
(Social security in Germany, men, EUR)**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

The same estimation procedure as for the example of the 60 year old new retiree in the base year is applied to all relevant age groups from the age of 0 to 100.<sup>122</sup> Figure 28

<sup>121</sup> It should be once again underlined that this figure does not represent the average pension benefit of a 59 year old retiree. In fact, it quantifies the amount of pension payments an average male representative of the overall population receives at the age of 59. This representative individual is with a high probability not yet retired — which explains the relatively low average pension benefit of EUR 1,300 per capita.

<sup>122</sup> We consider only differences until the age of 67. After this age, new retirees' benefits are negligible. This treatment allows designing maturation effects for future retirees' cohorts and is necessary since the existing retirees' benefit profile after the age of 67 is not a good predictor for future retirees' benefits. This is due to the fact that both average benefits and the share of pension cases vary substantially across existing retirees cohorts reflecting past differences in working careers. Note that this proceeding nonetheless maintains base year economic structures for new retirees indefinitely. In particular, the analysis thus abstracts from changes in labour force participation and unemployment rates for future new retirees' benefits. Please note that this does not count in case the age-sex-specific survivor pensions are available. In this case we consider the difference of the rescaled base year profile until the age of 90 in order to take into account widow's pensions in a more

illustrates the resulting profile of average benefits of new (male) retirees for the year 2006. This profile reflects the average pension payment per capita of the population of a male individual at age  $x$ , who retires in 2006. The shape of this profile is mainly determined by the probability of retiring at age  $x$ . The kinks at the ages of 60 and 63 indicate that the highest probabilities of retiring can be found at these ages.

### Estimation of pension benefits for new retirees in a future year

So far we have estimated the age-specific pension benefits of new retirees in the base year. For future years this profile remains constant, i.e. the base year retirement behaviour continues in the years to come.<sup>123</sup> As a consequence, the pensions of new retirees in future years  $t$  are estimated in the same way as in the base year (see Equation 41, step 2). Only the notation of the respective cohorts is slightly altered and now linked to the future year  $t$  and the base year  $b$ . Accordingly, a new retiree's benefit  $p_{t,k}^{new}$  in a specific year  $t$  of a cohort  $k$  is developed by calculating the absolute change in the benefit of the existing retirees of the cohort  $b-(t-k)$  (the cohort with the same age  $(t-k)$  in the base year  $b$ ) to the cohort one year younger in the base year, namely  $b-(t-1-k)$ .<sup>124</sup> Equation 41 sums up the calculation of pension benefit for future new retirees in a given future year  $t$ .

$$(41) \quad p_{t,k}^{new} = \underbrace{\left[ p_{b,b-(t-k)}^{exis} - p_{b,b-(t-1-k)}^{exis} \right]}_{\text{Step 2}} * \underbrace{(1+v)^{t-b}}_{\text{Step 3}} * \underbrace{\theta_{t,k}}_{\text{Step 4}}$$

for all cohorts  $b-D \leq k \leq b$ .

### Added value of the pension benefit for a future new retiree

The third step takes into account the fact that past pension rights are re-valued annually according to the benefit formula.<sup>125</sup> As a result, in most pension schemes the pension benefits of new retirees in year  $t+1$  will be higher than in the previous year  $t$ . This aspect is reflected by the valorisation rate  $(1+V)^{t-b}$  (see Equation 41, step 3). The variable  $v$  is the valorisation factor calculated according to the benefit formula.<sup>126</sup>

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accurate way. After this age, the data usually is non-representative due to small numbers of cases in the age cohorts above 90.

<sup>123</sup> Only in some cases where a future increase of the legal retirement age has been legislated, we alter future retirement behaviour respectively.

<sup>124</sup> Changes after the age of 67 years are generally set to zero since new retirees' old-age benefits after the age of 67 are negligible. The only exception from this rule is widow's pensions.

<sup>125</sup> In some pension schemes past earnings are valorised in other schemes so called pension points during the contribution career are yearly adjusted. In NDC schemes individual accounts are annually valorised. Usually, the valorisation of such past pension rights — whether reflected by reference earnings, NDC accounts or pension points — is linked to wage growth.

