

Technical compilation guide for pension data in national accounts

2020 edition



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guide for pension data
in national accounts**

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Abbreviations

AAE	Actuarial Association of Europe
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
DG ECFIN	Directorate General for Economic and Financial Affairs
DRV	Deutsche Rentenversicherung (German statutory pension insurance)
ECB	European Central Bank
EPC	Economic Policy Committee
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
OECD	Organisation for Economic Co-operation and Development
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	Sozio-oekonomisches Panel (German Socio-Economic Panel)
ZUS	Zakład Ubezpieczeń Społecznych (Polish social insurance institution)

1

Introduction

There is high public and policy interest in how people are providing for their future retirement, and the impact that it has on their consumption and saving behaviour now. As populations age in many European countries, and the choice of available pension schemes widens, the availability of statistics on pensions is increasingly important.

The 2008 SNA and the ESA 2010 provide detailed guidelines for compiling supplementary data on pension entitlements under defined contributions and defined benefit schemes. They cover schemes managed by non-general government units and schemes managed by the general government and also social security schemes¹. Since the implementation of these standards, pension entitlements of households (and pension obligations of the schemes) are recorded in national accounts (NA), although not all in the central framework of the national accounts². The 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 include the outstanding amounts of pension entitlements only in the supplementary table on pension schemes in social insurance³. Pension data on defined benefit schemes for employees and on social security pension schemes are based on actuarial estimates. In order to obtain high quality actuarial estimates, ensuring reasonable consistency with the actuarial valuation of the social security pension scheme, compilers of national accounts should cooperate with the social security institution responsible for managing the above scheme and are strongly recommended to seek the input of the actuary. Actuarial estimates are broadly applied in the insurance and pension fund business and are also described and discussed in this manual.

The supplementary table (ESA 2010 Transmission Programme Table 29) records all positions and flows in pension obligations of all pension schemes in social insurance. Table 29 provides information on both private and public schemes⁴. Pensions paid irrespective of contributory history

¹ 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.

² 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.'

³ 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. It is also part of the ESA 2010 Transmission Programme Table 29.

⁴ According to ESA 2010, paragraph 4.88: 'social insurance schemes are schemes in which participants are obliged, or encouraged, by their employers or by general government, to take out insurance against certain eventualities or circumstances that may adversely affect their welfare or that of their dependants. In such schemes social contributions are paid by employees or others, or by employers on behalf of their employees, in order to secure entitlement to social insurance benefits, in the current or subsequent periods, for the employees or other contributors, their dependants or survivors.'

are termed “social assistance” and are not included in Table 29⁵. The scope of table 29 is discussed in detail in Chapter 3.

Table 29 reports on accrued-to-date pension entitlements / liabilities (ADL) in social insurance, which are not suitable as a measure of the sustainability of social security and unfunded government employer pension schemes. Also as it is stipulated in the relevant EU regulation, “accrued-to-date pension entitlements in social insurance are not as such a measure of the sustainability of public finances”⁶.

These entitlements are not considered part of government debt. Sustainability analysis of a pension scheme should be linked to the scheme’s financing approach and usually requires different, more forward-looking calculation approaches, notably considering future flows of social contributions. ADL figures include future pensions of people already retired and future pensions of people working at present, corresponding to accrued rights, but exclude future pensions of people working at present corresponding to rights to be accrued over the rest of their career and future pensions of people not yet working/born.

In order to compile appropriate indicators of the sustainability of pension schemes, future pension and contribution information on an open system basis is necessary. In contrast, ADL figures should be simply interpreted as the amount of resources that would have to be set aside today in order to finance all pension rights which have been earned up to a given year. The above is sometimes referred to as a “scheme closure” scenario, representing the additional resources needed if the social security pension scheme was to be closed (e.g., in order to start a new scheme) while honouring all past accruals. In concept, this is similar to a termination reserve in a private pension plans, which could be terminated for various reasons and therefore, as most pension regulatory frameworks provide, they must be fully funded⁷.

In the context of the ESA 2010, it is therefore mandatory for European countries to record a full set of position and flow data on pension obligations of all social insurance pension schemes (as defined in Chapter 3) including the schemes managed by general government for its own employees and social security pension schemes. The first Table 29 data transmission took place in December 2017 with 2015 as the reference year, with following transmissions each three years for data relating to the year t-2. Since the end of 2018 Eurostat has disseminated Table 29 statistics on its [website](#).

The 1st Pension Expert Group meeting after data transmission took place in April 2019: representatives from 25 EU MSs, 2 EFTA countries, DG ECFIN, ECB, OECD and the AAE actively participated to its work by presenting and discussing Table 29 methodological issues and compilation experiences. The group also endorsed the revision of the Technical Compilation Guide for Pension Data in National Accounts (Technical Compilation Guide) in July 2020 before the 2nd Table 29 data transmission.

The Technical Compilation Guide helps countries compile pension entitlements and obligations to be included in the supplementary table as described above. It covers:

- the main methodological concepts to be applied to estimate pension entitlements and obligations (Chapter 2);
- the definition and classification of pension schemes covered in the supplementary table (Chapter 3);

⁵ According to ESA 2010, paragraph 17.04: “Social assistance is not part of social insurance. Social assistance benefits are payable independently of participation in a social insurance scheme, i.e. without qualifying contributions having been made to a social insurance scheme.”

⁶ Refer to recital (21) of the EU regulation 549/2013.

⁷ A detailed discussion on different concepts of pension entitlements and obligations - including their reliability as sustainability indicators - can be found in Section 2.1.

- the design and use of the supplementary table (Chapter 4);
- the core assumptions to estimate pension entitlements and obligations (Chapter 5);
- the data sources for compiling and estimating pension entitlements and obligations (Chapter 6);
- the approach to estimate defined benefit pension entitlements and obligations (Chapter 7).

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 for its employees and social security pension schemes. As counterparts, they are recorded as contingent liabilities of the government (see as a reference ESA 2010, paragraph 5.184).

The aim of Table 29 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 (as defined in chapter 3). 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 Table 29, the positions and flows of the pension obligations always correspond to the positions and flows of pension entitlements⁸.

The Table 29 pension reporting exercise is undertaken based on the Accrued-to-Date Liability (ADL) method, which is consistent with the closed-group approach. By contrast, the other major EU pension reporting exercise of the Ageing Working Group of the Economy Policy Committee is undertaken based on the open-group approach.⁹ A comprehensive description of the closed and open group approaches is provided in chapter 4 of the publication of the Social Security Committee of the International Actuarial Association (IAA, 2018¹⁰), an overview of which is presented on Box 1. Table 1 and Box 2 refer to the terminology more commonly used by national accountants.

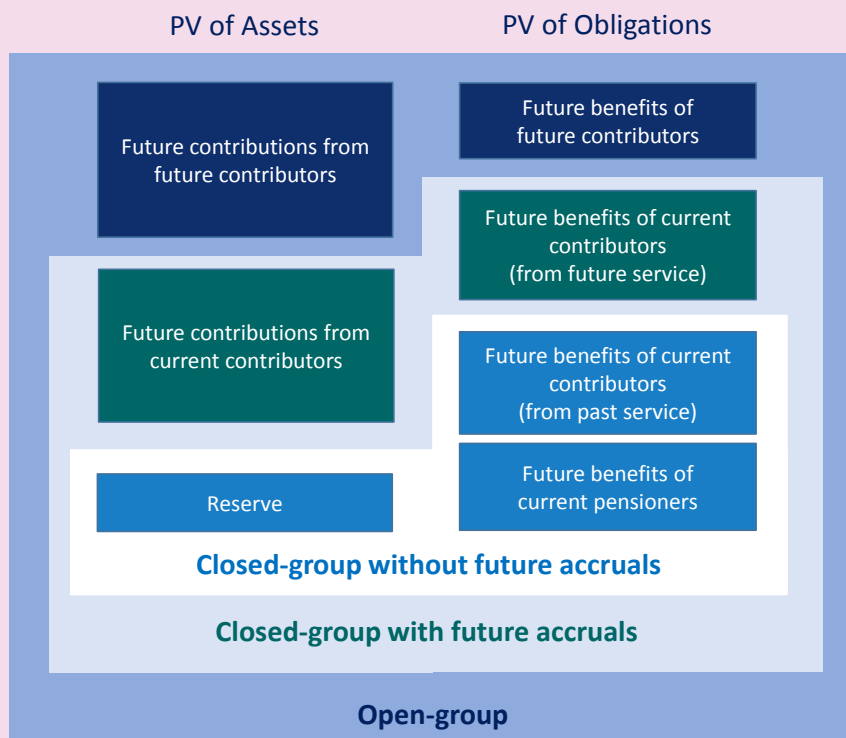
⁸ When the text refers to positions or flows of pension obligations, it corresponds to positions or flows of pension entitlements and vice versa.

⁹ The results of this exercise are presented in the triennial Ageing Report; the latest available report is the [2018 Ageing Report](#).

¹⁰ IAA. [Measuring and Reporting Actuarial Obligations of Social Security Systems](#). 2018. Ottawa, International Actuarial Association – Social Security Committee.

Box 1: Closed and open group approaches

The figure below compares graphically the closed and open-group approaches, through the means of a balance sheet, for a social security pension scheme (SSPS).



Note: PV = Present Value

- 1. Closed-group without future accruals:** This approach includes only current pensioners and contributors of the SSPS, with no future entrants (contributors) taken into account. Under this approach, the scheme's reserves (assets) are compared to the future benefits of current pensioners and of current contributors resulting from past service (obligations). There are no future contributions and no future accrual of new benefits.
- 2. Closed-group with future accruals:** This approach includes only current pensioners and contributors of the SSPS, with no future entrants (contributors) taken into account. Under this approach, the scheme's reserves and future contributions from current contributors (assets) are compared to the future benefits of current pensioners and of current contributors resulting from past and future service (obligations).
- 3. Open-group:** This approach takes into consideration all current pensioners and contributors as well as future contributors of the SSPS, including their future contributions and associated benefits, to determine whether current scheme's reserves and future contributions (assets) will be sufficient to pay for all future benefit expenditures (obligations).

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)

Pension entitlements in national accounts are measured on a gross basis; that is, these entitlements are not netted against expected revenue of government or expected household social contributions. No assets or accumulated social contributions are taken into account to compile any type of net entitlements. Only pension entitlements due to actual and future pension benefits are covered.

Box 2: Three concepts of pension obligations

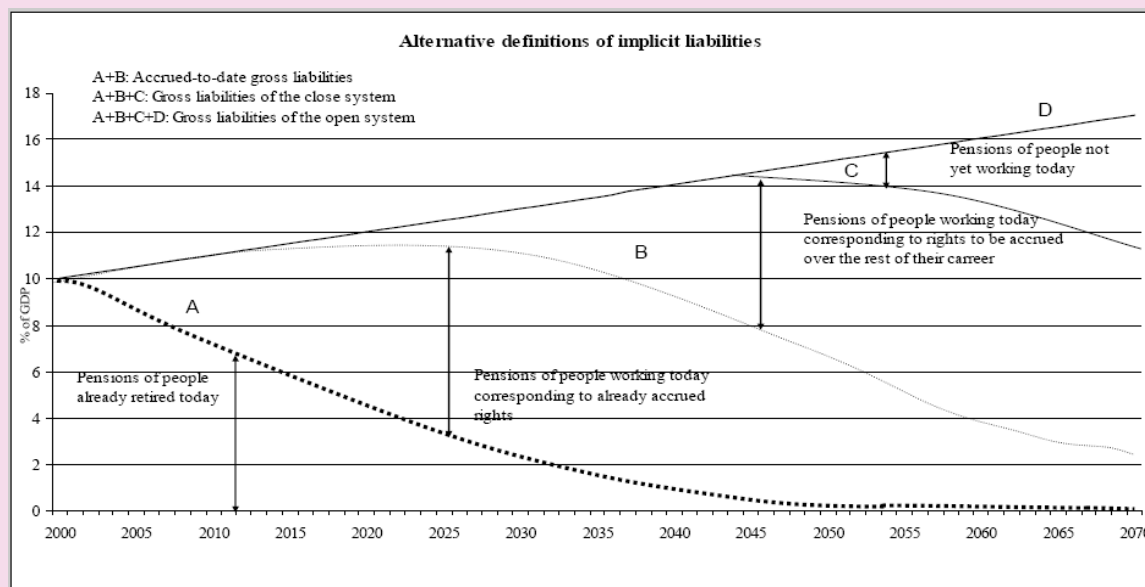
In the literature (see Franco, 1995, pg. 2) three main concepts of pension obligations have been introduced: the concepts of (a) *accrued-to-date liabilities (ADL)*; (b) *current workers and pensioners liabilities (CWL)*; and (c) *open-system liabilities (OSL)*¹¹. Box 2 gives a detailed description of 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 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 (corresponding to the pension schemes' obligations, on the liability side of the accounts) 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 pension schemes in social insurance in the EU countries are typically not made available by the manager of the pension

¹¹ The concepts of ADL, CWL and OSL correspond to the Box 1 approaches of Closed-group without future accruals, Closed-group with future accruals and Open-group respectively.

scheme, compilers of national accounts have to estimate the above actuarial values and ideally should refer to actuaries who will provide the relevant estimated values.

- 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 members 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 social insurance defined benefit 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 or changing the financing from PAYG to advance funding should be addressed on the basis of the ADL or the CWL concept, depending on the remaining time horizon of the scheme. Finally, only the ADL concept complies fully with the methodology used in national accounts.

The ADL concept is appropriate for national accounts purposes. It includes the present value of pension entitlements arising from already accrued pension rights. For example, it covers the pension entitlements accrued by current employees, 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 the accrued pension rights at the balance sheet date. The method is based on observable past events and transactions, such as membership of the pension scheme and paid contributions. However, such ex-post measures also rely on a number of assumptions in the modelling process.

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. These actuarial calculations require a number of careful assumptions to be made. They include assumptions about future life expectancy (through the use of mortality rates), which determine the payout period of future pensions and probability of current contributors dying or becoming disabled before reaching the pensionable age. 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.

It is also 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 3).

Box 3: Pension entitlements are not sustainability indicators

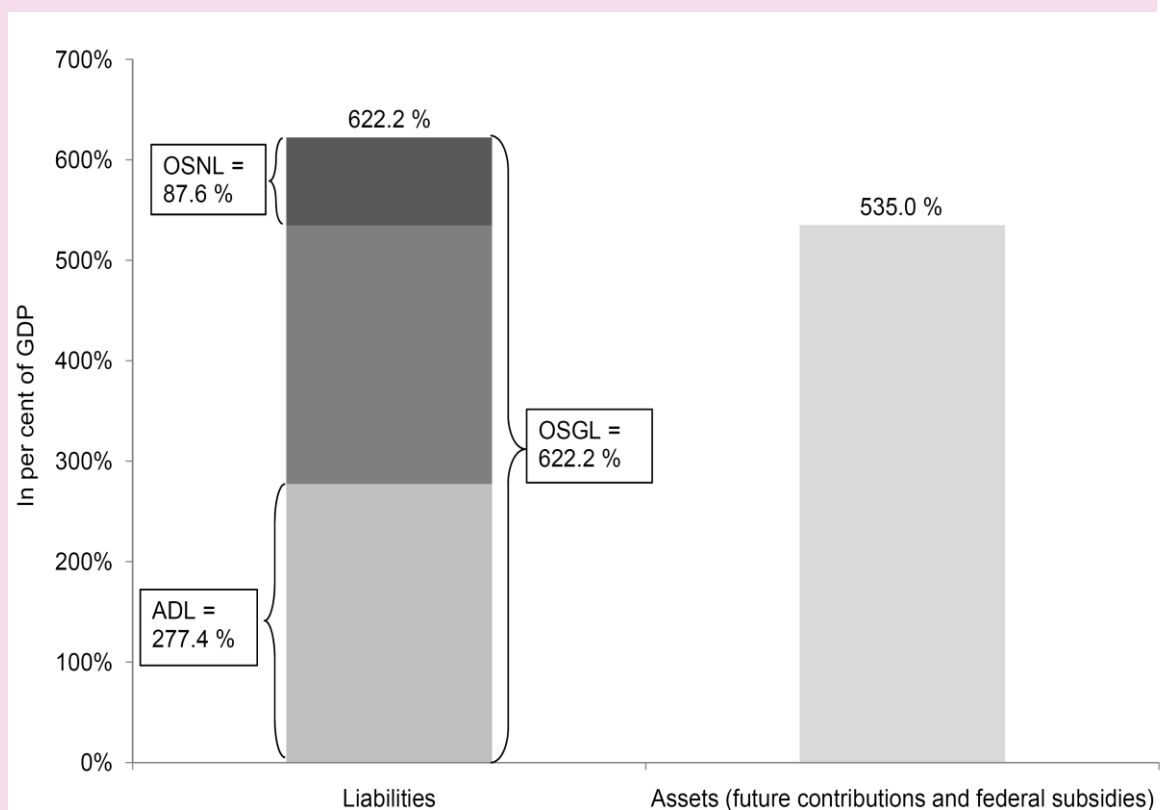
Measures of pension entitlements accrued-to-date are the appropriate data to be reported in the system of national accounts in the context of economic and policy analyses of households' pension wealth. They provide an estimate of the cost of a hypothetical termination of a pension scheme without reneging on accrued entitlements. In concept, this is similar to a termination reserve in a private pension plan. 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 some pension reforms, such as establishing a new system for new contributions 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 or assessing impacts of the reforms that impact both current and future entitlements, such as increase in retirement age. 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 any assets set aside nor the net present value of future social contributions. To assess fiscal sustainability it is vital to compare (future) pension obligations with the cash inflows arising from the corresponding future pension-related assets. In this context, the 2018 special issue of the International Social Security Review "Actuarial and financial reporting of social

security obligations” provides comprehensive reference material.

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, comprising of any current assets set aside and future social contributions. 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 including the development of mortality rates, 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 is used and the corresponding assets are included¹².

Figure 2: Accrued-to-date liabilities and related sustainability indicators



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

¹² For a description of extending the ADL approach, see Müller et al. (2010).

2.2 Actuarial assumptions following ESA 2010¹³

2.2.1 DISCOUNT RATE

The discount rate applied to estimates of future pension benefits in the case of accrued-to-date entitlements is one of the single most important assumptions to be made in the modelling of pension schemes, since its accumulated impact over many decades can be very large. The discount rate from a chosen approach may change over time, which would lead to revaluations in the accounts.

The discount rate can be seen as equivalent to the expected risk-free rate of return on assets held by a pension scheme. In the case of pension entitlements to be paid in the future, the discount rate can also be seen as the cost of capital in a sense that the future payments have to be financed by government, via the usual sources:

- (a) Net acquisitions of liabilities, such as loans and debt securities;
- (b) Net sales of assets; and
- (c) Government revenue.

A discount rate can be derived from this cost of financing.

The discount rate should be a risk-free rate. Some criteria for identifying suitable rates are given in the following sentences. The discount rate on high quality government and corporate bonds, e.g. of "AAA"-rating provides an appropriate reference. Yields for high quality corporate bonds are only used where the markets are broad. The bonds are to be of a residual maturity of the same order as the pension entitlements. The use of a discount rate based on a long-term maturity, where long-term is taken to be 10 years or longer, is recommended. The average of several years of the discount rate, linked to the length of the economic cycle, can be applied to smooth the time series of the discount rate. The assumption on the discount rate and the future development of wages should be consistent. Member States are required to provide the elements demonstrating the validity of the discount rate used for pension entitlements in the light of the various criteria mentioned above.