<sup>126</sup> Usually, the valorisation rate is linked to the wage growth.

## Pension reforms

The majority of European government-managed pension schemes have introduced wide-ranging reforms in recent years which will lower future pension benefits. In a fourth step, the benefits of future new retirees' are therefore reduced accordingly by a deduction factor  $\theta_{t,k}$  (see Equation 41, step 4). This factor reflects already implemented pension reforms, such as the raising of the legal retirement age in Germany from 65 to 67.

## Estimating the cumulated benefits of future new retirees

Lastly, the accumulated future benefits of new retirees need to be calculated. This fifth step cumulates year-by-year all future new pension benefits of an  $x$ -year-old representative (in the base year) during his remaining life cycle. Thus, for example, a 59 year old representative (in the base year) will have a certain probability of retiring at the age of 60, 61 and so on. Formally, this is done by cumulating year-by-year  $p_{t,k}^{new}$  according to Equation 42. The accumulated age-sex-specific future pension benefits  $p_{t,k}^{fut}$  of a retiree for a specific year  $t$  of the cohort  $k$  are defined as follows:

$$(42) \quad p_{t,k}^{fut} = p_{t-1,k}^{fut} (1 + g) + p_{t,k}^{new},$$

From this equation it follows that the average individual born in year  $k$  receives a future benefit in year  $t$  ( $t > b$ ) which consists of the accumulated pension payment one period earlier ( $t-1$ ) corrected by the pension indexation  $g$ <sup>127</sup> plus the pensions paid to new retirees in that year. In other words, a future new retiree (i.e. an individual who retired after the base year) in year  $t$  is to some extent a new retiree in this year  $t$  — receiving  $p_{t,k}^{new}$  — and to some extent an 'old' retiree who has already received a pension benefit in the years before  $t-1$ . Thus, the age-sex-specific benefit profile for future retirees builds up year-by-year to project the future accumulated benefits of retirees.

Figure 29 shows the development of future retirees' pension benefits for selected years. An example is a 50 year old male future new retiree (in the base year 2006). He is increasingly likely to enter retirement in future years (after the base year). In particular there is a strong probability that he will retire between the ages of 60 and 65, as can be seen by looking at the kinks in the profile for the year 2006. In 2025 — when he is aged 69 — his accumulated future new pension benefits will amount to EUR 12,000. After the age of 69, i.e. after the year 2025, his probability of taking retirement is close to zero. This explains why, in the year 2035 (at the age of 79) or in the year 2045 (at the age of 89), the

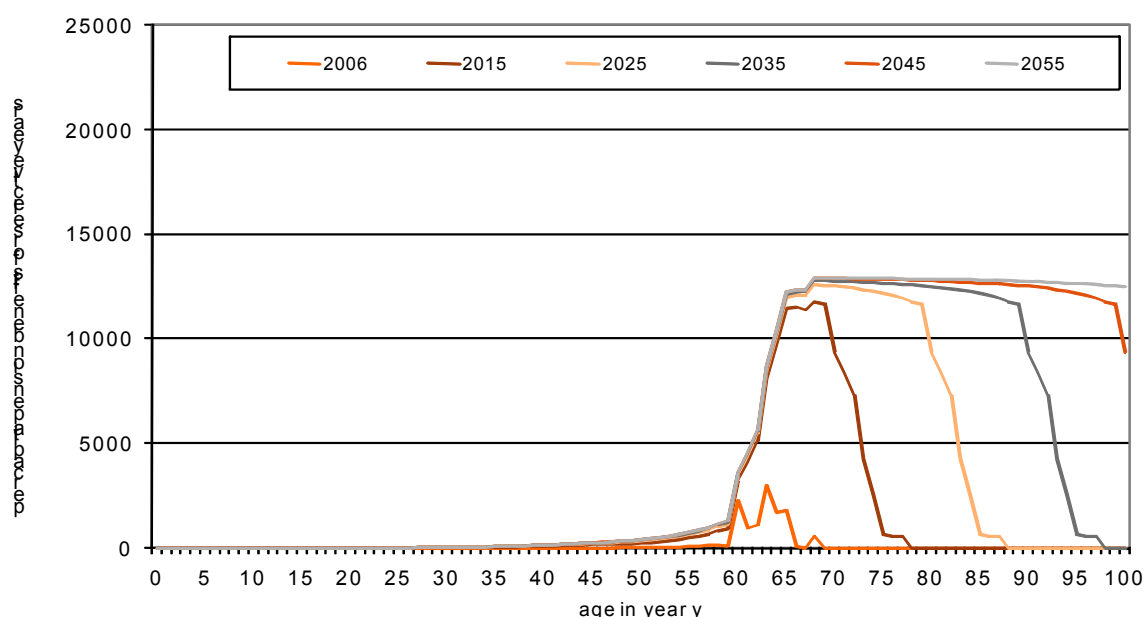
<sup>127</sup> The growth rate  $g$  reflects the annual indexation of pensions. In Germany pensions are indexed to the wage growth. The impact of the sustainability factor needs also to be taken into account.

amount of the accumulated future new pension benefits of this person is almost unchanged and equal to the level in 2025, which was roughly EUR 12,000.

As Figure 29 shows, after being built up almost completely the right to a full pension (year 2055), in the case of Germany his profile is considerably lower than the profile of existing retirees. This is due to reforms which will considerably lower future pension levels.<sup>128</sup>

**Figure 29**

**Build-up of accumulated future new retirees' pension benefits profile from 2006 to 2055 (Social security in Germany, men, EUR)**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

**Step 4 — Considering the proportion of full pensions accrued-to-date:** Now, in order to meet ADL, only that part of the future pension benefits (of current workers) which is earned until the base year has to be considered. This means in turn that  $p_{t,k}^{new}$  must be reduced by a factor  $\lambda_{t,k}$  representing the cohort-specific amount of entitlements of current contributors in relation to the full entitlements.<sup>129</sup>

Future pension benefits are thus finally defined by

$$(43) \quad p_{t,k}^{fut} = p_{t-1,k}^{fut} (1 + g) + \lambda_{t,k} p_{t,k}^{new},$$

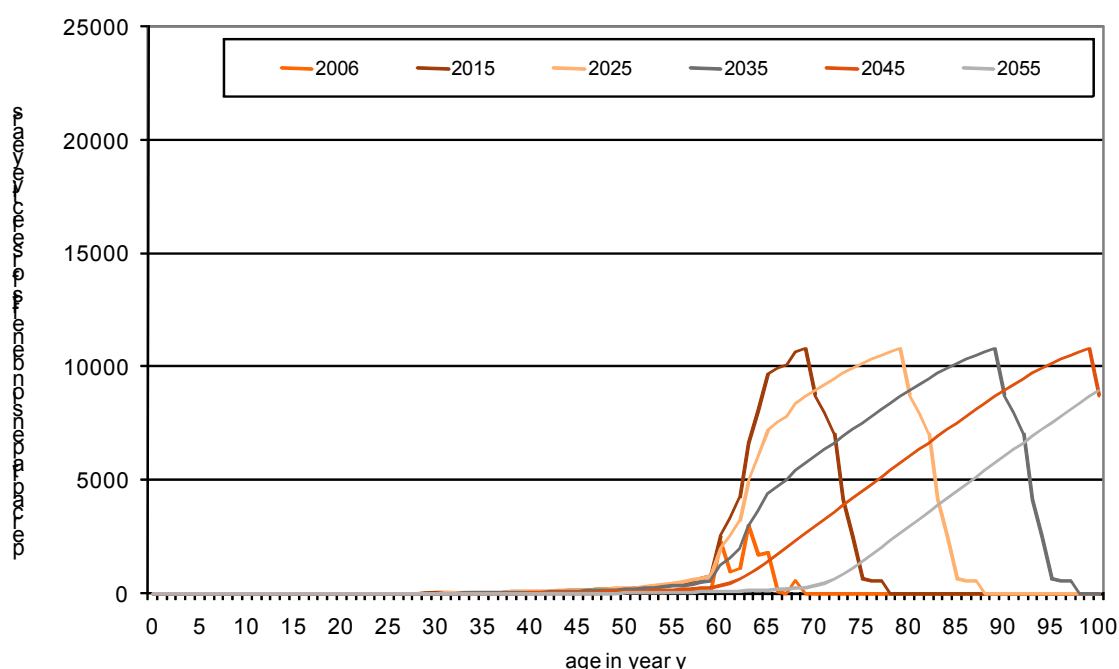
for all cohorts  $b-D \leq k \leq b$ .