The same discount rate has to be used for all pension schemes where government is the pension manager (including social security pension schemes) at whatever level of government since the desired result should approximate risk-free yields.

2.2.2 WAGE GROWTH

Defined benefit pension schemes often apply a formula to the member's salary - whether it be the final salary, an average of a period of years, or lifetime earnings - to determine the level of pension. The final pensions paid are affected by the average growth of members' salaries, notably through promotions and career progression.

It is, therefore, appropriate to consider what assumptions are made for the future development of wages. The assumed long-term development of wages should correspond with the observed discount rate. Both variables are, in the long-term, interdependent.

The accounting profession uses two actuarial methods to measure the impact of wage increases. The accrued benefit obligation (ABO) records only the benefits actually accrued to date. It represents the amount an employee could walk away with if he left the firm tomorrow, and may be the basis for assessing a person's net worth in the case of a divorce settlement, for example.

A projected benefit obligation (PBO) is a more prudent measure of what the eventual level of entitlement is likely to be. For an individual, the PBO makes assumptions about how many future

¹³ This section replicates ESA 2010 text (paragraph 17.165 to paragraph 17.183).

promotions the person is likely to receive and calculates his final salary accordingly. Then, if that individual has in fact only worked 20 out of an expected 40 years, it halves the final salary and calculates pension entitlement for the individual as if this were his current salary. Where an individual's ABO increases in steps as he is promoted, the PBO increases steadily over time. For the individual, PBO is always higher than ABO until the moment of retirement when the ABO catches up with the PBO.

The impact of wage increases needs to be reflected in transactions, because awarding a wage increase is a conscious economic decision taken by the employer. Moreover, in concept the ABO and PBO approaches lead, in the long run, to the same transactions being recorded, even if the timing of those transactions differs depending on the demographics of the scheme.

Changes to assumptions of future wage changes, which are generally made every few years in response to a general review of pension modelling assumptions or due to a major restructuring of the workforce, are recorded as other flows (revaluations).

A number of possible variants in the application of the ABO and PBO methods are observed in practice depending on how price and wage effects are treated.

One important factor is the treatment of indexation arrangements on pensions, where the pension to be paid will increase in line with nominal wage growth after retirement.

Given the importance of wage effects, it is recommended that the choice of an ABO or PBO approach be based on the underlying benefit formula in the pension scheme. Where this formula includes implicitly or explicitly a factor for wage increases (before or after retirement) then a PBO approach is followed. Where such a factor is not present, an ABO approach is used.

Box 4: ABO or PBO?

The choice between the two concepts may have a significant impact on the projected level of pension entitlements. Results are usually 10 to 20% higher when applying PBO instead of ABO. Therefore, clear guidelines have to be applied as to 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 (see Reinsdorf 2010). The International Public Sector Accounting Standards (IPSAS39) also recommend applying the PBO approach to measure pension obligations of defined benefit plans. In fact, the IPSAS39 requires an entity to use the Projected Unit Credit Method, which is equivalent to the PBO approach. 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.

For the estimation of pension obligations of defined benefit schemes for government employees and of social security pension schemes, which are not assumed to be terminated in future, to maintain consistency in Table 29 calculations across those schemes, it is recommended to apply the PBO approach.

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 (this is equivalent to an ABO approach);
- 2) price indexation;
- 3) wage indexation;
- 4) pensions indexed in accordance with indexation rules.

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.

2.2.3 DEMOGRAPHIC ASSUMPTIONS

Future pension payments are subject to demographic effects, in terms of the age/ gender balance of members and their longevity. Demographic tables are well established for the modelling of pension and life insurance schemes.

In the case of employment-related pension schemes, the membership of the scheme is well defined and, therefore, the data should be available. In the case of social security schemes, recourse is made to general population data if no specific data are available on social security membership.

In the use of longevity tables, also known as mortality tables, tables which are specified with regard to gender and groups of employees are preferred. The group of members receiving a disability pension should be modelled with different longevity assumptions, if possible.

Longevity assumptions should include the increase of longevity over time.

The modelling of pension schemes may involve the use of demographic assumptions other than longevity, for example future fertility rates, labour participation rates or migration rates in the case where the pension benefit or indexation formula is based on a "dependency ratio" or similar type of approach.

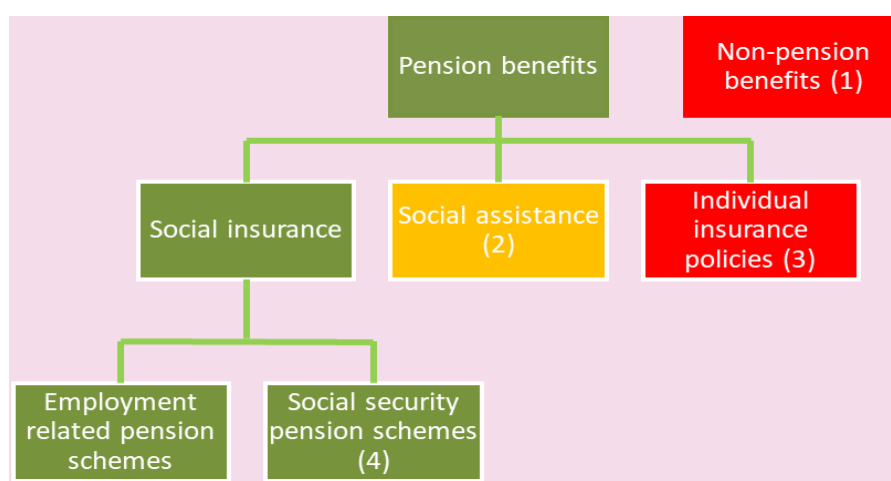
Where early retirement within a scheme is actuarially neutral, modelling is unaffected. Non-actuarially neutral early retirements have an effect, and they frequently arise given the way in which different interest rates are usually applied at early retirement. Therefore, the appropriate modelling of early retirement behaviour is important, particularly where a reform raises the future pensionable age.

3 Pension schemes in social insurance covered by the supplementary table

3.1 Classification of pension schemes

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 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



(1) "Other social insurance benefits, or non-pension benefits, are benefits which beneficiaries receive, directly or indirectly, depending on specific events and usually under predetermined legal or contractual terms. Excluding income in retirement, a number of other contingencies may be covered such as health insurance, unemployment insurance and long-term care insurance benefits." [ESA 2010, paragraph 17.15]

(2) "Elements of social assistance within pension schemes generally organised as social insurance may not be separable, and so occur in the supplementary table" [ESA 2010, paragraph 17.122]. In this case, Table 29 may include also elements of social assistance.

(3) Individual insurance policies are not included in Table 29 (ESA 2010, paragraph 17.122), unless participation in the scheme is compulsory, the scheme is organized collectively or employers make imputed or actual contributions to the scheme [ESA 2010, paragraph 17.06]. Therefore individual insurance policies in this context are not necessarily only "traditional" insurance products, and may be products which benefit from a government incentive (such as a tax reduction).

(4) Not recorded as assets/liabilities in core national accounts. Unfunded defined benefit schemes for general government employees are also not recorded in the core national accounts.

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.

Social insurance schemes are schemes in which participants are obliged, or encouraged, by a third party to take out insurance against certain social risks or circumstances that may adversely affect their welfare or that of their dependants. In such schemes, social contributions are paid by employees or others, or by employers on behalf of their employees, in order to secure entitlement to social insurance benefits, in the current or subsequent periods, for the employees or other contributors, their dependents or survivors. Contributions to social insurance schemes can also be paid by, or on behalf of, self-employed or non-employed persons¹⁴.

There are two types of social insurance schemes:

The first consists of **social security schemes** covering the entire community, or large sections of the community, that are imposed, controlled and financed¹⁵ by government units¹⁶.

The second type consists of other **employment related schemes**. Such schemes derive from an employer-employee relationship¹⁷ in the provision of pension, and possibly other, entitlements that are part of the conditions of employment and where responsibility for the provision of benefits does not devolve to general government under social security provisions¹⁸. Employment-related social insurance pension schemes may be managed by general government or by non-government entities, and they may operate either on a funded or unfunded basis. 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)¹⁹.

¹⁴ ESA 2010, paragraph 17.01.

¹⁵ Sometimes, a social security scheme might be financed only by employee and employer social contributions.

¹⁶ ESA 2010, paragraph 17.02 (a).

¹⁷ Schemes organised by trade unions (described in ESA 2010, paragraph 17.03(d)) are also included in this category of social insurance schemes, even though they are not necessarily employer related. Pension schemes for certain occupational groups, such as self-employed professionals, should be included if the participation in the scheme is obligatory or a substitute for participation in compulsory social security pension schemes and these schemes are collectively organized for the specific group.

¹⁸ ESA 2010, paragraph 17.02 (b).

¹⁹ Sometimes, a social security scheme operates on a partially funded basis, by holding a reserve fund, the level of which is equal to a multiple of annual scheme's expenditure, for example, three times the annual expenditure.

Figure 4: Social insurance schemes

	Characteristics	Form of organisation	Sector/Subsector
Social security	The participants are obliged by general government to insure against certain social risks.	Organised by general government via social security funds	Social security funds
Employment-related social insurance schemes other than social security	Employers can make it a condition of employment that employees insure against certain social risks	Organised by employers on behalf of their employees and their dependents or by others on behalf of a specified group	Sector or subsector of employer, insurance corporations and pension funds or non-profit institutions serving households

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 might be included in the data recorded by countries in the supplementary table, accompanied by suitable metadata for users.

Box 5: Social insurance or social assistance ? An example

Under social insurance, participants are obliged, or encouraged, by their employers or by general government, to take out insurance against certain eventualities or circumstances (ESA 2010, paragraph 4.88). In contrast, social assistance benefits in cash are current transfers payable to households by government units or Non Profit Institutions Serving Households to meet the same needs as social insurance benefits but which are not made under a social insurance scheme requiring participation (ESA 2010, paragraph 4.105).

In Country A the basic pension granted independently of contributions history is excluded from Table 29 – being classified as social assistance, whereas topping-up to the minimum pension has been retained, being based on specific conditions.

In Country B the social security pension consists of both a flat-rate part and a contributory part. The flat-rate part (basic pension) is partially contributory in the sense that a certain amount is granted only if a contribution record of at least X years can be proved (independently of the amount of the contributions paid) and additional conditions (citizenship, for example) also need to be satisfied. In this case, the whole flat-rate part might be included in Table 29 since, as mentioned also in ESA 2010, paragraph 17.122 “in practice, it may not be feasible, or sufficiently important, to completely separate the non-pension social insurance elements. Elements of social assistance within pension schemes generally organised as social insurance may not be separable, and so occur in the supplementary table.”

Individual insurance policies related to pensions are policies that beneficiaries take out in their own names – as individual pension plans - 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. They may benefit from government incentives. These individual insurance policies are not employment related and therefore are not recorded in the supplementary table.

Box 6: Individual or collective policy? An example

ESA 2010 (paragraph 17.122) specifies that individual pension schemes are not part of social insurance and therefore should not be included in Table 29. It explains the background for their exclusion as follows:

For a life insurance policy the benefits from the policy are treated as changes in wealth, recorded in the financial account. For a policy qualifying as social insurance, the benefits in the form of pensions are recorded as income in the secondary distribution of income account. The reason for the different treatment is that a policy other than social insurance is entered into entirely on the initiative of the policyholder. Policies that qualify as social insurance reflect the intervention of a third party, usually the government or the employer, to encourage or oblige the policyholder to make reserve for income in retirement. [ESA 2010, paragraph 16.68]

However, the practical classification of single schemes into one category or another may be quite difficult in some cases; following example illustrates this:

AAAs pension plans characteristics: “AAAs plans offer more flexibility. They are known as “contract-based DC plans” and operate on a different basis to occupational DC plans”. (OECD, 2008); “In a AAA, the scheme is run by a pension provider that your employer chooses, but your pension is an individual contract between you and the provider”. (National source)

BBBs pension plans characteristics: “Contributions are made by individuals, employers, or both. ... Employees who participate in a company pension plan may only make contributions to a BBB if company pension plan rules prohibit them from making additional voluntary contributions”. (OECD, 2008); “Employers that do not provide an occupational pension scheme for their employees are obliged to provide access to at least one BBB”. (National source)

They are similar for several reasons. (1) In both cases, pensions are contracts between an individual and a provider. (2) In both cases, the role of employer is the one of a “facilitator”, setting a contact between the individual and the provider. (3) Both the schemes seem to be “portable” – i.e. from one job to another. Concerning portability in particular under AAAs, if a person changes jobs, his or her group personal pension is normally automatically converted into a personal pension and the worker continue paying into it independently. However, it is necessary to check to see if the new employer offers a pension scheme. A worker may be better off joining the new employer’s scheme. Under BBBs, if a worker’s new job allows him or her to become a member of an occupational pension scheme, the worker may transfer their BBB into that scheme. Alternatively, if the new job is not pensionable or if the worker becomes self-employed, the worker can continue to contribute to their BBB. (4) AAA is a personal scheme but it is related to employment, while BBBs are more flexible and are available to everyone regardless of job or employment status. However, BBBs can be seen also as an occupational scheme supplement since an employer who has an occupational pension scheme that does not allow employees to make additional voluntary contributions, must make a BBB available, either as part of the existing occupational pension scheme (this requires an

amendment to the scheme rules) or as a separate additional voluntary contributions scheme.

It is apparent that the two schemes presented above are very similar. However, due to their slight differences in terms of their relation to employment status they are treated differently: AAA is included and BBB is excluded from Table 29.

Another interesting topic is that of “fully portable” schemes where a worker who changes job can choose to bring his or her “pot” into the next employer’s scheme or put the money to another use. There are currently a few schemes designed in this way across Europe, and it is questionable whether or not they should be identified as pension schemes. If a worker moves his or her resources each time into a new employer’s scheme, then at retirement there is a substantial resource to be used for retirement (thus the scheme could be considered a pension scheme). However, this may not be the case, in which case the scheme is a type of saving scheme. Only observation of the operation of the scheme in practice can determine if members use it as a pension scheme.

A presentation was devoted to this issue at the 2019 Pension Expert group meeting. The presentation and the following discussion showed that it is important to differentiate between an employer’s administrative arrangements and its obligation to contribute. If contributions are voluntary and the employer is only responsible for administrative collection arrangements, then such a scheme should be excluded from Table 29.

3.2 Social insurance schemes in Table 29

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:

Social insurance - according to ESA 2010, paragraph 17.01 - refers to a contractual insurance scheme in which participants are obliged, or encouraged, by a third party to take out insurance against certain social risks or circumstances that may adversely affect their welfare or that of their dependants.

The benefits received are conditional on participation in the scheme, and 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.

There may be some borderline cases where there are so-called “second pillar” compulsory schemes which have been subject to reform, and participants are thereafter obliged to remain as members of the scheme (for some proportion of their accumulated entitlements), or must choose between continuing to participate in the scheme and participating in a social security scheme. These schemes can be interpreted for statistical purposes as remaining of an obligatory nature, and therefore included in social insurance as part of Table 29. In case of doubt, the cases can be directly discussed with Eurostat to determine the most appropriate statistical treatment. It is important that suitable metadata is provided for these cases, to inform users.

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).

- **Social security pension schemes²⁰** 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 and are typically unfunded, operating on a pay-as-you-go basis²¹.

Social security pension benefits might be very basic or more generous, depending on specific characteristics.

In some cases, the benefits is fixed independently of the size of contributions and/or might depend on additional conditions (years of contributions, citizenship...). In other cases, countries have earnings-related social security pension schemes, where the level of future pensions depends on the earnings history of contributors.

In any case, universal flat-rate benefits funded by means other than contributions must be excluded from Table 29. This is the case, for example, of the Danish *Folkepension* financed through general taxation.

No pension entitlements for social security pension schemes are recognised in the core system of national accounts. They are only displayed in Table 29.

- **Employment-related pension schemes²²**, other than 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. Since each national pension system has its own history and its own uniqueness, Table 29 figures published show heterogeneity in terms of both levels and composition of future pension entitlements, where levels refer to total pension entitlements as percentage of a country's GDP and composition refers to the share of private pensions in total pension entitlements.

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 unfunded pension obligations of defined benefit pension schemes for government employees in EU countries are typically to be recorded in Table 29 only.**

²⁰ Defined in paragraph 17.43 of the ESA 2010 regulatory framework.

²¹ Some social security schemes are partially funded, holding some reserves.

²² Defined in paragraph 17.49 of the ESA 2010 regulatory framework. To be noted that ESA 2010 also provides for schemes established by non-employers, see paragraph 17.03.

3.3 Defined contribution, defined benefit and other pension schemes

The supplementary table distinguishes between two types of pension schemes: *defined contribution schemes* and *defined benefit schemes*.

According to ESA 2010, paragraphs 17.54 & 17.55, a **defined contribution scheme** is a pension scheme where the benefits are defined exclusively in terms of the level of the fund built up from the contributions made over the employee's working life and the increases in value that result from the investment of such funds by the manager of the pension scheme²³. The entire risk of a defined contribution scheme to provide an adequate²⁴ income in retirement is borne by the employee.

An underfunded defined contribution scheme from the perspective of the pension provider 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, thus ensuring that scheme's obligations are equal to assets at any given time.

A **defined benefit scheme** – ESA 2010, paragraphs 17.57 & 17.58 - is a pension scheme where the benefits payable to the employee on retirement are determined by the use of a formula, either alone or in combination with a guaranteed minimum amount payable. The risk of a defined benefit scheme to provide an adequate²⁵ income in retirement is borne by the employer or a unit acting on his behalf.

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 manager²⁶ of the pension scheme bears the risk of providing a prescribed 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 or partially funded arrangements. Therefore, pension entitlements need to be estimated using actuarial methods, described later in Chapter 7 of this technical guide.

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 those of defined benefit schemes. In these schemes, the risk of providing a prescribed retirement income is shared between the pension manager and the beneficiary of the scheme. The most important forms of such hybrid schemes in the area of social security are **notional defined contribution (NDC) schemes**, which “are similar to defined contribution schemes but with a guaranteed minimum amount payable” [ESA 2010, paragraph 17.60]. 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.

²³ 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.

²⁴ In the context of a defined contribution scheme, “adequate income” has the meaning of “targeted income”.

²⁵ In the context of a defined benefit scheme, “adequate income” has the meaning of “prescribed income”.

²⁶ For a definition of the term manager see below.

3.4 Core and non-core accounts

The supplementary table on pensions in social insurance distinguishes between pension schemes whose positions are recorded also in the core system of national accounts and those recorded only in Table 29. 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, unfunded defined benefit schemes for general government employees are also recorded only in the supplementary table.

3.5 Pension manager, multi-employer pension scheme and pension administrator²⁷

The supplementary table classifies pension schemes according to the sector classification of the manager²⁸ of the pension scheme. A **pension manager** is mandated by the employer to manage the pension scheme. He/ she is responsible for setting the terms of an employment-related pension scheme and bears the ultimate responsibility for pension entitlements²⁹. 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 funds³⁰. 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.