<sup>128</sup> For an overview of the considered reforms see Müller et al. (2009), p. 51ff.

<sup>129</sup> The calculation of the factor  $\lambda_{t,k}$  requires the knowledge of the average age-sex-specific wage distribution. Many other surveys work with one single average wage over the whole career which leads to different results.

The reduction of future retirees’ benefits to account for only the part that is accrued to date is outlined in Figure 30. Given that PBO is applied in this case, the benefits are cut in a linear manner according to the ratio of contribution years until base year to average contribution years until retirement.

**Figure 30**  
**Amount of average future retirees’ pension benefits accrued to date**  
**Profile from 2006 to 2055 (Social security in Germany, men, EUR)**



Source: Forschungszentrum Generationenverträge, University of Freiburg.

Note that the accrued-to-date concept requires a definition of the valorisation and accruing process for the entitlements. As a matter of principle there are several possibilities that have to be accounted for, including ABO and PBO. These two approaches, which applied in the Freiburg model, are described below.

**Step 5 — Aggregating and discounting pension benefits:** Finally, the ADL of the pension scheme are calculated by discounting and adding up the above projected pension benefits over the cohorts living in the base year. For the real discount rate, a value of 3 per cent has been applied.

Thus, the  $ADL_b$  (accrued-to-date liabilities of the base year  $b$ ) can be expressed as follows:

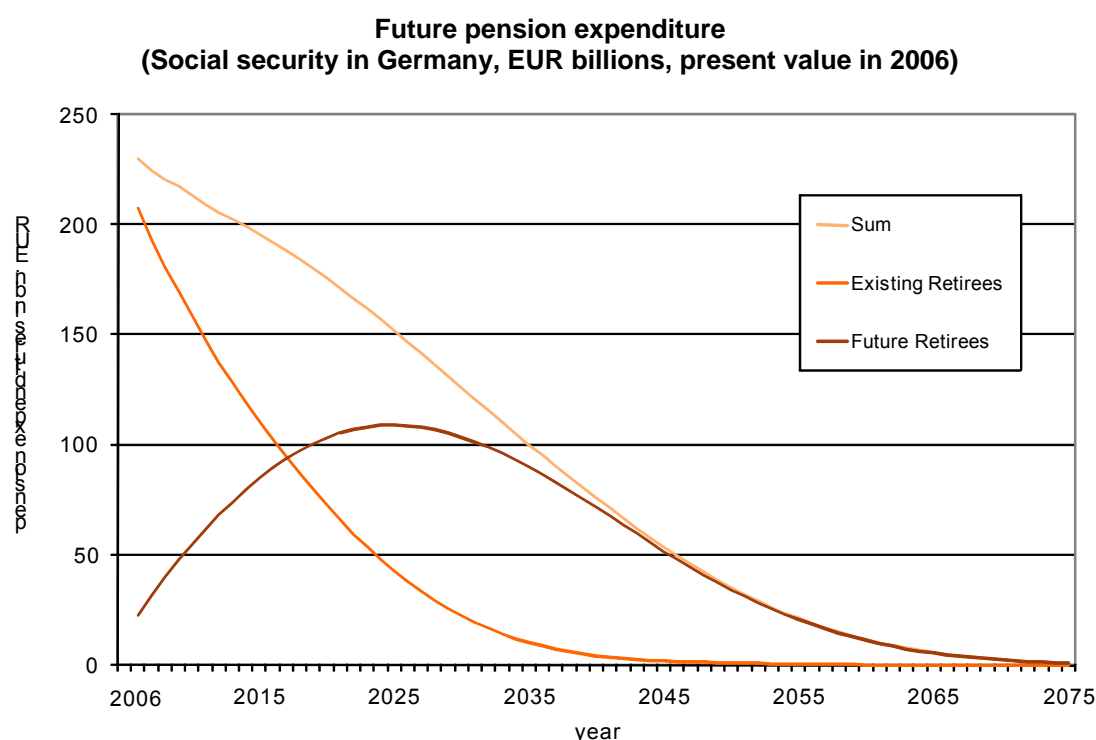
$$(44) \quad ADL_b = \sum_{t=b}^{b+D} \sum_{k=b-D}^b \frac{(p_{t,k}^{exis} + p_{t,k}^{fut})}{(1+r)^{t-b}} C_{t,k}$$

This means that, in every period  $t$ , the pension benefits of the existing retirees ( $p_{t,k}^{exis}$ ) and the pension rights accrued until the base year ( $p_{t,k}^{fut}$ ) — which are both discounted by the factor  $(1+r)$  for every future year  $(t-b)$  — are multiplied by the number of members of this

age cohort  $C_{t,k}$ . This is done for each age group, beginning with those born in  $k=b-D$ , which goes back 100 years prior to the base year.

Figure 31 shows the development of the projected aggregates. The sum of the existing retirees' benefits decreases due to the phasing out of the profiles, i.e. due to the ageing of existing retirees. By contrast, the aggregated benefits of future retirees show an inverse u-shaped pattern, because the future retirees' benefits initially increase as a result of the building up of the profile. However, these benefits are reduced accordingly, since only the accrued-to-date amount is considered.

Figure 31



Source: Forschungszentrum Generationenverträge, University of Freiburg.

### Implementation of ABO and PBO in the Freiburg model

As described previously in this chapter, pension entitlements are estimated by calculating future pension payments. In layman's terms this is done by projecting present age-sex-specific pension payments into the future, taking into account the indexation of the respective pension scheme plus any pension reforms which have already been decided and which will have an impact on future pensions. In order to receive the ADL of a pension scheme, it is crucial to divide the beneficiaries of future pension payments into two groups: The first group consists of those who are receiving pension payments today. The members of this group enjoy full pension entitlements because they have already retired



and are unable to increase their pensions by paying contributions.<sup>130</sup> The pension payments of this group — the ‘existing retirees’ (or more precisely: persons who are already in retirement in the base year) — are accordingly projected in line with the relevant indexation until the last retiree dies.

The second group consists of persons who do not yet receive pension payments. They have earned some kind of pension entitlements in the past — regardless of whether they took up employment only one year ago or are close to retirement — and they will probably earn more pension entitlements in the future, up to the time when they retire. It follows that this group does not yet enjoy full pension entitlements. The ADL approach includes entitlements earned up to the base year only; therefore the projected future pension payments of a ‘future retiree’ (or more precisely: a person who will retire after the base year)<sup>131</sup> has to be reduced. This introduces the issue of ABO versus PBO:

New pensioners will enter the pension scheme in every year after the base year. The initial question to be answered is what will be the amount of the first paid benefit in relation to the new pensioners’ benefits in the base year. Let the amount of first paid pension — sometimes referred to as the primary insurance amount (PIA) — in the year  $b$  be  $B(b)$  and the constant per-capita wage growth in real terms be  $g$ . When applying the PBO approach, the first paid pension will be defined as follows:

$$(45) \quad B_t = B_b(1 + g)^{t-b}$$

Since  $g$  is assumed to be constant over time, the first paid pension can also be expressed subject to the base year  $b$ .

$$(46) \quad B_{t+1} = B_b(1 + g)^{t-b}$$

When changing to the ABO approach, it has to be borne in mind that no allowance is made for future pay increases. In the current case, only general wage growth is observed. It follows that the first paid pension of a future year  $t$  in the ABO approach changes to:

$$(47) \quad B_t = B_b$$

The difference between Equations 46 and 47 can be explained by the different approaches of ABO and PBO. The latter takes into account general future wage growth,

<sup>130</sup> This counts only for pension schemes which do not allow their beneficiaries to increase their pension after retirement, i.e. by taking up employment, paying contributions and thus augmenting their pension entitlements.