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 generated³¹. 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 employment³².

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.

²⁷ The definitions of “pension manager”, “multi-employer pension scheme” and “pension administrator” are also provided in the ESA 2010 manual, in the dedicated section corresponding to paragraphs 17.72 to 17.79.

²⁸ Please note that the term ‘manager’ is used synonymously for the word ‘sponsor’.

²⁹ The pension manager entirely bears the risk in a defined benefit scheme, whereas in case of a pure defined contribution he/she does not bear the risk and in case of a shared-risk scheme he/she partially bears the risk.

³⁰ The pension manager entirely bears the risk in a defined benefit scheme, whereas in case of a pure defined contribution he/she does not bear the risk and in case of a shared-risk scheme he/she partially bears the risk.

³¹ It depends on the type of social security scheme and its legal provisions. In case of social security arrangements with shared risks, this does not apply.

³² This might be regarded as rather theoretical. In practice, the government often, as a consequence of relevant legislation might be obliged to change the provisions of a social security pension scheme, including increasing contribution rates or reducing benefit entitlements (typically with respect to future service), or alternatively the pension scheme might have itself self-adjustment mechanisms, stipulated in the law and thus avoiding political interference.

Please note that the same unit may in practice carry out both functions of pension manager and pension administrator.

4

Columns and rows in the supplementary table

The supplementary table on positions and flows of all pension schemes in social insurance provides a complete and comparable framework for compiling and presenting comparable balance sheets and transactions and other flow data of all types of pension entitlements from a debtor's (pension manager) and also from a creditor's (household) point of view. The table also covers stock and flow data not fully recorded in the core national accounts for specific pension schemes such as government-unfunded defined benefit schemes with government as the pension manager, and social security pension schemes.

All elements of the supplementary table are recorded with no deductions made for taxation, further social contributions or the service charge associated with the pension scheme.

This chapter describes in detail the columns and rows in the table. The outline follows closely chapter 17 of the ESA 2010 (paragraphs 17.121 to 17.161).

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

Relations	Row No	Recording		Core national accounts					Not in the core national accounts		Total pension schemes	Counterparts: pension entitlements of non-resident households ¹	
		Pension manager	Non-general government			General government				Social security pension schemes			
			Defined contribution schemes	Defined benefit schemes and other ² non-defined contribution schemes	Total	Defined contribution schemes	Defined benefit schemes for general government employees ³	Classified in financial corporations	Classified in general government ⁴				Classified in general government
Column number		A	B	C	D	E	F	G	H	I	J		
Opening balance sheet													
	1	Pension entitlements											
Changes in pension entitlements due to transactions													
Σ 2.1 to 2.4 – 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 ⁵											
	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											
Changes in pension entitlements due to other flows													
	8	Changes in entitlements due to revaluations ⁶											
	9	Changes in entitlements due to other changes in volume ⁶											
Closing balance sheet													
1 + Σ 5 to 9	10	Pension entitlements											
Related indicators													
	11	Output											

¹ Counterpart data for non-resident households will only be shown separately when pension relationships with the rest of the world are significant.

² Such other non-defined contribution schemes, often described as hybrid schemes, have both a defined benefit and a defined contribution element.

³ Schemes organised by general government for its current and former employees.

⁴ These are non-autonomous defined benefit schemes whose pension entitlements are recorded in the core national accounts.

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 must 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 ■ will contain different data from the core national accounts.

4.1 Columns of the supplementary table

Recording	Core national accounts							Not in the core accounts	Total Pension Schemes	Counterparts: entitlements of	
Pension manager	Non-general government			General government						Resident households	Non-resident households
		Defined benefit schemes and other non-defined contribution schemes	Total	Defined contribution schemes	Defined benefit schemes for general government employees			Social security pension schemes			
	Defined contribution schemes			Classified in financial corporations	Classified in general government	Classified in general government					
Column number	A	B	C	D	E	F	G	H	I	J	K

The columns of the table refer to the three groupings of pension schemes, as follows:

- (1) By type of recording into pension schemes completely recorded in the core national accounts (columns A to F) and those whose entitlements are only recorded in the supplementary table (columns G and H);
- (2) By type of pension manager into non-general government (columns A to C) and general government pension schemes (columns D to H); pension schemes including social security classified in general government are shown in columns D, F, G and H; and
- (3) By type of pension scheme into defined contribution schemes (columns A and D) and defined benefit schemes (columns B and E to G).

For the most part, the beneficiaries of pension schemes are resident households. In some countries, the number of non-resident households receiving pension benefits may be significant. In this case, column K is added to show the total for non-resident households.

The decision to record the pension entitlements of an unfunded employment-related defined benefit pension scheme where government is the pension manager within the standard national accounts or only in the supplementary table depends on the nature of the defined benefit scheme. The guiding principle for inclusion in the national accounts is the closeness of the scheme to the national social security pension scheme.

There is a wide diversity of schemes in the EU, and including all schemes would lead to inconsistencies in recording. So entitlements of unfunded employment-related defined benefit schemes where government is the pension manager might be recorded only in the supplementary table. This affects the calculation method in the core national accounts of the imputed employer social contributions for these schemes.

Pension schemes are classified further according to the pension manager, as government and non-government pension managers.

Some employer pension schemes have a mixed membership, for example including both government employees and employees of public corporations, and many pension schemes have frozen the membership of participants who have moved to other employers. A scheme having a small proportion of non-government employees does not prevent the scheme being described as having a government pension manager.

General government-funded defined benefit schemes for its own employees are shown in columns E and F. Column E shows schemes managed by a pension fund or an insurance corporation and column F those schemes managed by general government itself. Government schemes for its own employees where the pension entitlements do not appear in the core national accounts are shown in column G. The sum of columns E, F and G therefore shows the total responsibility of government for pension entitlements for its own employees.

4.2 Rows in the supplementary table

The rows of the table relate to balance sheet positions, transactions and other flows associated with pension entitlements of the schemes included in the supplementary table. There is reconciliation between the opening stock of pension entitlements of such schemes at the beginning of a period and the closing stock of pension entitlements at the end of a period, taking account of all transactions and other flows during the period. For schemes recorded in columns G and H, the stocks of pension entitlements are not recorded in the core national accounts, but many of the transactions are recorded in the core national accounts.

Row No	
	Opening balance sheet
1	Pension entitlements
	Changes in pension entitlements due to transactions
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 ¹
2.5	Less: pension scheme service charges
3	Other (actuarial) increase of pension entitlements in social security pension schemes
4	Reduction in pension entitlements due to payment of pension benefits
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
	Changes in pension entitlements due to other economic flows
8	Changes in entitlements due to revaluations ²
9	Changes in entitlements due to other changes in volume ²
	Closing balance sheet
10	Pension entitlements
	Related indicators
11	Output

¹ Such 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 factor applied.

² A more detailed split of such positions has to be provided for columns G and H based on the model calculations carried out for those schemes (see paragraphs 17.158-17.160).

Opening and closing balance sheets

Row 1 shows the opening stock of pension entitlements, which is exactly equivalent to the closing stock of the previous accounting period. **Row 10** shows the corresponding closing stock of pension entitlements at the end of the accounting period.

Changes in pension entitlements due to transactions

Employer and employee actual social contributions are recorded in **rows 2.1 and 2.3**, as in the core national accounts. In the case of some pension schemes, notably social security pension schemes, it is necessary to distinguish actual social contributions relating to pensions from social contributions relating to other social risks such as unemployment.

For defined benefit pension schemes, employer imputed social contributions could be measured as the balancing item – any changes in entitlements over the year not included in other rows of the table are captured in **row 2.2**. This row covers "experience effects" where the observed outcome of pension modelling assumptions (wage growth rate, inflation rate and discount rate) differs from the levels assumed. Zeroes are shown in this row for defined contribution schemes³³.

Alternatively, the employer imputed social contributions in row 2.2 could be actuarially calculated as the difference between Current Service Cost³⁴ in a given year and the sum of employees and employer social contributions paid in that year plus the experience effect which reflects the assumptions taken in the calculation of opening stock of pension entitlements and the actual experience.

Row 2.4 shows the property income earned or imputed in the schemes, which is routed via the households sector or the rest of the world sector. It should be noted that for all defined benefit schemes including social security, whether funded or unfunded, this property income is equivalent to the unwinding of the discount rate. In other words, the value is equal to the discount rate times the pension entitlements at the beginning of the accounting period.

Some of the entries in the rows of columns G and H, specifically the actual contributions made by both employers and employees, appear in the core national accounts, even though the entitlements and change in entitlements do not. Other entries in the columns for G and H shown only in the supplementary table are shaded in the table and explained below.

The imputed contribution by employers in row 2.2 for those government schemes for which entitlements appear in column G but not in the core national accounts requires special consideration. Within the core national accounts the imputed contributions are to be estimated on the basis of actuarial calculations. In cases where the actuarial calculations cannot obtain a sufficient level of reliability and in such cases only, two other approaches are possible to estimate government employers' imputed pension contributions as follows:

- (1) on the basis of a reasonable percentage of wages and salaries paid to current employees; or
- (2) as equal to 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 on the same basis as for private schemes.

³³ If the employer has truly "contracted out" the "management" of a DB scheme to an external unit, the pension manager (and not the employer) bears the ultimate responsibility for pension entitlements (ESA 2010, paragraph 17.75). Any discrepancy between the actuarial assumptions of the pension manager (e.g. an insurance company) and the reality (experience effect) is borne by the manager not the employer. So "imputed employer social contributions" should be zero also for these DB schemes. However, ESA 2010, paragraph 17.136 indicates that the "experience effect" has to be recorded as in row 2.2 to reflect this in the "changes in pension entitlements due to social contributions and pension benefits" (row 5). According to the Table 29 structure (see Figure 5) the "experience effect" has to be recorded in row 2.2 of Table 29 in the sector to which the "manager" of the scheme belongs (imputed "employer" social contributions, by convention).

³⁴ It represents the actuarial present value of the projected benefits, calculated based on the prescribed ADL methodology and assumptions and attributable to employees' service in the current year.

An item calculated on the same actuarial basis in respect of social security is shown in **row 3** as "other (actuarial) accumulation of pension entitlements in social security funds". It is, thus, distinguished from employers' imputed social contributions.

Given that the supplementary table provides a complete breakdown of the changes in pension entitlements over the accounting period, it is necessary to introduce a specific row to deal with the case whereby actual social contributions to the social security pension scheme are not actuarially based, and, therefore, there is an imputed contribution, which is not the responsibility of any employer. Such imputed transactions of social security pension schemes are shown in row 3 as other actuarial increase of pension entitlements in social security pension schemes. The entries in this row can be positive or negative – the negative cases occur in a social security pension scheme where the discount rate is higher than the scheme's internal rate of return. The internal rate of return of a pension scheme is the discount rate that equalises the present value of the actual contributions paid and the discounted value of pension entitlements accrued through those contributions. Negative entries occur for example when contributions have been raised above the actuarial required level in order to finance a short-run cash shortfall³⁵.

Row 3 does not represent cash transfers from tax revenues, and would be recorded in the standard accounts as current transfers between government units if they have no impact on pension entitlements. In some Member States, governments make transfers to pension schemes which 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 figure calculated by difference.

Differences in the accounting period encountered between assumed and actual wage growth (that is the wage growth part of the "experience effects" or "actuarial effects" when modelling) need to be reflected in transactions (employer's imputed social contributions), along with all other experience effects.

Row 3 figure represents the difference between Current Service Cost in a given year and the sum of actual social employees' and employer's contributions paid during that year. It also captures any "experience effects" observed for social security pension schemes where the observed outcome of pension modelling assumptions (wage growth rate, inflation rate and discount rate) in that year differs from the levels assumed³⁶.

Row 4 shows pension benefits that are paid during the accounting period. Payment of pension benefits has the effect of "settling" some of the pension entitlements included in the opening stock in row 1.

Row 5 presents the changes in pension entitlements due to contributions and benefits. It is row 2 plus row 3 less row 4. This balancing item measured from the non-financial accounts is generally equivalent to that measured from the financial accounts³⁷.

³⁵ A positive or negative entry occurs when the total amount of actual contributions raised by or on behalf of active contributors in a given year is below or above the Current Service Cost of pension benefits for those contributors in that year.

³⁶ A breakdown of the row 3 figure could be disclosed, showing separately the "Experience effect" and the remaining amount of imputed social contributions.

³⁷ There may be differences in some particular cases. ESA 2010 requires a different recording of pensions as opposed to voluntary financial transactions in life insurance and annuities (F.62). Households are treated in the financial accounts as owning pension entitlements (F.63) as well as F.62; the excess of pension contributions, over pension receipts (for simplicity hereinafter net contributions) leads to an increase in the net worth of households due to transactions. However, the net contributions are deducted from primary income, similar to taxes, in the calculation of disposable income of households, as the net contributions are not available for consumption. The net contributions increase saving but are not funded by disposable income. Contributions to F.62 by contrast are

One characteristic of the changing environment of pensions is the increasing possibility of having "portable pensions", where a person moving jobs can transfer the pension entitlement with the former employer to one with the new employer. When this happens, the pension entitlement of the household concerned is unaffected but there is a transaction between the two pension schemes as the new one assumes the liability of the former. In addition, there will be a counterpart transaction in some assets to match these liabilities.

If government assumes the responsibility for pension provision for the employees of a non-government unit through an explicit transaction, any payment by the non-government unit needs to be recorded as pre-paid social contributions (F.89).

When one unit takes over the responsibility for pension entitlements from another unit, this is recorded in **row 6** as the transfer of pension entitlements from the original pension scheme to the new pension scheme. There may also be an underlying transfer in cash or other financial assets to compensate the new pension scheme, and it is possible that the value of the transfer of financial assets is not exactly equal to the value of the pension entitlements transferred, however row 6 only relates to the transfer of entitlements between schemes.

Employers are increasingly reforming the pension schemes they manage in response to demographic and other factors. Reforms may take the form of a change to the benefit formula, a change in the retirement age, or a change in other scheme provisions.

Only enacted³⁸ pension reforms lead to recording in the national accounts, in the estimates of pension entitlements in the year in which enactment takes place and subsequently in observed flows. An announcement by an employer of its intention to undertake a pension reform is not a sufficient basis to introduce the effects of the reform into national accounts data.

In some cases of reform, the employer chooses to leave the vested rights of existing members untouched and only applies the reformed arrangements for future acquisition of additional entitlements. There would be no immediate impact on current pension benefits. The impact would be seen in future measures of pension benefits, in line with the accrued to date approach.

However, in some cases the employer decides to make reforms which affect the accrued to date entitlements for existing members; for example, a general increase in retirement age for all members. Such types of reforms change the stock of pension entitlements during the year in which they are enacted. This effect must be accounted for as a flow. It may be very large since it affects current and future pension entitlements.

Changes in pension entitlements are recorded as transactions as follows:

- (a) If the entitlements of a pension scheme are included in the core national accounts, and the employer agrees to a change in the terms of pension entitlements via negotiation with the affected employee, this change is recorded as a transaction in the core national accounts (under imputed employer social contributions);
- (b) If the entitlements of a pension scheme are not recorded in the core national accounts, and the employer agrees a change in the terms of pension entitlements via negotiation with the affected employees, this change is recorded as a transaction in the supplementary table;

financial transaction funded by household savings. In order to neutralise this effect, an adjustment (D.8) is added to the disposable income, or adjusted disposable income, of households in the use of income accounts before arriving at saving. Because of this different treatment the borderline between pensions and voluntary saving schemes is particularly important for the consistency of the non-financial and the financial accounts.

³⁸ "Enacted" means that the reform legislation (in whatever form it takes) is passed.

In the case of social security, if changes in pension entitlements are agreed by the parliamentary authorities, this is recorded in the supplementary table as if it were negotiated.

Changes in pension entitlements that are imposed without negotiation are recorded as other changes in the volume of assets.

Changes in accrued-to-date entitlements arising from past service are recorded as capital transfers.

Row 7 shows the impact of reforms of pension scheme structures on entitlements relating to past service.

Changes to pension entitlements due to other economic flows

Rows 8 and 9 account for the other flows as revaluations and other changes in volume associated with pension schemes in social insurance. Table 17.7 illustrates the other flows, divided into revaluations and other changes in volume.

Revaluations are due to changes of key model assumptions in the actuarial calculations. These assumptions are the discount rate, the wage rate and the inflation rate. Experience effects are not included here unless it is not possible to identify them separately. Other changes in actuarial estimates are more likely to be recorded as other changes in volume of assets. The effects of price changes due to the investment of the entitlements are recorded as revaluations appearing in the revaluation account.

When the demographic assumptions used in the actuarial calculations are changed, they are recorded as other changes in the volume of assets.

Table 2: Other flows as revaluations and other changes in the volume of assets

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

Figure 6: Pension entitlements and their changes

	Contributions (actual, imputed of which: property income) (rows 2 and 3)	Pension benefits (row 4)	
		Financial services	
	Other flows (revaluations, other changes in volume) (rows 8 and 9)	Changes in pension entitlements (due to transactions and other economic flows)	
Pension entitlements at the beginning of the period (row 1)			Pension entitlements at the end of the period (row 10)
Stock at t_0	Transactions and other flows between t_0 and t_1		Stock at t_1

This chart is purely illustrative and no specific meaning should be attributed to the size of the different boxes.

Related Indicators

Financial services produced by all pension schemes are recorded as being paid by scheme members, and so the costs of pension schemes are not recorded as intermediate consumption of the employer operating the scheme. Financial services are shown separately from social contributions. Presenting financial services in this way means the figures shown as contributions received by employees from their employers are exactly the same as that part of the contributions paid by the employees to the pension scheme. Furthermore, it is not necessary to show which element of social contributions covers the service fee. It is the household contribution supplement that covers the service fee for a defined contribution scheme and it is either the employers' or the household contribution that does so for a defined benefit scheme.

As output is recorded for all employer pension schemes, which the scheme's members consume, row 11 shows the output by type of scheme³⁹.

³⁹ Row 11 (output) exists in ESA 2010 but has been removed from this table because it is equivalent to row 2.5 by construction, and therefore would just duplicate that row.

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 chapter 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 and/or supervisory data sources (see chapter 6).

For defined benefit schemes for general government employees and for social security pension schemes, such data are typically not available and need to be compiled based on data taken from government finance and population statistics. With respect to the social security pension schemes, separate actuarial estimations usually need to be undertaken for the purposes of national accounts recording, based on sufficient and reliable administration data which could be compiled from the relevant social security institutions' databases.

For such actuarial estimations various assumptions have to be made: economic, demographic and scheme-specific assumptions.

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 economic assumption concerns future **wage growth**. Often, the development of future pension levels is highly dependent on wage assumptions, e.g. via pension formula (when pension amount is based on salary) and pensions-in-payment indexation. Other economic assumptions concern the inflation rate and the (un-)employment rates.

Further, **demographic assumptions** — mainly concerning mortality rates — play a significant role in estimating pension entitlements.

Following the appropriate choice of the economic assumptions as well as demographic assumptions, the estimation of pension entitlements is described for such government-managed pension schemes.

Finally, some **other assumptions**, which are scheme-specific, include for example the prevalence rates for disability, retirement rates and family structure.

5.1 Economic assumptions

5.1.1 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, as shown in the following table.

Impact of the discount rate on pension entitlements: 2015 pension entitlement of households' defined benefit schemes for general government employees and for social security pension schemes (i.e., column G plus column H of Table 29)

COUNTRY	minus 1pp	base case	plus 1pp
Belgium	1 345 507	1 123 394	955 829
Bulgaria	81 692	71 861	63 853
Czech Republic	469 711	390 371	330 385
Germany	9 745 970	8 079 140	6 818 550
Estonia	65 999	52 384	42 654
Ireland	424 900	345 500	284 600
Spain	3 678 476	3 102 318	2 665 228
France	9 804 000	8 108 000	6 837 000
Croatia	123 763	105 688	91 495
Italy	6 603 446	5 631 628	4 875 826
Cyprus	47 911	40 044	34 004
Latvia	51 504	43 403	37 196
Lithuania	96 717	78 559	65 153
Hungary	316 554	260 615	219 100
Malta	30 549	24 841	20 625
Netherlands	1 385 508	1 164 296	993 897
Austria	1 499 284	1 255 532	1 069 407
Poland	1 352 364	1 127 612	962 232
Portugal	667 480	561 751	482 877
Romania	347 470	286 358	240 827
Slovenia	148 490	121 709	101 738
Slovakia	312 275	248 052	201 679
Finland	747 019	631 547	542 795
United Kingdom	8 631 482	6 736 087	5 375 045
Iceland	13 590	11 364	9 668
Norway	1 029 533	850 838	716 662
Switzerland	1 509 349	1 244 000	1 044 883

Source: Eurostat [nasa_10_pens2]

Base case is a real rate of 3% (5% nominal). The discount rates used for the first data transmission (December 2017, on 2015 data) were based on 2018 Ageing Report recommendations (European Commission, 2017; European Commission, 2018). Sensitivity analysis excludes Denmark and Sweden.

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 7.

Box 7: 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, such aspects of risk and preferences need to be taken into account when considering the creditor perspective.

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 rate⁴⁰. Furthermore, the choice of the discount rate is ideally 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, for the first Table 29 data transmission – December 2017 on 2015 data – it was recommended by the Ageing Working Group to set the discount rate at three per cent in real terms and five per cent in nominal terms. As a general rule, since Table 29 data are collected every three years, for every transmission the discount rate is aligned with the one recommended in the Ageing Report, also a triennial exercise.

The ultimate long-term interest rate assumptions adopted by the Ageing Working Group for the 2021 Ageing Report have been lowered to a level of two percent for the discount rate in real terms for all the EU countries. As a result the nominal target discount rate is set at four percent in nominal term (the inflation target being: 2%) for all EU countries except for:

- Poland and Romania, where the target nominal rate is set at 4.5% (the target inflation set by the respective National Central Banks being 2.5%) and
- Hungary, where the target nominal rate is set at 5% (target inflation: 3%).

Another difference for the 2021 Ageing Report is that the linear convergence to the above set targets is assumed to be reached (and maintained thereafter) by (T+30) 2050 as opposed to T+10, as in the previous Ageing Report. As a result, an intermediate country-specific convergence target has been set for nominal long-term interest rates at T+10 (2030), according to the forward rates at t+10, as per the following table:

⁴⁰ E.g. IPSAS recommends (long-term) government bonds as a basis for the discount rate.

Target long-term nominal interest rates at T+10 (2030) (May 2020)

Country	10Y interest rate in T+10
AT	0.56
BE	1.17
BG	1.18
CY	2.69
CZ	2.38
DE	0.15
DK	0.36
EE	1.12
EL	2.44
ES	2.12
FI	0.49
FR	1.04
HR	1.75
HU	2.91
IE	1.04
IT	3.33
LT	1.31
LU	0.46
LV	0.92
MT	1.45
NL	0.24
PL	1.79
PT	2.35
RO	6.14
SE	0.88
SI	1.93
SK	1.29
UK	1.03

The appropriate choice of discount rate for pension obligations under public pension schemes is discussed in more detail in Box 8.

Box 8: 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 main 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.

- 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 to ensure comparability.

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

Frequent changes in the discount rate between estimation exercises can make it difficult to explain to the public and compare time series of pension entitlements since outcomes can differ widely. As stated above and confirmed by the results of first Table 29 data transmission sensitivity analysis, variation in the discount rate may change outcomes considerably.

Why to choose a discount rate of two per cent per annum?

The long-term interest rate assumptions that underpinned the Ageing Report (AR) 2018 long-term projections until 2070 contain elements dating back to 2006. The conventional assumptions on long-term interest rate that have underpinned the AWG work over the past 15 years reflect historical averages in some countries⁴¹. However, the macroeconomic environment has substantially changed over the past decades, as acknowledged by a vast literature.

Risk-free nominal interest rates in advanced economies have been trending downward, for several decades (see Figure 7)⁴². Real rates declined in parallel, although to a slightly lesser

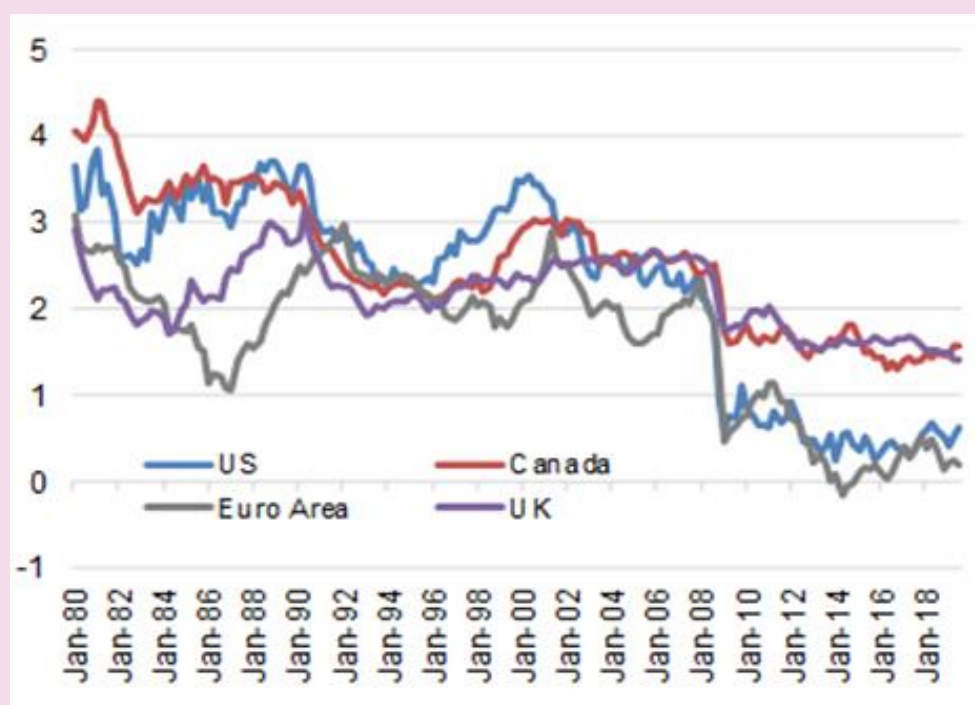
⁴¹ See European Commission (2017), "The 2018 Ageing Report: Underlying Assumptions and Projection Methodologies", European Economy Institutional Paper, No. 065, Part I.4. Table I.4.1.

⁴² European Commission (2020), Note to the EFC on 'Drivers of the Low Interest Rate Environment', 27 February 2020, Brussels (see attachment to this note).

extent. Persistently low inflation and sluggish economic growth suggest a secular decline of the real equilibrium rate to historically low levels, as reflected in market expectations of persistently low interest rates in the years to come. This global phenomenon is well documented in the literature, being attributed to both “structural factors” having triggered an excess of real savings over investment (ageing and low productivity trends, sluggish invention and innovation, low investment profitability, income growth in emerging economies, rising income or wealth inequality, deleveraging), but also to some more circumstantial or policy-related drivers, such as the scarcity of safe assets coupled with increased demand during global uncertainty, especially in the euro area after the sovereign debt crisis⁴³.

Figure 7: Interest rate decline

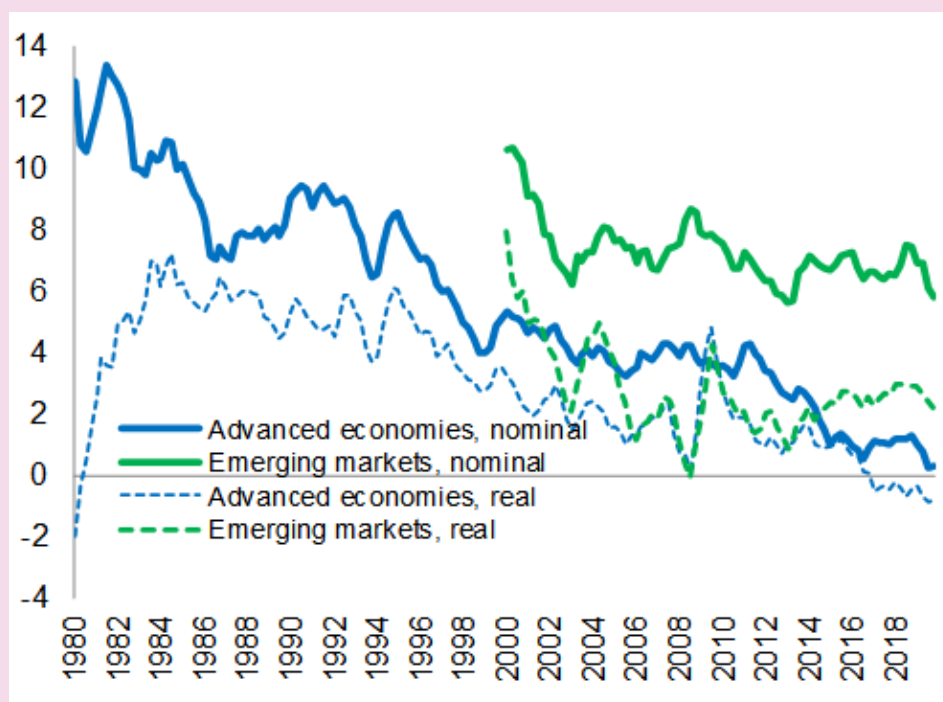
7a. Natural (or real equilibrium) rate estimates for advanced economies



Notes: *Estimates provided by the New York Fed, following Holston, Laubach, Williams (2017).

Source: EFC note quoted, based on New York Fed.

⁴³ For a thorough survey of the literature and the empirical evidence see: European Commission (2020), Note to the EFC on ‘Drivers of the Low Interest Rate Environment’, 27 February 2020, Brussels.

7b. Nominal and real 10-year yield on government bonds, %

Notes: *Simple averages of available data for selected countries.

Source: EFC note quoted, based on Macrobond, national sources.

5.1.2 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 growth⁴⁴. 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. In these circumstances, the PBO approach — described in Section 2.2 — is used, and 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 growth⁴⁵.

⁴⁴ In Notional Defined Contribution (NDC) systems, generally, future pension levels are determined by the wage growth or more precisely the wage bill growth in the economy.

⁴⁵ When applying the ABO method no assumptions have to be made about the future development of wages. Under ABO method, the members' pensions are determined solely on the basis of their current salary in the base year. The use of the ABO method is appropriate when the pension formula is not linked to future salaries (e.g. flat-rate benefit plans) and has to be mentioned by countries in the metadata.

Determining the wage growth assumption

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:

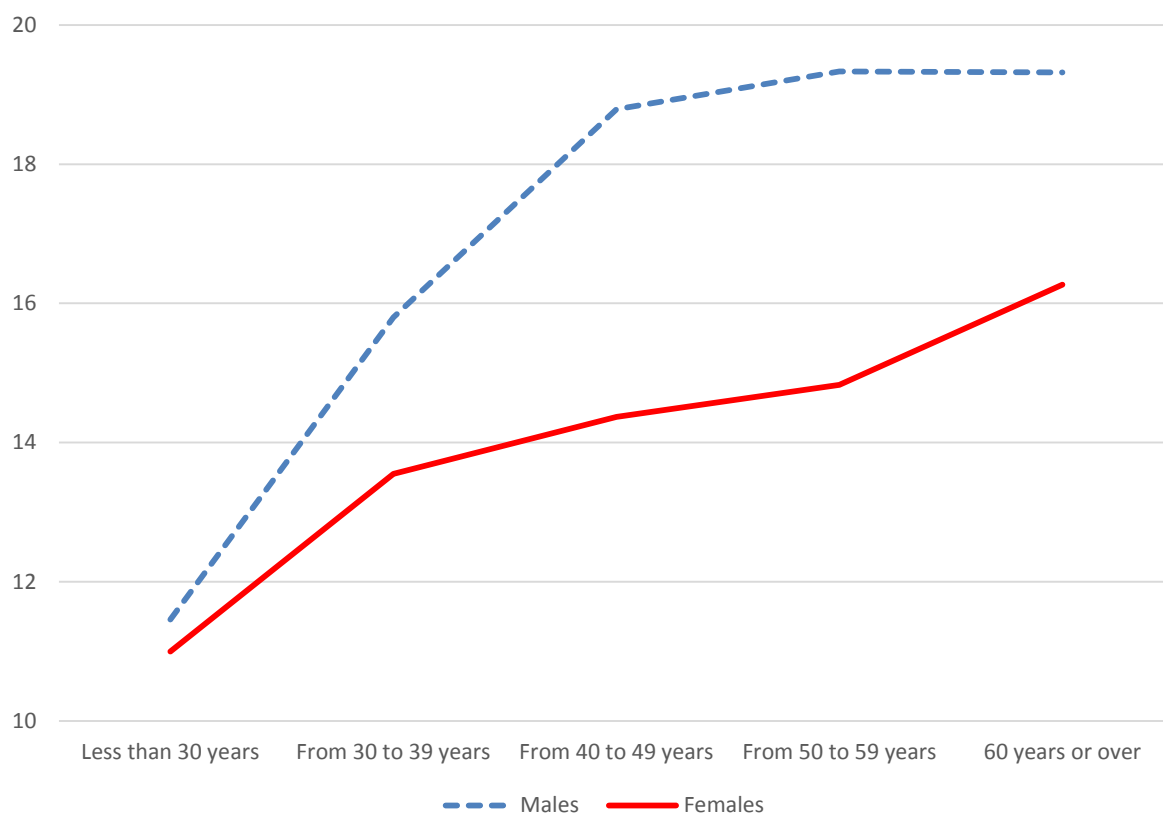
- 1) Promotions and the career progression; and
- 2) The general wage growth in the economy

The first factor, the **career path** of individuals is usually relatively age-specific. European countries generally show an increasing over the employment cycle — as illustrated in Figure 8. In the European Union, younger cohorts (here aged less than 30 years) generally earn less than their older counterparts in the workforce. With an increasing age, average earnings rise and reach their maximum usually close to the end of working-life. To approximate future career paths, it is useful to take the earnings profile for the base year as the basis. It is assumed that the present age- and gender-specific salary structure will remain constant over time.

Based on Eurostat information available on the structure of earnings in Europe, we can observe the following:

- A male individual aged less than 30 years in the base year 2014 can expect to earn almost 70 per cent more due to career progression by the end of his career.
- A women individual aged less than 30 years in the base year 2014 can expect to earn almost 50 per cent more due to career progression by the end of her career.

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.

Figure 8: Age and sex specific earnings profile – mean hourly wages (EUR)

Source: Eurostat, 2014 Structure of earnings survey: hourly earnings [earn_ses_hourly].

The second factor, the **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.

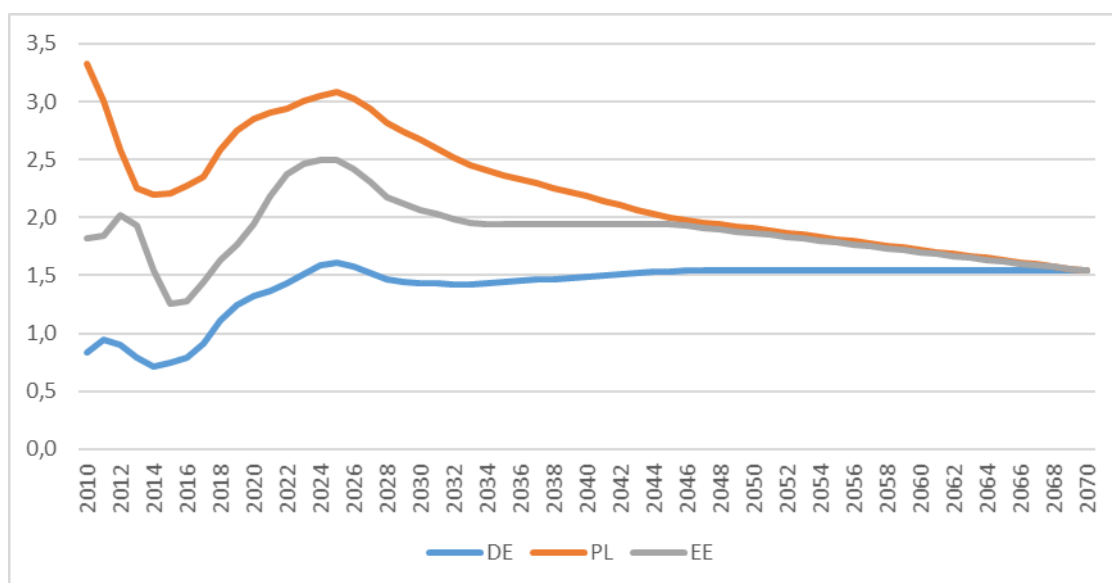
Generally, it is assumed that, over the long term, average wage growth follows labour productivity growth in the economy.

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 and Estonia in Figure 9).

Choice of wage growth assumption

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

Figure 9: Ageing Working Group labour productivity and wage growth paths for Germany, Poland and Estonia



Source: EC-EPC 2018 Ageing Report (Ageing Working Group).

In many government-managed pension schemes of the EU countries, wage growth also plays a crucial role in the indexation of pension benefits. 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 assumption

The assumption 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 every three years, in the Ageing Report document on Underlying Assumptions and Projection Methodologies. The latest edition was the 2018 Ageing Report, and next update is scheduled for October 2020. If there are changes in the assumptions for future real wages, this will be recorded as other flows (revaluations).

5.1.3 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 9). 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.

Choice of future inflation

For the future, an ultimate inflation rate of two per cent should be applied⁴⁶. This is in line with the ECB's inflation rate target of just under two per cent over the medium term as well as the AWG's long-term assumption of price inflation.

Box 9: 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:

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

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*:

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

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

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

Since expected inflation (π^e) is in both the nominator and the denominator, it is almost cancelled out. GDF_{real} and $GDF_{nominal}$ 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.

5.1.4 (UN)EMPLOYMENT RATES

The level of future pensions may be directly linked to (un)employment rates in the economy. 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.

5.2 Demographic assumptions

Eurostat database is constantly updated with its most recent population projections⁴⁷. The datasets are composed by baseline population projections and various sensitivity tests.

Data available include:

- Projected population on 1 January by age and sex, and by single year time interval for several decades ahead of projections' base-year;

⁴⁶ Except for Hungary (3%), Poland (2.5%) and Romania (2.5%).