<sup>131</sup> Please note that ‘future retirees’ involve all individuals that retire after the base year. In contrast to this, ‘new retirees’ indicate individuals who retire in a certain year  $x$  in the future. Those individuals who retire in the year  $x$  will in that year enter the group of ‘future retirees’. In the year  $x + 1$  they will still be ‘future retirees’ but not ‘new retirees’ anymore.

while ABO does not consider any future changes of earnings; the wage level of the base year is kept constant in real terms.<sup>132</sup>

The second difference between ABO and PBO can be observed when reducing the initially calculated full benefits of ‘new pensioners’ according to the concept of ADL. The full benefits are reduced by a vector — the ‘accrued-to-date vector’ — which expresses the entitlements earned up to the base year as a share of the amount of entitlements which qualifies for a full pension. This share is given for every projection year. It is straightforward that the share decreases from a value close to one for primary pensions paid out shortly after the base year to a value of close to zero for primary pensions paid out in the distant future. This vector is multiplied by the respective accounts of full pension entitlements and the outcome is the amount of pension entitlements earned up to the base year for every projection year, known as the ‘accrued-to-date entitlements’. The difference between ABO and PBO is shown by the different consideration of increases in personal earnings during the person’s working life. Generally, the earnings at the beginning of a person’s career are less than the average earnings and end up somewhere above average as the person comes closer to retirement. PBO takes this effect into account, ABO does not.

Regarding the accrued-to-date vector in the PBO approach, only the missing amount of contribution years has to be taken into account, given that the full pension primarily calculated by the model includes assumptions for both personal and general wage growth. In summary, the difference between ABO and PBO consists of two parts. The first part is general wage growth, which in most cases is connected to general economic growth. The second part is the development of earnings over the individual’s career.<sup>133</sup>

### **Results of the Freiburg model — the supplementary table of 2007**

Table 5 illustrates the results of the actuarial model, the non-core accounts of the supplementary table for Germany in 2007. A distinction is made between social security (column H) and government employee pension schemes (column G). The stocks of pension entitlements in these columns are estimated on the basis of the Freiburg model using the PBO approach.

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<sup>132</sup> It is crucial that this only counts for the calculation of the first paid pension or PIA. When projecting a benefit which has already been paid out before, i.e. the indexation of existing benefits, a constant real wage growth is assumed. In this regard the ABO approach displays a schizophrenic world where in one situation future wage growth is considered and in the other it is not. Please note, that there are other interpretations of the ABO approach which do not consider (post-retirement) pension indexations.

<sup>133</sup> For a further description see also section 7.3.

**Table 5**  
**Supplementary table for Germany**  
**PBO, EUR billions, 2007**

		Non-core national accounts		
		(figures in bn. EUR)		
		Defined benefit schemes for general government employees classified in general government	Social security pension schemes	
		G	H	
		<i>Opening Balance Sheet</i>		
	1	Pension entitlements	1,129.18	6,522.94
		<i>Changes in pension entitlements due to transactions</i>		
Sum 2.1 to 2.4	2	Increase in pension entitlements due to social contributions	51.17	489.27
	2.1	Employer actual social contributions	0.00	78.21
	2.2	Employer imputed social contributions	-5.41	
	2.3	Household actual social contributions	0.00	84.89
	2.4	Household social contribution supplements	56.58	326.17
	3	Other (actuarial) increase of pension entitlements		-75.23
	4	Reduction in pension entitlements due to payment of pension benefits	46.52	234.87
2 + 3 - 4	5	Change in pension entitlements due to social contributions and pension benefits	4.65	179.17
	6	Transfers of entitlements between schemes	0.00	0.00
	7	Changes in pension entitlements due to other transactions	0.00	-178.19
		<i>Changes in pension entitlements due to other economic flows</i>		
	8	Changes in entitlements due to revaluations	0.00	0.00
	9	Changes in entitlements due to pension scheme reforms	0.00	0.00
		<i>Closing Balance Sheet</i>		
	10	Pension entitlements	1,133.83	6,523.92
		Pension entitlements (% of GDP 2007)	46.80	269.20
	11	Output	L	3.57

Source: Source: Forschungszentrum Generationenverträge, University of Freiburg, based on data provided by the respective pension schemes.