⁴⁷ See <https://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-data>, where also detailed information on the methodologies applied can be found.

- Assumptions on future age-specific fertility rates; sex-specific and age-specific mortality rates and international net migration levels;
- Corresponding approximated values of the life expectancy by age and sex.

The following demographic balances and indicators are also available:

- Total numbers of the projected live births and deaths;
- Projected population structure indicators: proportions of broad age groups in total population, age dependency ratios and median age of the population.

5.2.1 LIFE EXPECTANCY

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

In the case of social security pension schemes covering a large part of the population, demographic data provided by Eurostat ensure a comparable data set across EU countries. Eurostat provides age- and sex-specific mortality tables for all EU countries. Only if specific data on the mortality of social security members are available such data should be used⁴⁸. Since mortality rates differ widely between men and women, a sex-specific differentiation of mortality data is necessary.

Assumptions provided by Eurostat regarding future life expectancy should be applied as well. In doing so:

- Eurostat's most recent population projections must always be used.
- In the case of several sensitivity tests for Eurostat population projections, the baseline projections must always be assumed.
- Furthermore, assumptions regarding future life expectancy must again be differentiated by gender.

5.2.2 FERTILITY RATE

The modelling of some pension schemes may involve the use of other demographic assumptions such as future fertility rates. Assumptions on the total fertility rate may play a role in certain benefit formulas under specific pension schemes, where, for example, future pensions might be linked to demographic developments, which are partly determined by projected fertility rates (or projected number of births).

In addition, 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.

⁴⁸ 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. In contrast, the beneficiaries of disability pensions might have significantly higher mortality rates than average members of the population.

5.2.3 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. Different pension rules may 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.

The choice of demographic assumptions

It is recommended for Member States to use the Eurostat's latest available population projections framework with respect to the demographic assumptions of mortality, fertility and migration.

5.3 Other assumptions

Pension entitlements calculations for a pension scheme in accordance with Table 29 requirements require a set of assumptions specific to the scheme in addition to the discount rate, the demographic and economic assumptions. Key scheme-specific assumptions include the disability prevalence rates, the retirement rates, the distribution of past insurance credits, the distribution of insurable earnings, the family structure statistics and the pensions in payment indexation.

The appropriate choice of scheme-specific assumptions for pension obligations under social security pension schemes, which could be made in accordance with international actuarial standards, is discussed in Box 10.

Box 10: Setting scheme specific assumptions — an actuarial perspective

The International Standard of Actuarial Practice on Financial Analysis of Social Security Programs, ISAP2⁴⁹ provides guidance to social security actuaries performing financial analyses of social security pension schemes, thus giving intended users confidence that:

- Actuarial services are carried out professionally and with due care;
- The results are relevant to their needs, are presented clearly and understandably, and are complete; and
- The assumptions and methodology (including, but not limited to, models and modelling techniques) used are disclosed appropriately

ISAP2 requires scheme-specific assumptions to be determined on a realistic best estimate⁵⁰ basis, in contrast to, for example, the life insurance rating process in which the actuary often uses a certain margin of conservatism. Scheme-specific assumptions are set having regard to experience analysis to determine, to the extent that the available data permits, if experience trends are relevant to the setting of certain assumptions. It is appropriate, therefore, in carrying out financial pension entitlement calculations, to have regard as much as possible to scheme-specific experience in addition to the provisions of the social security pension scheme, and the assumed values of all of the above scheme-related variables should be disclosed in a relevant country report.

⁴⁹ See http://www.actuaries.org/CTTEES_ASC/isaps/pdf/isap2.pdf

⁵⁰ Best estimate assumptions are such that it is expected that the resulting projection of the social security program experience is not a material underestimate or overestimate of the obligation.

5.3.1 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 by single age and gender.

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

For the determination of prevalence rates for disability, it is important to use the specific experience of the pension scheme in order to generate the correct number of new annual invalidity/ disability pensioners. In particular, the number of new cases of disability pensions during recent past years are typically used to estimate future disability prevalence rates. To estimate the incidence rate, the data on new cases should be collected by age and sex.

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, in many member states the eligibility age for old-age pension is legislated to increase in future. Then prevalence rates for older age cohorts must be constructed following the experienced age-dependence of disability prevalence. Also, future behavioural responses of this kind are difficult to forecast. Due to this uncertainty, constant prevalence rates are likely to be used for the estimation of pension entitlements.

5.3.2 RETIREMENT RATES

To set the assumption of future retirement patterns, the data need to be collected on past retirement experience under the pension scheme, for which the data on new retirement pensions awarded, by age at retirement and gender, are necessary. The calculation of retirement rates must be consistent with the rule applicable to testing the eligibility of insured persons for the retirement pension, for example, by referring to contribution credits. If the retirement age has recently changed, experience data may need adjusting before they are used to calculate retirement rates, taking into account time lags between the scheme's modifications and the time the modification appear in the statistics. Similarly, if the retirement is legislated to increase in future, the assumed retirement rates by age and gender need to be shifted upwards accordingly.

5.3.3 DISTRIBUTION OF PAST INSURANCE CREDITS AND INSURABLE EARNINGS

When estimating future eligible pensioners (retirement, death or disability) and calculating new pension award amounts, the variables of the distribution of past insurance credits and a distribution of insurable earnings should be considered.

5.3.4 FAMILY STRUCTURE STATISTICS

Statistics on the family structure of the insured persons is necessary for the calculation of pension entitlement to survivors' benefits. Assumptions need to be established on the probability of being married at death, the age difference between spouses, the average number of children possibly eligible for an orphan's benefit and the average age of orphans.

The above assumptions on family statistics are derived from scheme past experience if these information is recorded and emerging trends. Otherwise, family statistics can be based on other national or international sources.

5.3.5 PENSIONS-IN-PAYMENT INDEXATION

Pensions-in-payment are adjusted at regular intervals in accordance with pension scheme's indexation rules. The above adjustment is typically linked to the variation of price or wage index.

When the scheme does not guarantee a periodic indexation and instead has a practice of ad hoc indexation, the pensions are assumed to be indexed according to the assumption adopted in the AWG exercise. Under AWG framework, pensions are indexed according to the legislated rules which stipulate price or wage indexation, or an indexation which combines the above two.

If pensions-in-payment are not adjusted on a regular basis in line with economy (wages), the pension scheme would quickly lose its significance. In that context, under the AWG framework, the minimum pension is typically indexed according to the nominal wage growth.

6

Data sources for compiling pensions entitlements

Different data sources can be utilised to fill in the supplementary table on pension schemes. Accounting, administrative and statistical data generally provide a suitable basis, in particular for employment-related social insurance schemes other than social security, recognised in the core system of national accounts.

Information for columns on government schemes for its own employees not recognised in the core national accounts and social security pension schemes (column G and H of Table 29, respectively) can be partly obtained from administrative data of general government. Some rows, however, have to be estimated based on an actuarial model⁵¹.

The various data sources that can be used to complete the supplementary table are outlined in the following sections.

6.1 Accounting data for private employer-sponsored pension schemes

The accounting statements of private businesses 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

These standards are explained below to facilitate the interpretation and use of pension data from sources that apply these accounting standards⁵².

⁵¹ The figures of column F may also be estimated by an actuarial model depending on the accounting practices.

⁵² In all cases, data from any source have to be adjusted according to National Accounts valuation and principles.

A. INTERNATIONAL ACCOUNTING STANDARD (IAS) FOR PRIVATE BUSINESSES

The accounting treatment of pension schemes in private businesses is set out in International Accounting Standard 19 (IAS19 (2011) – “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. The standard establishes the principle that the cost of providing employee benefits should be recognised in the period in which the benefit is earned by the employee, rather than when it is paid or payable, and outlines how each category of employee benefits are measured, providing detailed guidance in particular about post-employment benefits. It furthermore requires full recognition of changes in the net defined benefit liability including immediate recognition of defined benefit costs.

As the recognition of costs and liabilities is based on the accrual principle and not on payments made, IAS19 does not distinguish between funded and unfunded pension schemes. 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 the cost to the employer in the current period, thus the only balance sheet obligations recorded are for employer contributions not paid by 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 accrued pension rights at the balance sheet date.

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, or where there is no deep market in such bonds, by reference to market yields on government bonds. Currencies and terms of bond yields used must be consistent with the currency and estimated term of the obligation being discounted.
- The “Projected Unit Credit Method” should be used; this method is equivalent to the Projected Benefit Obligation (PBO) approach described in chapter 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; (iv) actuarial gains and losses⁵³, to the extent recognised; (v) past service cost⁵⁴, to the extent recognised; (vi) the effect of any plan curtailments or settlements (e.g. pension reforms).

⁵³ Representing the experience effect of outcomes compared to assumptions, and also changes in assumptions between one modelling exercise and the next.

⁵⁴ Past service cost is recognised as an expense at the earlier of the date when a plan amendment or curtailment occurs and the date when an entity recognises any termination benefits, or related restructuring costs under IAS 37 Provisions, Contingent Liabilities and Contingent Assets. [IAS 19(2011).103].

B. NATIONAL ACCOUNTING STANDARDS FOR PRIVATE BUSINESSES

As regards companies that do not apply IAS, accounting practices differ across Europe. In some jurisdictions, 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 IAS19⁵⁵.

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.

6.2 International standards, administrative data and actuarial calculations for government-managed pension schemes

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 data on a cash basis are available. For the government-managed pension schemes the figures for the supplementary table (in columns G and H) can only be partly derived directly from administrative data. Large parts of the rows in columns G and H need to be estimated with an actuarial model.

6.2.1 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 (IPSAS39 – “Employee Benefits”). IPSAS 39 is largely based on IAS19⁵⁶. Yet it diverges from IAS19 in one main respect: there is more leeway concerning the discount rate, as it can be based on the market yields of government bonds, high quality corporate bonds, or any other financial instrument. 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.

Where IAS19 or IPSAS39 based accounts are available, they can often be readily used to complete the main parts of the supplementary table. In these accounts, the pension 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, ECB pension funds statistics may need to be used (see below).

It should be noted that the IPSAS39 standard does not cover reporting by social security pension schemes. Social security pension benefits are covered by IPSAS42 (“social benefits”) which takes a

⁵⁵ In Germany, for example, an ABO approach and a fixed interest rate were used for a long time. With 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 and published on a monthly basis <https://www.bundesbank.de/en/statistics/money-and-capital-markets/interest-rates-and-yields/discount-interest-rates/discount-interest-rates-793604>).

⁵⁶ For further information on IPSAS 39 see <https://www.ifac.org/system/files/publications/files/IPSAS-39-Employee-Benefits.pdf>

narrower view of an entity's liability for future payments (when there is "the satisfaction by each beneficiary of all eligibility criteria to receive a social benefit payment")⁵⁷. This means that the balance sheet entries based on IPSAS42 are not suitable for direct use as statistical balance sheet data.

6.2.2 PENSION DATA DIRECTLY OBTAINED FROM ADMINISTRATIVE DATA

Parts of column G of general government employees pension schemes and column H of social security pension schemes 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
- row 2.5** pension scheme service charges; 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.

If pension data cannot be obtained from administrative entities, alternative sources may be used. They are described in Box 11.

Box 11: 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 according to Regulation 458/2007 of the European Parliament and of the Council. It contains statistics on the expenditure and receipts of social protection schemes as well as on the number of pensioners. 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 and pensioners data are categorised by various types of pensions included in old age pensions, disability pensions, survivor's pension and early retirement for labour market reasons pensions (which is part of the unemployment function). ESSPROS data are available with a time lag of less than two years (generally after 17 to 22 months after the end of the reference year). 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 chapter 3) — ESSPROS divides benefits into means-tested benefits and those that are not means-tested. However, ESSPROS lacks precision on a number of issues that are important for pension entitlements. For example, it provides only limited information on the characteristics of pensioners, which is differentiated by gender but not by age. However, the coverage of pensioners in number is complete and includes those living in institutional households. Also, no distinction is made between government employee and social security pension schemes. However, ESSPROS schemes are classified according to five criteria, including "decision making" (government-controlled vs. not government-controlled schemes), "legal enforcement" (compulsory vs. non-compulsory schemes) and "establishment of entitlements" (contributory vs. non-

⁵⁷ More explicitly – "The maximum amount to be recognized as a liability is the costs the entity expects to incur in making the next social benefit payment. This is because social benefit payments beyond this point are future events for which there is no present obligation".

contributory schemes) and data and metadata by individual schemes are made available by Eurostat for the large majority of countries. Links and comparison between ESSPROS and national accounts have been developed in recent years both at conceptual and practical (data) level.

COFOG and detailed tax and social contribution receipts

Another macroeconomic/ fiscal 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 allocated to the COFOG groups “old age”, “survivors”, “unemployment” as well as the COFOG class “disability”, like in ESSPROS. At the same time, government expenditure on actual or imputed employers’ social contributions is reflected within compensation of employees in the relevant groups (e.g. “police services” for police personnel). It should be noted that published COFOG data provide only a very rough overview of pension expenditure aggregates. They cannot give a differentiated picture of pensions since the transmission programme does not distinguish between social cash transfers in the context of social insurance and social assistance. Furthermore, no differentiation is made between government employee and social security pension schemes. Furthermore, social cash transfers in the context of disability pensions are transmitted together with social cash transfers in the context of sickness. Accordingly, aggregated COFOG data should only be used for the supplementary table if no other data source is available.

Detailed tax and social contribution receipts provide actual and imputed pension contributions. The level of detail (by scheme, for government/ non-government employees) provided varies.

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, Norway, Switzerland, Montenegro, Serbia, North Macedonia, Turkey. 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. Furthermore persons living in institutions are not interviewed.

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.

6.2.3 PENSION DATA TO BE ESTIMATED BY AN ACTUARIAL APPROACH: ALL ROWS EXCEPT 2.1, 2.3 AND 4 ⁵⁸

a. Data inputs for the actuarial estimation of pension entitlements

In addition to rows 2.1, 2.3 and 4 of Table 29, which are directly derived from administrative data as per part 6.2.2, other rows in column G and H need to be estimated using an actuarial approach, including actuarial pension model.

Sufficient and reliable data are an essential element necessary for performing such actuarial estimates for Table 29 purposes. Such data can be obtained from institutions responsible for the management of the data pertaining to the pension scheme participants and provisions. Those institutions could include social security institutions and other government bodies, including ministries.

The data that enables actuarial estimates to be performed include current beneficiary and contributor data and information on current and past pension scheme rules, as well as any planned future changes in these rules (e.g. benefit formula, eligibility for benefits and contribution basis). In particular, the summaries of key pension data in the base year, which could be used not only as a basis for setting pension scheme's assumptions but also as a starting point for the actuarial pension calculations, include:

- the insured population (contributors);
- the distribution of insured wages among contributors;
- the distribution of past insurance credits of contributors; and
- the number and average amount of pensions in payment by type of pension.

The above data would be disaggregated by each insured population grouping, such as age (by single age), gender (males/ females), income group (by earnings band) and employment category (public/ private).

The actuary responsible for the above actuarial analysis should comply with national and/or international actuarial standards of practice and/or other relevant guidance that describe data requirements, checking and validation procedures, use of incomplete data and disclosure of limitations, as well as other aspects related to the data. The above standards include the International Standard of General Actuarial Practice of the International Actuarial Association (IAA), ISAP1⁵⁹, and in case of a social security pension schemes, ISAP2.

In practical terms, the actuarial models used for the purposes of undertaking projections for public schemes under the AWG framework, which are based on an open-group approach, could also be used for the actuarial estimation of pension entitlements under the Eurostat national accounts framework, which are based on a closed-group approach. In fact, in the 2017 Table 29 pension exercise, the majority of Member States used a macro-simulation cohort pension model, which is typically used for the purposes of the AWG pension projection exercise. Furthermore, the team which conducted the actuarial estimations for Eurostat purposes was, in many cases, the same which conducted the AWG pension projections. Therefore, at national level, close collaboration and exchange of common data sources between the pension experts dealing with the Eurostat pension calculations and those of the AWG exercise is highly recommended.

⁵⁸ It may be for some schemes that the pension scheme service charges (row 2.5) are also measured using administrative data, in which case an actuarial approach is not needed for this row.

⁵⁹ ISAP1.

b. Quality issues and benchmarking

While the estimation of pension entitlements should be based on a harmonised approach across Europe, particularly with respect to the framework of assumptions, this may not always be feasible in practice. Nonetheless, to ensure accurate estimations, the disaggregation of pension data, as mentioned above, should be applied and in particular, the following general data 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”. Nevertheless, they should comply with certain quality criteria and be based on standard actuarial mathematics for public pension schemes (see chapter 7).

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 for example the World Bank’s pension reform modelling software PROST, the International Labour Office (ILO) generic pension modelling tool, although generational accounting models can be used for benchmark exercises too⁶⁰.

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.

6.3 Regulatory data – ECB Pension funds statistics

The ECB Regulation on pension funds (ECB/2018/2)⁶¹ remedies shortcomings of the current non-harmonised and incomplete quarterly statistics on pension funds (PFs), in particular the limited transaction data due to insufficient data quality. The enhanced statistics better supports the European System of Central Banks (ESCB) in its monetary and financial analyses and its contribution to the stability of the financial system.

⁶⁰ 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.

⁶¹ [Regulation \(EU\) 2018/231 of the European Central Bank of 26 January 2018 on statistical reporting requirements for pension funds \(ECB/2018/2\)](#).

The ECB Regulation is addressed to autonomous pension funds, as defined by the European System of National and Regional Accounts (ESA 2010). ECB Regulations set out the ECB's statistical requirements for MFIs and other financial corporations in the euro area. They are binding on the entities to which they are addressed and are directly applicable, meaning that they do not need to be transposed into national law. They instruct reporting entities on, for example, statistical reporting requirements in terms of definitions, classifications, frequency and timeliness. Only those pension funds that are institutional units separate from the units that create them are included. Non-autonomous pension funds set up, for example, by credit institutions or non-financial corporations are not covered, since they are not separate institutional units. Individual pension plans offered by insurance corporations or other institutions are also excluded from the scope of the Regulation, as are social security schemes.

The ECB Regulation defines a harmonised statistical reporting population and the data to be provided by pension funds includes quarterly data on funds' outstanding amounts and transactions broken down by country, economic sector, maturity and the type of pension plan (e.g. defined contribution and defined benefit), as well as detailed security-by-security reporting⁶².

Annual PFs liabilities data are homogeneously collected by every Member State as defined in the Regulation. The quarterly PFs liabilities data, for which there is no direct reporting in most Member States, are estimated (e.g. outstanding amounts, transactions and adjustments). The Eurosystem has developed a methodological framework⁶³ by referring to background theory, studying possible estimation methods and testing the alternatives on using actual data from supervisory sources (e.g. European Insurance and Occupational Pensions Authority's Institutions for Occupational Retirement Provision (EIOPA's IORP) templates and other supervisory sources). The methodology provides guidance to the NCBs on choosing the most appropriate technique to reflect and estimate the missing quarterly PFs data on liabilities. In practice, the methodological framework also provides the compilers and the users with all the available technical material (e.g. model codes, methodological explanations, references and mapping) with the objective to support them in implementing different tests and compilation methods in their own specific case.