Starting with the general government employer pension scheme (column G), pension entitlements at the beginning of 2007 total EUR 1129,18 billions (row 1). This figure is calculated on the basis of the Freiburg model. In contrast to social security pension schemes, there are no actual contributions to this scheme, and so zeros are entered in rows 2.1 and 2.3. The imputed social contributions amount to minus EUR 5.41 billions (row 2.2). This row serves as a balancing item. It represents the difference between current benefits and actual contributions payable (by both employers and employees). Supplements to household social contributions account for EUR 56.58 billions. In practice, they are equal to the nominal discount rate (5 per cent in this case) times the pension entitlements at the beginning of the respective base year. The overall increase in pension entitlements due to social contributions (row 2) — reflecting the sum of rows 2.2 and 2.4 — amounts to EUR 51.17 billions. Pension benefits paid out in 2007 reduce the entitlements by EUR 46.52 billions. This figure has been provided by the institutions responsible for government employee pension schemes, namely the general civil servants' scheme and the supplementary pension scheme (VBL).

The change in benefits (row 5) amounted to EUR 4.65 billions in 2007. It is calculated by subtracting row 4 from the total of rows 2 and 3. There were no changes of pension entitlements due to other transactions (row 7) such as legislated pension reforms. Nor has

there been a transfer of entitlements between schemes in 2007 (in column G). Furthermore, no changes in entitlements due to revaluation (row 8) or other changes in volume (row 9) need to be considered in 2007. At the end of 2007, pension entitlements (row 10) amount to EUR 1,133.83 billions, which is equal to 46.8 per cent of GDP in 2007. This figure is also estimated using the actuarial model. Unfortunately, no data on financial services —on the cost of running the pension scheme during 2007 — have been provided. Therefore, the letter *L* is entered in the last row 11 — indicating that no data are currently available.

With regard to social security pensions in Germany (column H), the value of the opening stock of pension entitlements was EUR 6,522.94 billions in 2007. Actual contributions paid by households and employers account for EUR 84.89 billions and EUR 78.21 billions respectively. The data needed to complete the rows 2.1 and 2.3 have been provided by the statutory pension insurance scheme as well as the old age insurance for farmers, which is also covered by social security in Germany.

The household contribution supplement comes to EUR 326.17 billions, the residual value (row 3) is minus EUR 75.23 billions. This row reflects the case of actual social contributions that are not actuarially based. In the case of this base year the negative value is due inter alia to the increase in pension contributions from 19.5 to 19.9 per cent in the German statutory pension insurance scheme, without an increase in pension entitlements. Pension benefits in 2007 amount to EUR 234.87 billions, which has led to a difference of EUR 179.17 billions in pension entitlements.

In 2007 Parliament approved a major pension reform of the statutory pension insurance scheme by increasing the legal retirement age gradually from 65 to 67 between 2011 and 2029. Furthermore, a catch-up element was introduced into the pension formula in 2007 which factors in non-implemented deductions from the period 2011 to 2013. According to actuarial estimates this reform lowered the level of pension entitlements by EUR 178.19 billions. — as shown in row 7 (changes in pension entitlements due to other transactions). The final result, is a closing stock of pension entitlements amounting to EUR 6,523.92 billions, which is equivalent to 269.2 per cent of GDP in 2007.

The service fees to run the pension schemes covered under social security are recorded as additional information in row 11. According to the published data, the German statutory insurance scheme service fees amounted to EUR 3.57 billions in 2007.

## 8.2 Using business accounts and regulatory data — to complete columns A to C

The following section presents a case study of the completion of columns A to C in the supplementary table. Accordingly only pension schemes recorded in the non-general government sector are taken into account. The worked example is given for the supplementary table for Germany in the base year 2006. Table 6 shows columns A to C.

**Table 6**

### Columns A to C of the supplementary table for Germany, 2006

Relations	Code	Row No.	Pension manager	Non-general government		
				Defined contribution schemes	Defined benefit schemes and other <sup>1)</sup> non-defined contribution schemes	Total
			Code	XPC1W	XPB1W	XPCB1W
			Column number	A	B	C
<b>Opening balance sheet</b>						
	XAF63LS	1	Pension entitlements (incl. contingent pension entitlements)			479000
<b>Changes in pension entitlements due to transactions</b>						
						49000
Σ 2.1 to 2.4 – 2.5	XD61p	2	Increase in pension entitlements due to social contributions			49000
	XD6111	2.1	Employer actual social contributions			35000
	XD6121	2.2	Employer imputed social contributions			
	XD6131	2.3	Household actual social contributions			14000
	XD6141	2.4	Household social contribution supplements <sup>2)</sup>			
	XD619	3	Other (actuarial) change of pension entitlements in social security pension schemes			
	XD62p	4	Reduction in pension entitlements due to payment of pension benefits			32000
						17000
2 + 3 - 4	XD8	5	Changes in pension entitlements due to social contributions and pension benefits			
	XD81	6	Transfers of pension entitlements between schemes			
	XD82	7	Change in entitlements due to negotiated changes in scheme structure			
<b>Changes in pension entitlements due to other flows</b>						
	XK7	8	Changes in entitlements due to revaluations <sup>6)</sup>			
	XK5	9	Changes in entitlements due to other changes in volume <sup>6)</sup>			
<b>Closing balance sheet</b>						
1+ Σ 5 to 9	XAF63LE	10	Pension entitlements (incl. contingent pension entitlements)			499000
	XPI	11	Output			

Source: Destatis.

As the example makes clear, the German data do not enable a differentiation to be made between defined contributions (column A) and defined benefit schemes (column B). Only

the total of pension schemes classified in the non-general government sector can be reflected in the supplementary table in column C. Generally, when compiling the supplementary table, countries should make a distinction between defined contribution (column A) and defined benefit schemes (column B).

The total of pension entitlements at the beginning of 2006 (row 1) amounted to EUR 479 billions. This figure is published annually by the Deutsche Bundesbank.<sup>134</sup> It is based on a number of sources. Much of the pension data was provided by the German Federal Financial Supervisory Authority (BAFIN). This public institution is responsible for the supervision of banks and financial services providers. In this context most pension schemes are required to submit frequent reports to this body. However, not all types of pension schemes are covered by the BAFIN in Germany: other institutions such as the German Insurance Association (GDV), which is the umbrella organisation for private insurers in Germany, provide data to complete the data on pension schemes. The data sources consist of both regulatory and accounting data. In cases where the entries did not appropriately reflect the current value of pension entitlements on the market, further conversions have been applied in line with the accounting standards of the ESA. The increase in pension entitlements due to social contributions (row 2) during the year 2006 amounted to EUR 49 billions. This number is made up of employers' actual contributions of EUR 35 billions (row 2.1) plus actual household social contributions (row 2.3) amounting to EUR 14 billions in 2006. These values come from the German Federal Statistical office (Destatis). It should be emphasised that the data used in row 2.1 and row 2.3 are also used in the core accounts.<sup>135</sup> Furthermore, entitlements have been reduced during the year 2006 due to payments of pension benefits (row 4) amounting to EUR 32 billions. This figure was also provided by Destatis and is taken from the core accounts.<sup>136</sup> Altogether, pension entitlements during the year increased due to social contributions and pension benefits (row 5) by EUR 17 billions. The stock of entitlements at the end of 2006 (row 10) amounted to EUR 499 billions. This figure, which is provided by the Deutsche Bundesbank, is based on the same data as the opening balance (row 1).

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<sup>134</sup> See Deutsche Bundesbank (2007), p. 26.

<sup>135</sup> See Destatis (2010), p.248.

<sup>136</sup> See Destatis (2010), p. 244.

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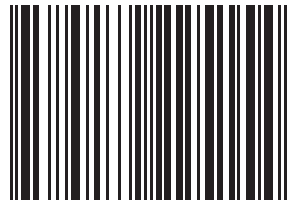
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