The ECB Regulation is binding on those countries whose currency is the euro (euro area countries). Nevertheless, non-euro area Member States are to implement all measures that they consider appropriate for collecting the statistical information needed to fulfil the ECB's statistical requirements, and, where relevant, for making timely preparations for joining the euro area. The first data under the ECB Regulation referred to the third quarter 2019.

⁶² For a detailed description of the reporting requirements please see [ECB Regulation on statistical reporting requirements for pension funds \(ECB/2018/2\)](#): Part 3, Reporting Tables: Table 1a: Assets (stocks and revaluation adjustments –including exchange rate adjustments-) or financial transactions, Table 1b: Liabilities (stocks and revaluation adjustments –including exchange rate adjustments-) or financial transactions) and Table 1c: country breakdown: (stocks and revaluation adjustments –including exchange rate adjustments-) or financial transactions. Table 2: Required security-by-security data. Table 3: Number of members of pension schemes.

⁶³ The ECB released a dedicated manual including the methodological framework. See https://www.ecb.europa.eu/stats/financial_corporations/pension_funds/shared/Pension_fund_statistics_Compilation_Guide.pdf.

7

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

7.1 Introduction

Chapter 7 presents the methodologies used in estimating Table 29 pension entitlements for government-managed pension schemes, based on two alternative modelling techniques, the simulation (Section 7.2) and typical agent (Section 7.3) respectively.

In the Table 29 pension reporting exercise, the majority of Member States use a macrosimulation⁶⁴ cohort pension model, which is typically used for the purposes of the AWG pension projection exercise. In addition, a small number of Member States use a microsimulation⁶⁵ pension model in their Table 29 actuarial estimations. Section 7.2 provides an overview of the actuarial methodological framework which is based on macrosimulation and microsimulation techniques.

Section 7.3 describes the methodologies used for the estimation of accrued-to-date pension entitlements, based on a simplified approach which uses a typical agent model. Such a model is used by a small number of Member States in their Table 29 pension calculations.

The actuarial approach⁶⁶ to estimating Table 29 pension entitlements 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 technical audience, including actuaries and other technical experts, such as pension experts, statisticians and data compilers. Furthermore, this chapter is intended to assist countries which have not yet (fully) built up a model to calculate accrued-to-date pension obligations.

7.2 Actuarial methodological framework using simulation modelling techniques

7.2.1 OVERVIEW OF METHODOLOGICAL APPROACH

As presented in chapter 2, the calculations of the public pension scheme obligations are done by applying the accrued-to-date (closed group) method. The closed group methodology does not permit new entrants to the pension scheme from the valuation date onwards. In addition, under the closed group without future accruals the current scheme active contributors at the valuation date are assumed to make no further contributions beyond that date, and hence accrue no future service

⁶⁴ Projections rely on grouped data.

⁶⁵ Projections rely on individual data.

⁶⁶ As outlined in chapter 2, an actuarial calculation of pension entitlements is based 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.

benefits. Hence, the obligations are comprised of accrued benefits up to the valuation date with respect to current beneficiaries and current contributors.

For the purposes of calculating accrued-to-date pension obligations under the closed group without future accruals method, either a pure closed group method can be used, or it might also be necessary to undertake a projection run under the closed group with future accruals method, which assumes future benefit accrual with respect to the current active participants⁶⁷ (pro rata method).

In the case when a pure closed group method is used, future contributions of current contributors are assumed to be zero and only contributions prior to the calculation date are used to determine benefits. The use of such method raises questions about determining the eligibility for certain benefits. It is especially true when such eligibility is defined in terms of non-zero contributions during a certain period preceding the event that gives rise to the benefit.

Therefore, the choice between the use of the pure closed group without future accrual calculations and pro rata method depends on the scheme's design, especially on the way the eligibility for benefits is defined and its materiality on the calculation of pension obligations. In particular, if the value of accrued-to-date benefits, which are linked to the eligibility requirement, for example the contributory period, is financially material, the pro rata method should be used.

67 Under the closed group with future accruals method, no new entrants to the scheme are allowed for, and the obligations are equal to the present value of all expected future benefits to existing pensioners and all accrued and future rights of current active participants.

Box 12: Pro rata method

Projections under the closed group with future accruals could be necessary for the following two reasons:

1. Determine the cohorts of eligible beneficiaries for each projection year by applying the scheme's eligibility conditions as well as identify their type of benefit (survivor, disability, old-age pension, grant or other type of benefit); so for example, when the contributor has accumulated at the valuation date a contributory period which is lower than the minimum qualifying period in order to be eligible for an old-age pension benefit, under a closed-group with future accruals method the beneficiary's eligibility is assessed at retirement age.
2. Determine the portion of the future benefit that has accrued up to the valuation date. This is done by applying a pro rata basis factor to the benefit amount computed under the closed group with future accruals method.

In general, the **Pro rata basis factor** is defined as the ratio of the actual contributory period under closed group without future accruals method to the total (actual and future) contributory period of the cohort eligible for a benefit in the projected year under a closed group with future accruals method. This factor is also expressed as follows:

$$\text{Pro rata basis factor} = \frac{\text{Actual contributory period}}{\text{Actual contributory period} + \text{Future contributory period}}$$

This approach allows to give a uniform weight to the actual and future contributory periods without giving a higher weight to the accrued years of contribution up to the valuation date.

Depending on the scheme provisions, the pro rata basis factor may need to be modified to account for non-employment credits and accrual rates that vary by service or age, as described in part 7.2.2.

Hence, the calculation of the pension obligations under the closed group without future accruals method for each possible type of benefit will be as follows:

- **Obligations for existing old-age pensioners, existing disabled pensioners and existing survivor pensioners** - the present value of all future pension payments from old-age pensions, disability pensions and survivor pensions respectively.
- **Obligations for future survivor pensioners emerging from the death of existing old-age and disability pensioners** – the present value of the corresponding future payments to which the survivors would be entitled to.
- **Obligations for future recipients of benefits from old-age pensions, disability pensions and survivor pensions emerging from the death of an active contributor** – the present value of all future pension payments under
 - closed group without future accruals method⁶⁸, or
 - closed group with future accrual method and applying the *Pro rata basis factor* for the respective type of pension.

⁶⁸ If this method is used, future old age, disability and survivor benefits only for participants who are eligible to the respective benefits at the calculation date are considered.

7.2.2 OTHER METHODOLOGICAL CONSIDERATIONS

Credited years for education, child-care and other non-employment credited years

Some schemes include non-employment periods, such as education or child-care, into the total contributory accumulated period. These credited years can be either recorded as they occur or computed and recorded at the year of retirement.

When actual credited years for education, child-care and other non-employment years are recorded as they occur, these are taken into account as at the valuation date.

When non-employment credited years are not recorded as they occur but are computed at the year of benefit take-up, the accrued non-employment credited years should be estimated. One possibility could be to compute the average non-employment credited years over the whole active life period from past experience data for all the projected cohorts of new pensioners under closed group with future accrual methodology. Then, to apply the *Pro rata basis factor* corresponding to the member at age “x” at the valuation date to the average of non-employment credited years.

Minimum pension

If the minimum pension is based on a minimum amount accrued for each contributory year, one simply needs to check if the accrued pension benefit is above the minimum pension that should be accrued for the corresponding contributory period. If it is below, the accrued pension benefit is increased to the minimum corresponding level.

If the minimum pension is a flat amount not related with the contributory period, one compares the projected pension benefit at the benefit take-up date to the minimum pension under the closed group with future accrual method. If the projected pension benefit at the benefit take-up date is lower than the minimum pension, the projected pension benefit is increased to the minimum pension. Then, the accrued minimum pension at the valuation date is computed by applying the *Pro rata basis factor*.

Non-uniform accrual rates

Sometimes the accrual rates are not uniform over the whole career. For example, in Greece, the accrual rate for the earnings-related component of the social security pension scheme increases with the number of years of contribution, and in Finland the accrual rate, for certain cohorts during a transition period, increases with age. In those cases, if the *Pro rata basis factor* is applied to the projected benefit at the benefit take up date, this produces a higher accrued benefit at the valuation date than if the accrued benefits were calculated using the accrual rate based on the years of contribution at the valuation date. The opposite could happen if in a country the accrual rate is reduced for future years.

7.2.3 KEY METHODOLOGICAL FEATURES OF PENSION MODEL

The actuarial pension model used for the purposes of Table 29 pension reporting exercise should satisfy the following key methodological features, thus complying with quality standards:

- The model is based on standard actuarial mathematics for social security schemes and on actuarially assumed transition probabilities (mortality rates, incapacity rates, retirement rates, etc.) which are used to map the transition of an insured person (active person⁶⁹, inactive person⁷⁰ and pensioner) in a given year onto the next year's status.

⁶⁹ Active insured person refers to an individual who has made at least one contribution to the social security scheme during a given year.

- The development of the active insured population is linked to the evolution of total employed population and earnings assumptions, which, in turn, are explicitly linked to the assumptions on macroeconomic growth and the wage share of GDP.
- The active insured population is disaggregated into population groupings, which exhibit different insurance profiles. Examples of such groupings include:
 - age (by single age);
 - gender (males/ females);
 - employment type (salaried employees/ self-employed); and
 - wage/ earnings level (by wage band).

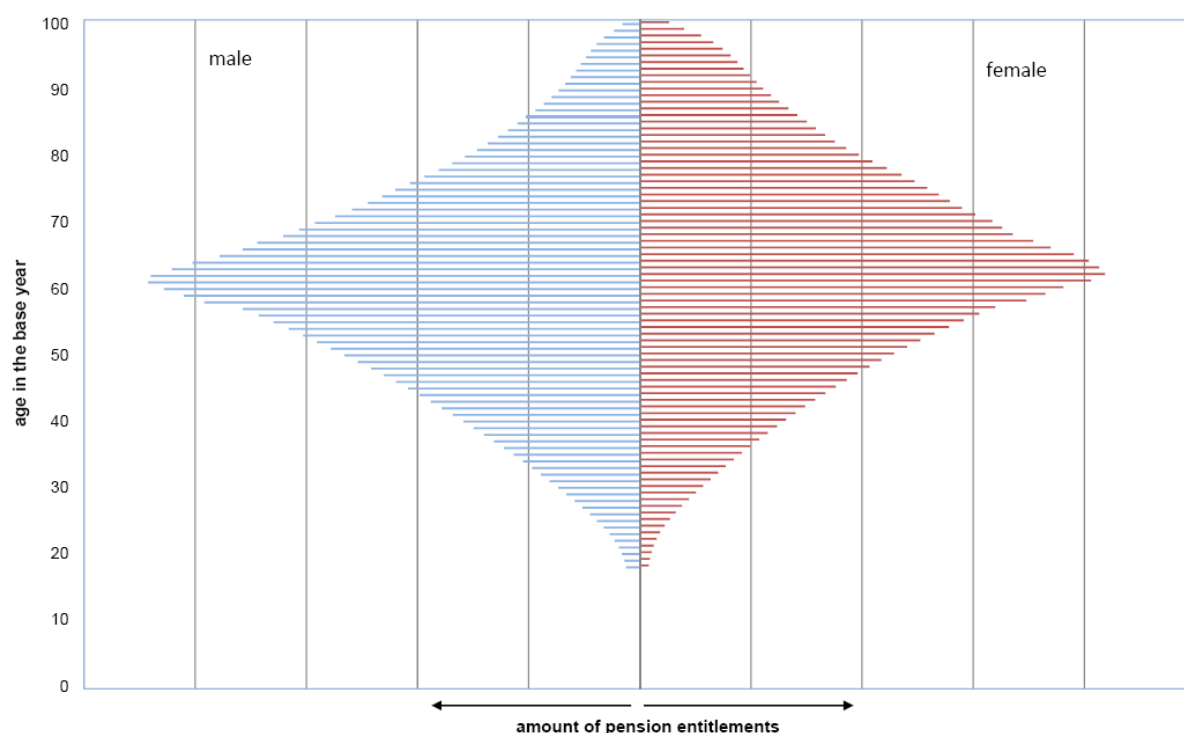
7.3 Step-by-step estimation approach using typical agent modelling techniques

7.3.1 OVERVIEW

The aim of section 7.3 is to outline step-by-step the procedure to estimate pension entitlements of unfunded public pension schemes using typical (representative) agent modelling techniques. The calculation procedure, which is aimed at technical audience, is outlined using formal equations as well as various illustrative examples.

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 10 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.

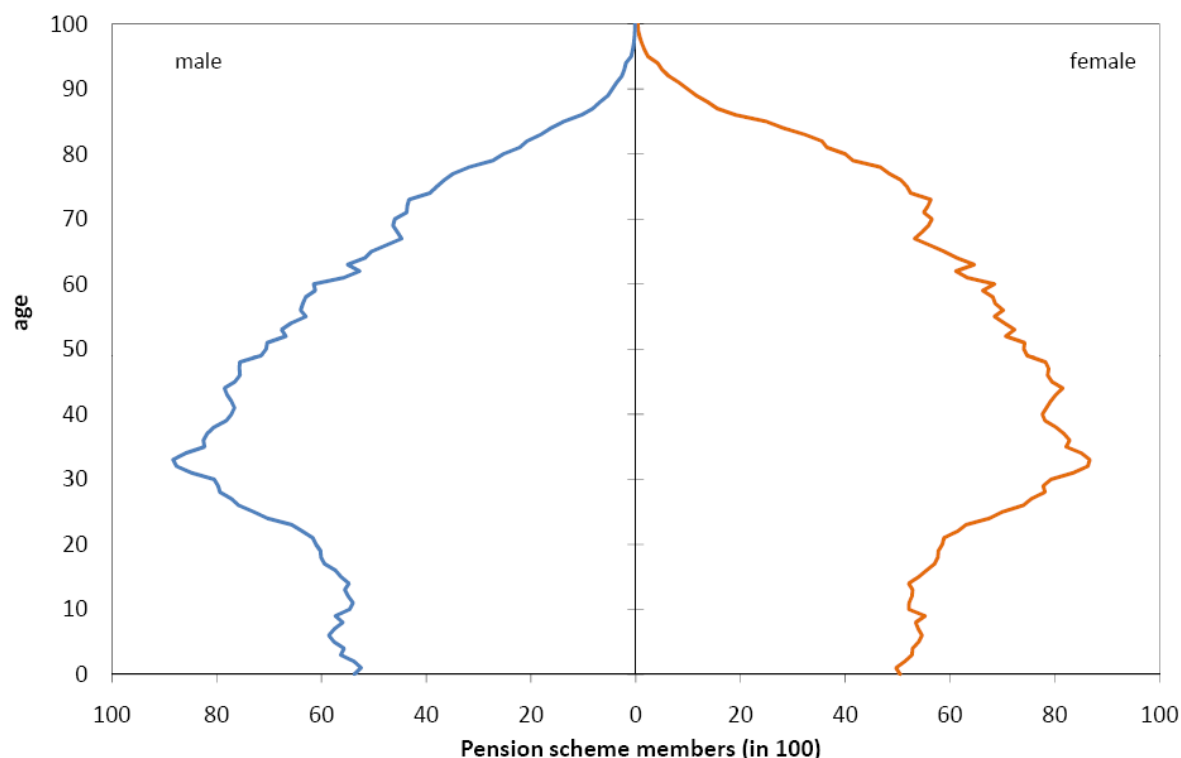
⁷⁰ Inactive insured person refers to an individual who has made no contribution during the last year due to being unemployed, or out of the labour force, or emigrant, but is registered in the social security scheme, i.e., made contributions during previous years.

Figure 10: Example showing distribution of pension entitlements by age and gender

Source: Forschungszentrum Generationenverträge, University of Freiburg.

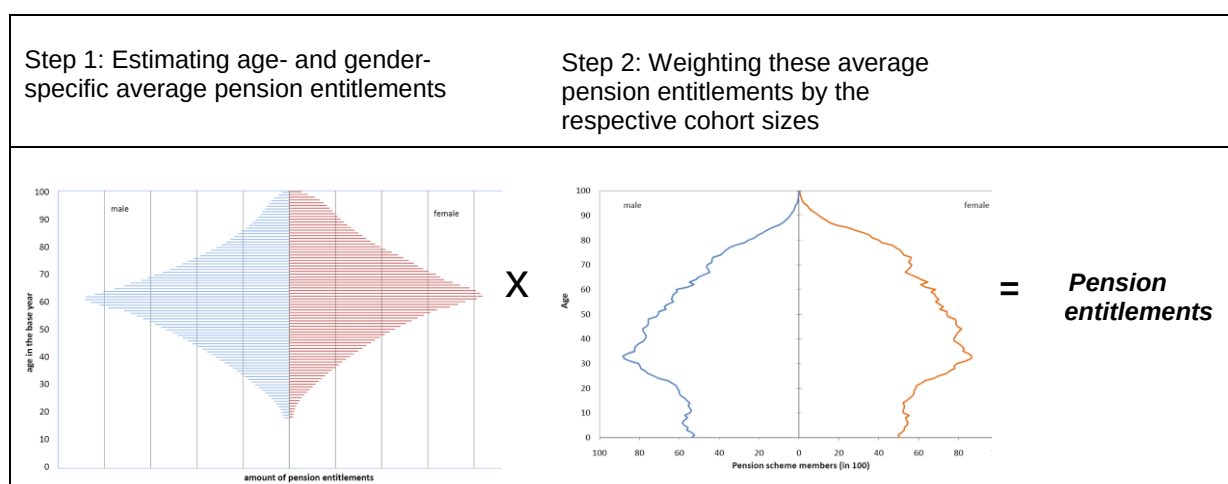
Besides age-specific differences, differences in pension rights between genders are also apparent. As displayed in Figure 10, women have usually accrued lower pension entitlements than men. Such gender differentials may be explained by, for instance, shorter contribution periods, as well as lower average wages for women, which result in comparably lower pension benefits and entitlements. To estimate accrued-to-date 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 (parts 7.3.2 to 7.3.4) considers the pension entitlements of a single participant. In step 2 (see Equation 35 at the end of chapter 7), these individual pension rights are aggregated.

7.3.2 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 entitlements⁷¹. In the following parts, 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 ($f = b + s - x$),
- $p_{s,g,f}$ = the probability of a representative individual of gender g of surviving to age s in a future year f ($f = b + s - x$)⁷²,
- 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 $B^{accrued}$ denotes the annual 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.

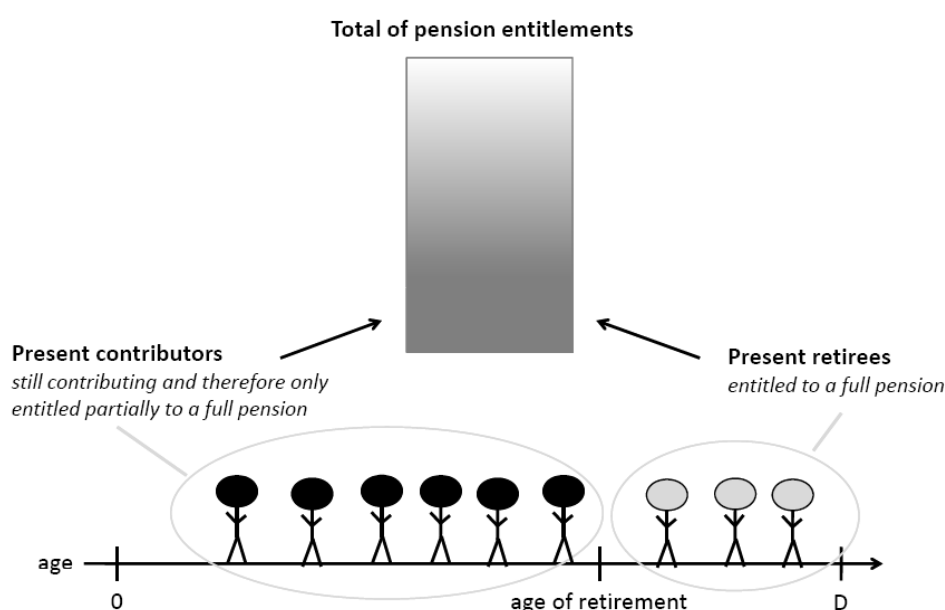
⁷¹ Please note that the following definitions may not be fully applicable for disability, survivors' and early retirement pensions. It should be e.g. taken into account that after the death of a retiree his/her surviving spouses/orphans (if existing) are entitled to a survivors' pension benefit. For a further description of the differentiation by pension type see "Estimating pension entitlements" under part 7.3.4.

⁷² These survival rates should reflect the expected increase of the life expectancy according to the newest EUROPOP projections. For a further discussion see part 5.2.1.

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 benefits⁷³. 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.

Figure 13: Differentiation between present contributors and retirees



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 (part 7.3.3). Then an equivalent description will be provided for present contributors (part 7.3.4). The following two parts always consider an average representative of a certain age group and gender.

7.3.3 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 die⁷⁴. To illustrate the estimation approach for current retirees, see the example in Box 13.

⁷³ 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. .

⁷⁴ 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 23.

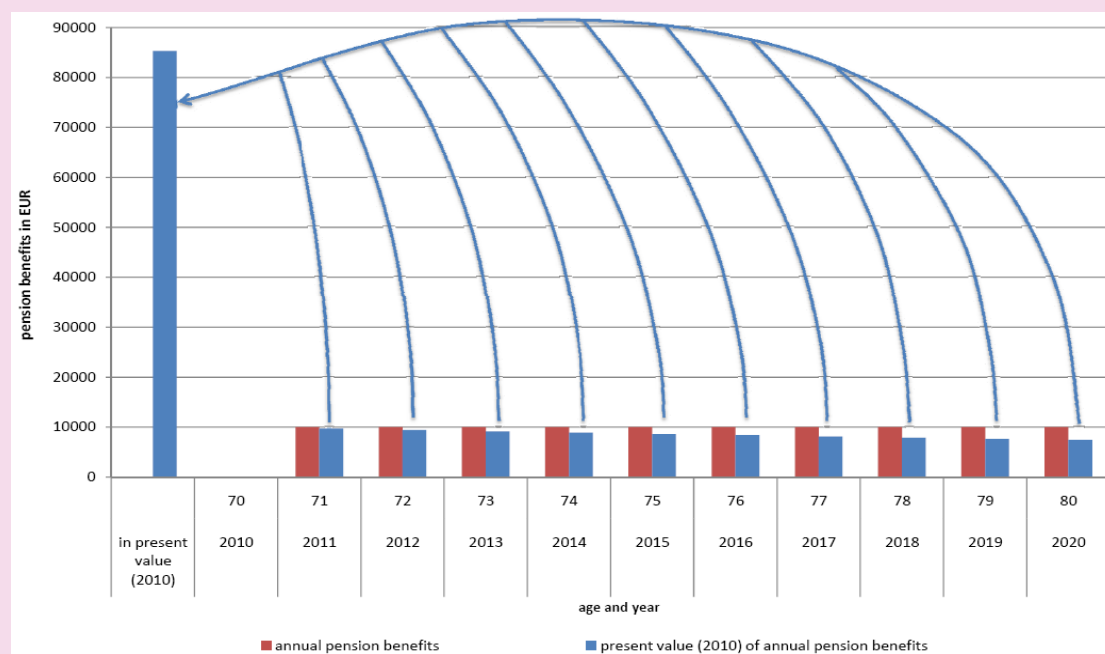
Box 13: Estimating pension entitlements for current retirees

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 Eurostat⁷⁵. 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 if one uses a discount rate of 3 per cent (this is only illustrative, please see the above guidance discount rates to be applied). 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.

⁷⁵ For a further description of the demographic data and assumptions see section 5.2.

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.

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 2010⁷⁶.

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 growth⁷⁷. 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 part 5.1.3, 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 expectations⁷⁸. The indexation of pensions with prices as well as with wages is illustrated in Box 14, which shows calculating pension entitlements both in nominal and in real terms.

⁷⁶ For an overview on the supplementary table see chapter 4.

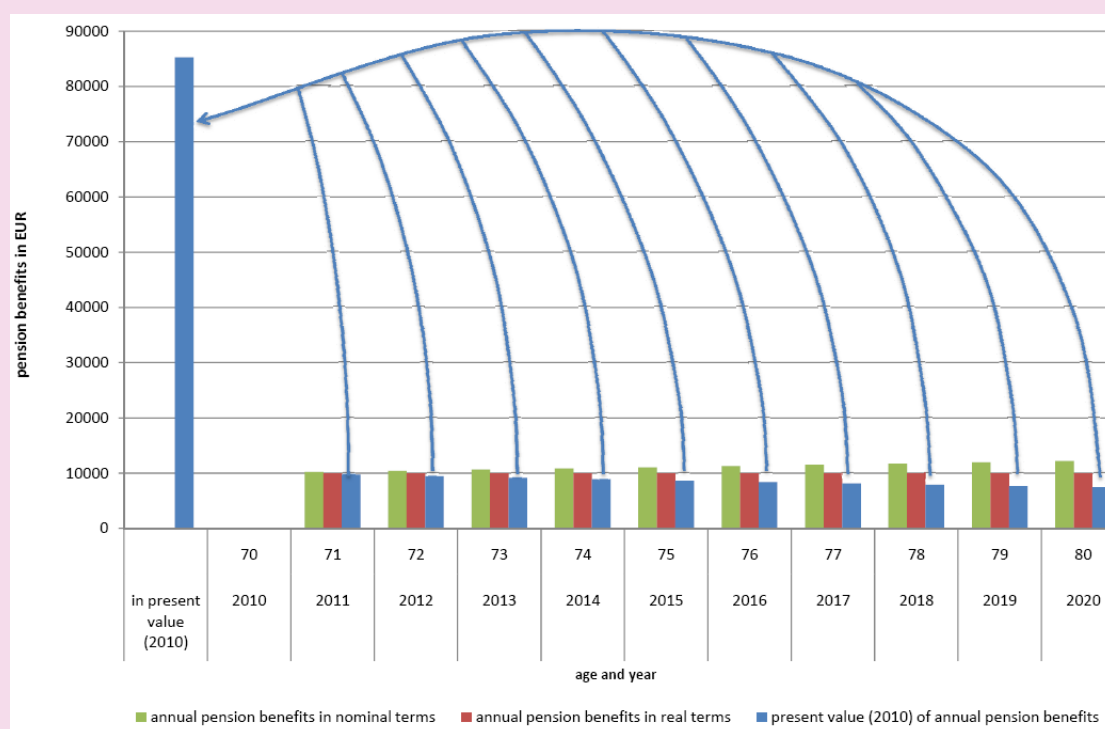
⁷⁷ For example Finland adjusts pension benefits annually with 80 per cent of CPI changes and with 20 per cent of the growth of the earnings level.

⁷⁸ For a further discussion on these two approaches see part 5.1.3.

Box 14: 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 13. 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.

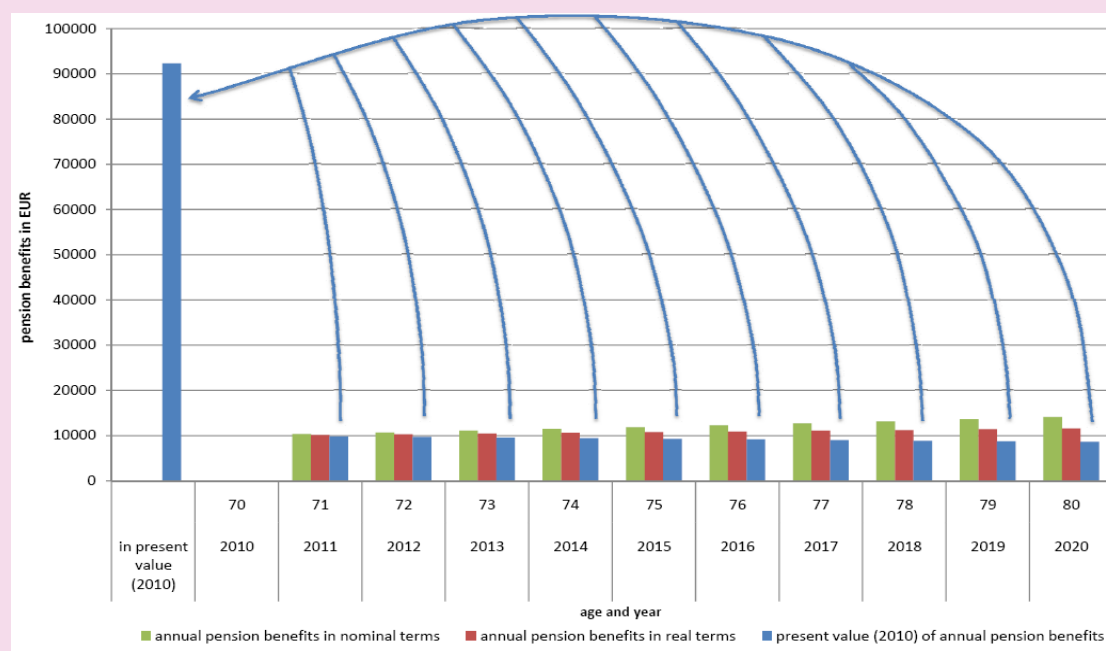
As outlined in part 5.1.3, both approaches, a nominal and a real calculation approach, should lead to almost the same level of pension entitlements. It is, however, crucial that the approach used for the pension indexation is also applied to the discount rate. In other words, if the projection is undertaken 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, an assumption of 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 if inflation is assumed to be 2 per cent. 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 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 part 7.3.4 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, two per cent in real terms should be applied.

7.3.4 ESTIMATING INDIVIDUAL PENSION ENTITLEMENTS FOR CURRENT CONTRIBUTORS

A general overview

The estimation of pension entitlements for current contributors closely follows the approach described in the previous part. 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 pension⁷⁹ 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 pension B^{full} has been accrued-to-date, the so-called accrual factor λ is introduced (see Equation 8)⁸⁰.

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

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 (λ) 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 λ ($0 \leq \lambda \leq 1$) 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 paragraphs describe how to estimate the initial annual pension benefit accrued-to-date ($B_r^{accrued}$) at the point of retirement r .

⁷⁹ 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 text.

⁸⁰ Please note that Equation 8 follows the same notation as Equation 5.

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. 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 paragraphs are structured as follows: first, the estimation of the initial annual pension benefit accrued-to-date ($B_r^{accrued}$) is outlined, applying a homCC approach and a hetCC approach; then these annual pension benefits will be projected over the remaining retirement phase to calculate the final result, namely the pension entitlements of current contributors.

Estimating the initial pension by applying homogeneous contribution careers

With the homCC approach, future accrued-to-date pension benefits ($B_r^{accrued}$) of current contributors are not directly calculated on the basis of past contribution data. In fact, $B_r^{accrued}$ 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.

The estimation under the homCC approach proceeds as follows. In the first step, future full pensions⁸¹ B^{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^{full} which is accounted for with the so-called accrual factor λ . Equation 9 summarises formally the steps for the estimation of $B^{accrued}$.

$$(9) \quad B^{accrued} = B^{full} * \lambda$$

Step 1 Step 2

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

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 pensioners⁸². All future new retirees are assumed

⁸¹ As outlined before a full pension is defined as the pension level one receives after the completion of the individual contribution career.

⁸² 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.

to have the same contribution history as present new pensioners, i.e. using homCC as a basis⁸³. As a consequence, future new retirees will receive (almost)⁸⁴ 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)⁸⁵ 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 θ should be applied (defined by a reform or, for instance, inherent in the benefit formula, as in the notional defined contribution scheme).

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

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 ⁸⁶.

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 counterparts⁸⁷. This aspect is also taken into account with the valorisation factor v in Equation 11.

⁸³ It should be stated that such an assumption is only reasonable in pension schemes which are sufficiently matured.

⁸⁴ 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.

⁸⁵ 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.

⁸⁶ Under the ABO approach v would equal to zero in schemes with a wage-indexation.

⁸⁷ 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.

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 λ .

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 schemes⁸⁸. Against this background, the following description of the accrual factor is based on the PBO method⁸⁹. Generally, the 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 retirement⁹⁰,

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 participant⁹¹,

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 15.

⁸⁸ 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).

⁸⁹ It should be noted, that the accrual factor can also be applied — after a few modifications — for the calculation of ABO entitlements.

⁹⁰ 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.

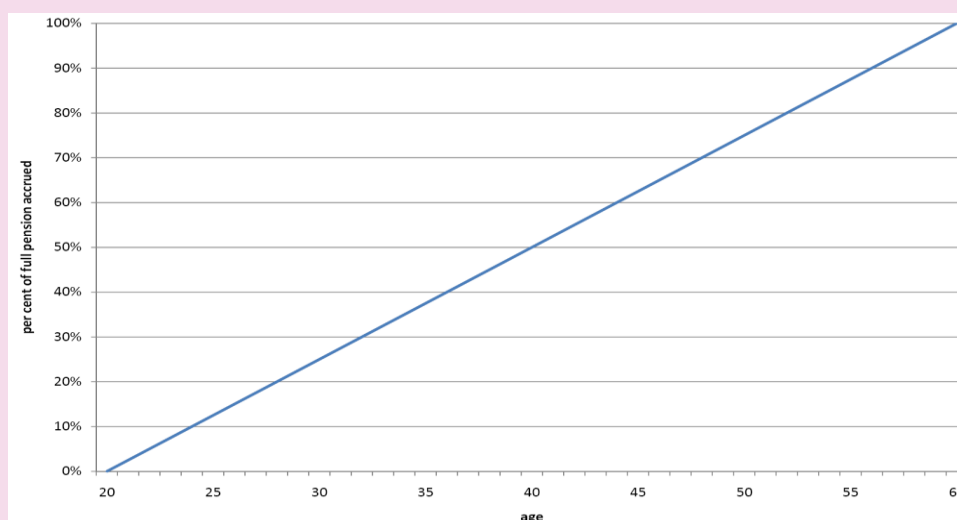
⁹¹ Please note that this definition holds for old age and early retirement pensions. In case of disability pensions l denotes the age when an individual is expected to become disabled while for the estimation of survivors' pensions l represents the expected age of death of the pension scheme participant. For a further discussion on a differentiation of the estimations by pension type see the following paragraph "differentiation by type of pensions".

Box 15: 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)

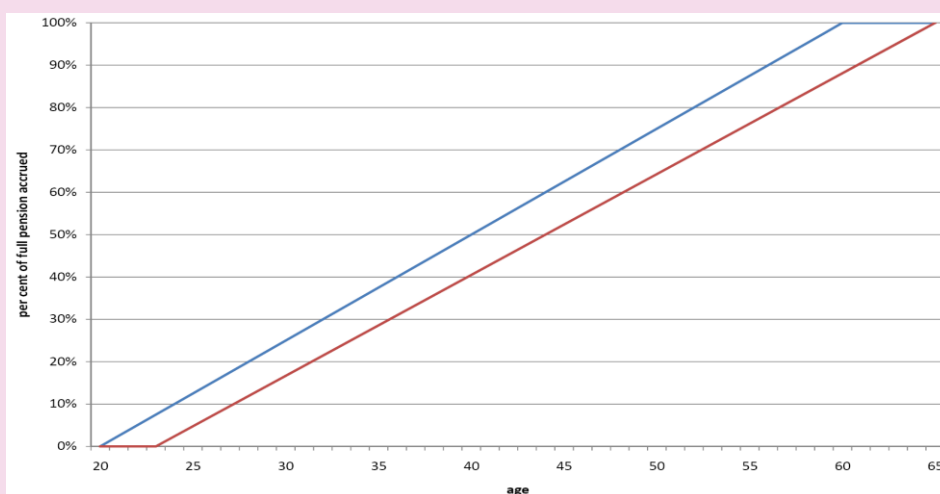


Source: Forschungszentrum Generationenverträge, University of Freiburg.

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 18⁹².

⁹² 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.

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 gender⁹³.

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 16 below.

⁹³ 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.

Box 16: 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 17 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 17: 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 23. 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 $\lambda_{x,g,d,b}$ as well as the annual pension benefit $B_{s,g,d,b+s-x}$ depend on the respective choice of the retirement age l .

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

where

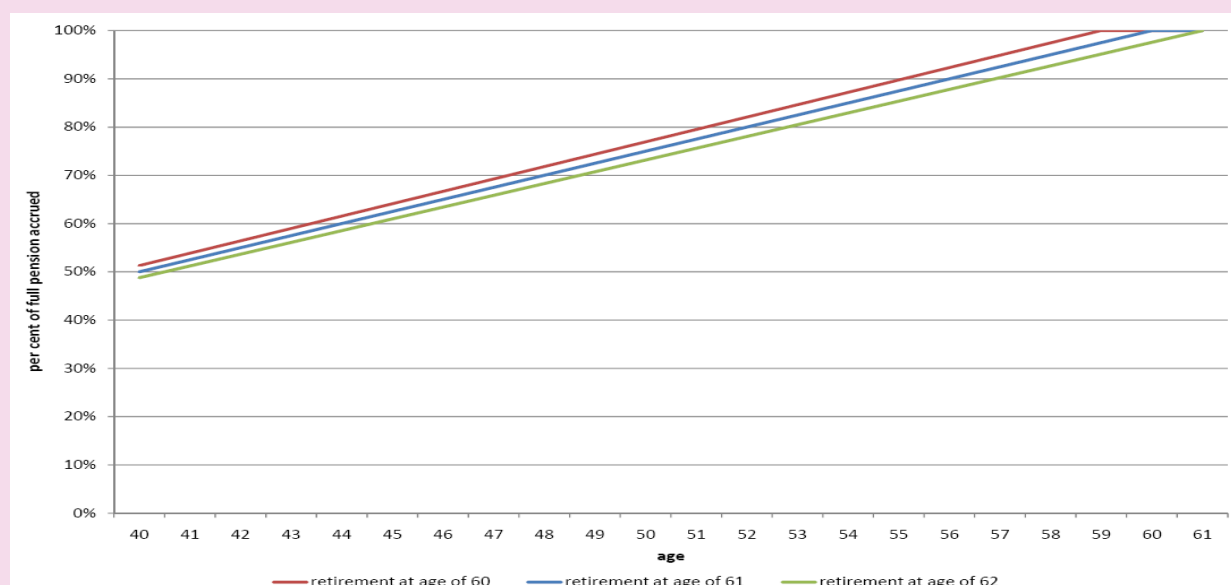
$l^{\max}$ = the highest possible retirement age,

$\lambda_{x,g,l,b}$ = 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 ,

$B_{s,g,l,b+s-x}^{\text{full}}$ = 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



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 cohorts⁹⁴. To consider such hetCC, comprehensive data on the contribution history of current contributors need to be collected. On this basis, the accrued-to-date pension benefit ($B_r^{accrued}$) 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 $B_r^{accrued}$ 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

⁹⁴ Such differences are also referred to as *cohort effects*.

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 18.

Box 18: 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 found⁹⁵). 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 years.

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

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 earnings⁹⁶.

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

In recent years, final earnings benefit formulas have been replaced in many countries by pension account

⁹⁵ In the UK also earnings-related public pension schemes can be found.

⁹⁶ Currently reference earnings in this scheme cover all earnings since 1985.

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.

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

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 accounts⁹⁷.

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

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.

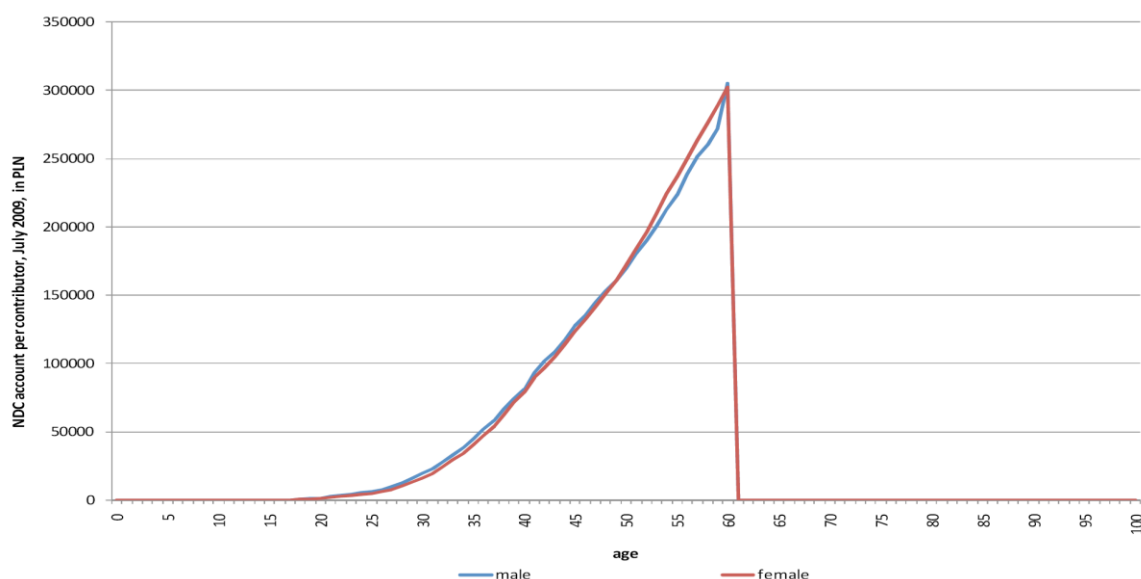
In a flat-rate pension scheme like those found in the Netherlands, the accumulated number of contribution or residence years should be taken into account. It is useful to collect past contribution data broken down by one-year age groups and by gender. This are data for the accumulated contribution years 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 Poland⁹⁸.

⁹⁷ 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.

⁹⁸ 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.

1. 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 16.

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 18⁹⁹.

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

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 19.

Box 19: 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”¹⁰⁰ (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 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.

⁹⁹ 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 considerable. In the example given in Box 19 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.

¹⁰⁰ 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.

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 $B_r^{accrued}$ 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 sufficient¹⁰¹. However, to estimate pension entitlements with the PBO approach — described in section 2.2 — some further steps need to be taken: future wage increases have to be considered for the estimation of $B_r^{accrued}$. 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

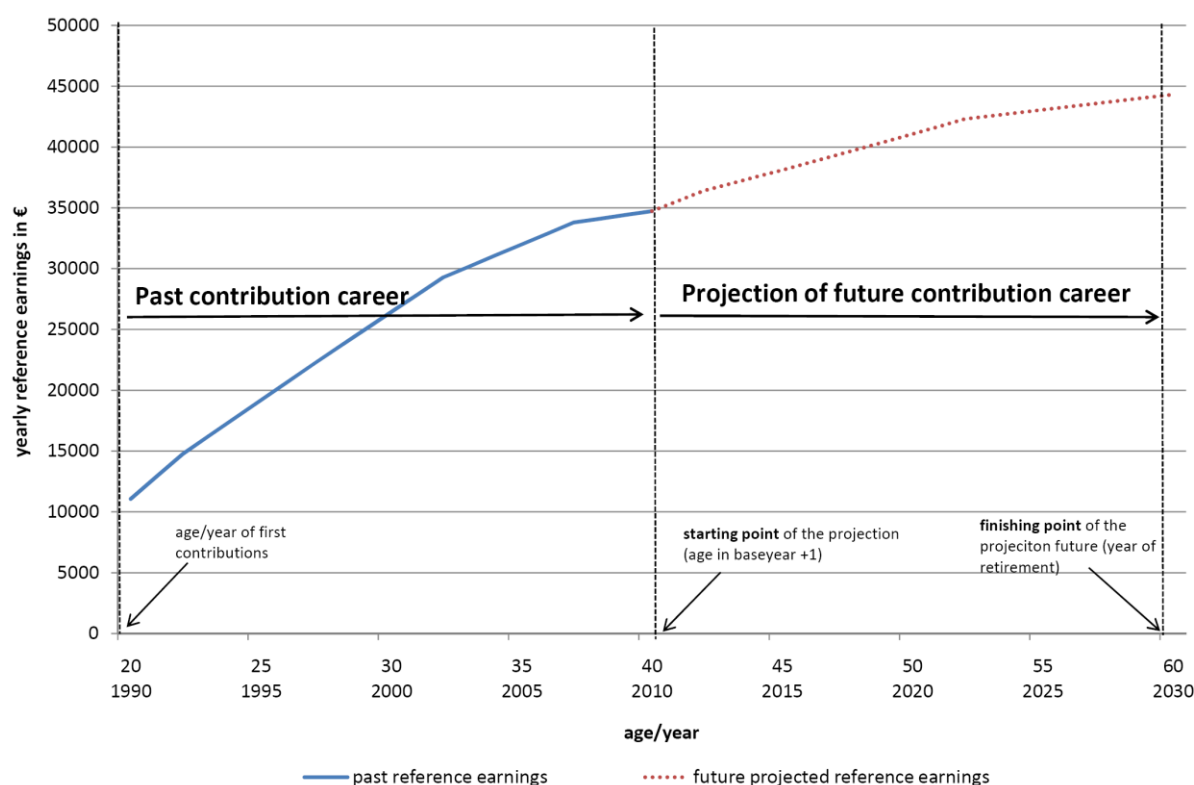
First, it is important to set the starting and finishing point of the required projection. Commonly, the projection of the future contribution career should start after the year for which the latest data on past earnings is available. Since the aim is to estimate pension benefits upon retirement, the 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 16.

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 2010¹⁰². 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 2030¹⁰³, when he is expected to retire, his contribution career needs to be projected.

¹⁰¹ 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.

¹⁰² 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.

¹⁰³ 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.

Figure 21: Projection of the future contribution career under the PBO approach

Source: Forschungszentrum Generationenverträge, University of Freiburg.

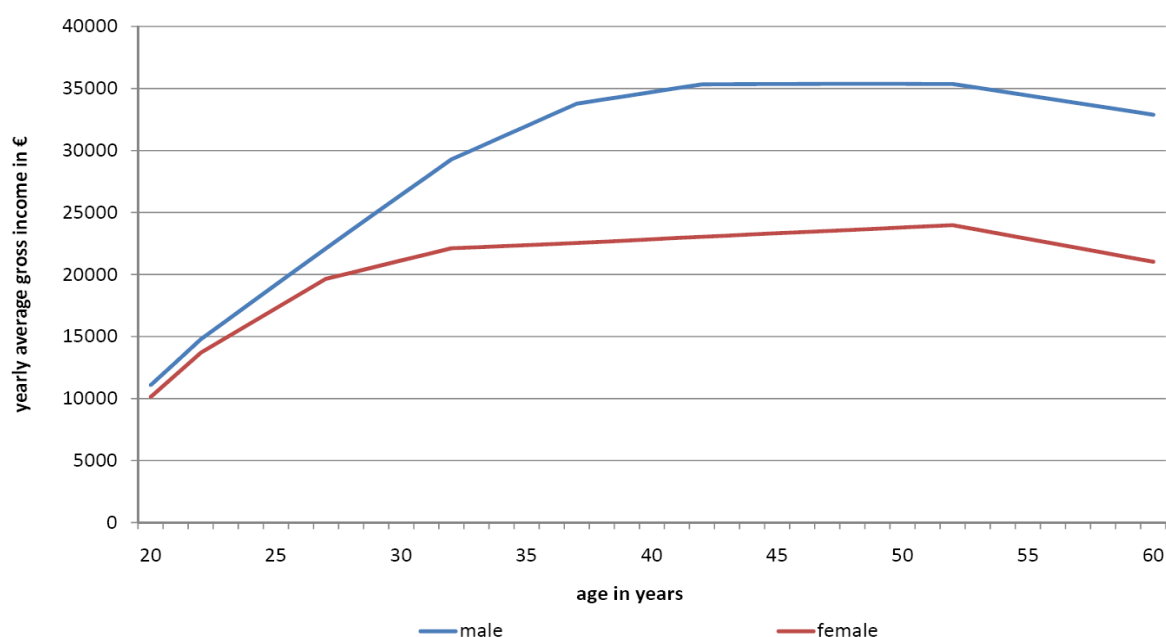
Required assumptions for the earnings projection

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

- 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 part 5.1.2, 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: Age- and gender-specific earnings profile (DRV 2006)

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 ,

π_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 π and

general wage growth in the economy g . Of course, inflation should only be considered if the calculation is carried out in nominal terms¹⁰⁴.

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 Section 6.2. As outlined in part 5.1.2, the AWG assumptions on future labour productivity growth provide a suitable basis for estimating general wage growth in the economy¹⁰⁵.

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 20.

¹⁰⁴ For a further discussion see part 5.1.3.

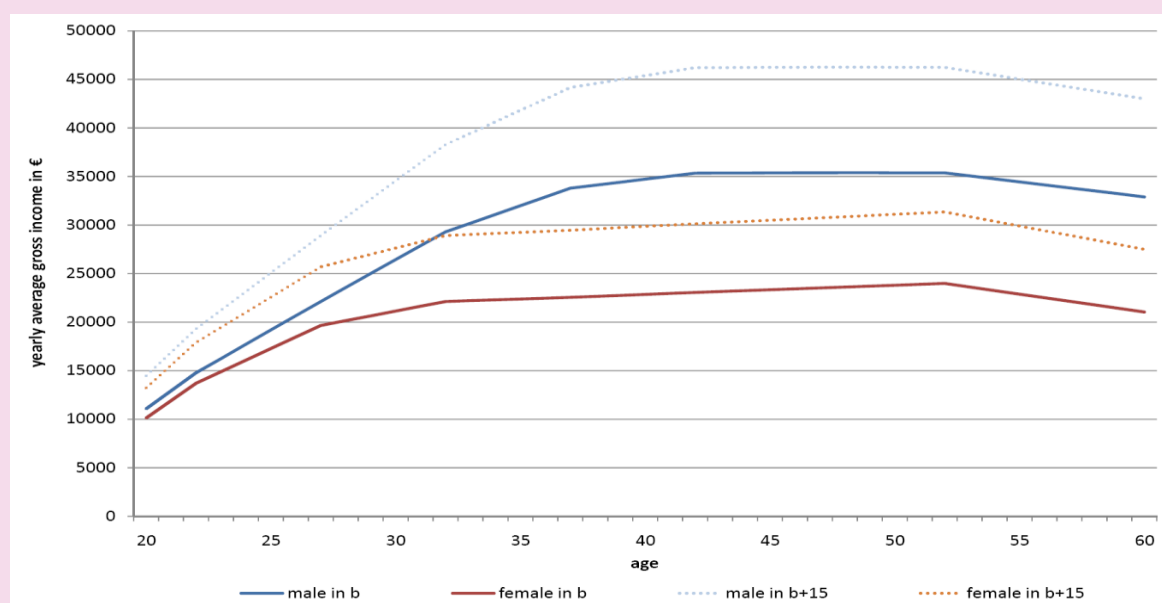
¹⁰⁵ For a more detailed discussion on the future wage growth assumption see part 5.1.2.

Box 20: 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 23. 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 $B_r^{accrued}$ 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)¹⁰⁶ 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 levels¹⁰⁷. It is important to reflect this aspect in the estimation of $B^{accrued}$. 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 economy¹⁰⁸. Only a few pension schemes (e.g. in Portugal) choose a lower indexation of past contributions, using the CPI¹⁰⁹. 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).

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

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

¹⁰⁶ Reference earnings are defined as the past earnings relevant in the benefit formula.

¹⁰⁷ Generally, an extension of the reference earnings translates into a decrease of pension levels — given the ceteris paribus condition.

¹⁰⁸ 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 part 5.1.2.

¹⁰⁹ 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.

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 21.

Box 21: 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.

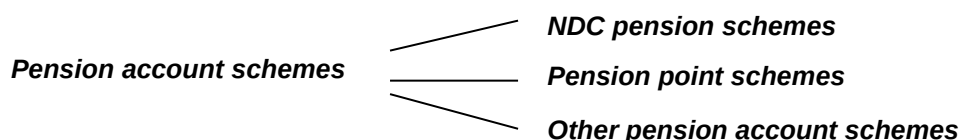
III. Estimation of accrued pensions in pension account schemes

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 accounts¹¹⁰.

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).

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

As a first step, appropriate assumptions about the future retirement age r of current contributors are needed¹¹¹. 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.

¹¹⁰ 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 '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.

¹¹¹ For a further discussion on the choice of future retirement ages see Box 16.

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 accounts¹¹². 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 ($PV_{b,r}$).

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

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)¹¹³. $B_r^{accrued}$ 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 $B_r^{accrued}$ 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.

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

Estimating pension entitlements

In the paragraphs above, the procedure to estimate the initial annual pension accrued-to-date $B_r^{accrued}$ was outlined — applying both a homogeneous and a heterogeneous contribution careers approach. In other words, the calculation of the “starting pension” of current contributors was

¹¹² 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.

¹¹³ For a discussion of the choice of the retirement age see Box 16.

described. On this basis, it is relatively straightforward to estimate pension entitlements of present contributors. First, the initial pension level $B_r^{accrued}$ 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 part 7.3.3.

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)¹¹⁴.

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

An example of the procedure to estimate pension entitlements for current contributors is provided in Box 22.

Box 22: 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 ($B_r^{accrued}$) 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 part 7.3.4 under "estimating the initial pension by applying the homogeneous contribution careers".

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.

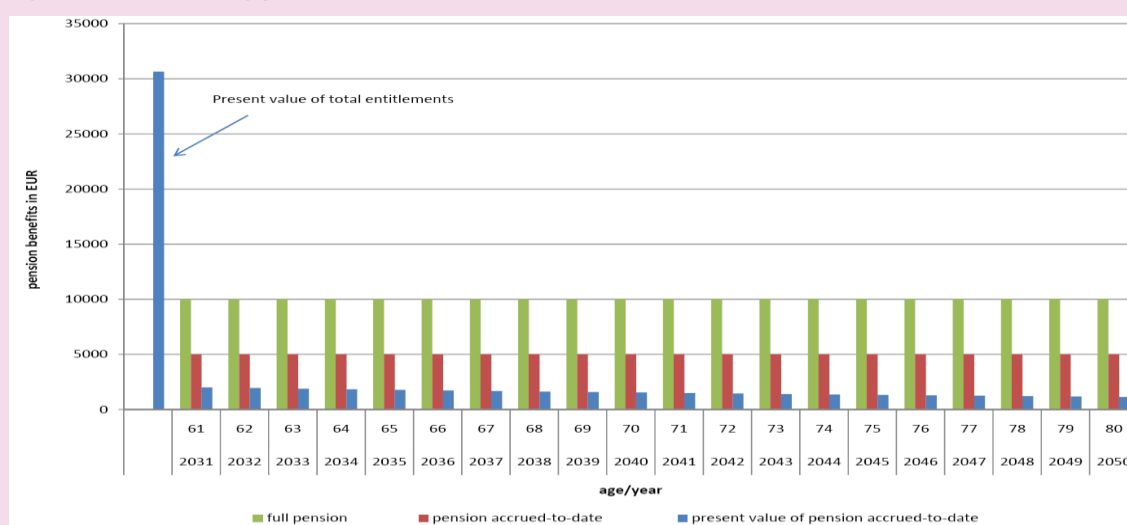
The aim is to calculate pension entitlements in the present value terms of the base year. All future accrued pension payments are therefore discounted. Since these future flows are paid out in the far future, in 20 to 40 years they are heavily discounted (see blue bars in Figure 20). At this stage of 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

¹¹⁴ Please note that Equation 33 equals Equation 5. For a description of the used parameters and variables see, therefore, Equation 5.

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 gender¹¹⁵.

Figure 24: Estimating pension entitlements of current contributors



Source: Forschungszentrum Generationenverträge, University of Freiburg.

Differentiation by type of pension

As outlined in section 3.1, 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 3 displays the breakdown of aggregate payments by type of pension for the social security pension scheme in Slovakia.

¹¹⁵ 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 23 with the probability to die before retirement.

Table 3: 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
Total of pension payments	126.519
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 beneficiary¹¹⁶. Box 23 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 3): a detailed estimation of disability and survivors' pension entitlements (for current contributors)¹¹⁷ may initially be disregarded¹¹⁸. Under such circumstances, the final old age pension 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 year¹¹⁹.

¹¹⁶ Also pension type specific survival rates may represent a reason to differentiate the calculation by pension type. E.g. survival rates of disabled individuals $p_{s,g}^{disab}$ may deviate from the average survival rates applied for old age. If possible — as outlined already in part 5.2.1 — such pension type-specific survival rates should be taken into account.

¹¹⁷ 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.

¹¹⁸ 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 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.

¹¹⁹ This rescaling approach has been applied e.g. by Holzmann et al. (2004), see p.34. In the Slovakian example shown in Table 3 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 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.

Box 23: 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 modifications¹²⁰.

Pension entitlements of current contributors should reflect the fact that these individuals retire with a certain probability q^{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 ($x + 1 \leq d \leq D$)¹²¹. For every d the accrual factor $\lambda_{x,g,d}$ 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 .

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

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

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

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

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^{old} in a future year f

¹²⁰ In case a hetCC approach is applied accrued pension benefits are estimated directly. Therefore, the accrual factor λ 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 part 7.3.4 under “estimating the initial pension by applying heterogeneous contribution careers”.

¹²¹ 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 16.

$$(f = b + d - x)^{122},$$

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

$PV_{x,g,d,f}^{disab}$ = 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,

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

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

$B_{s,g,d,m}^{full,surv}$ = 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^{disab} = the highest possible age to receive B^{disab} ,

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 ,

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

$p_{s,g,m}^{surv}$ = 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).

The approach to calculating pension entitlements for average present pensioners (part 7.3.3) and for average current contributors (part 7.3.4) 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 .

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

¹²² 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.

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