EUROPEAN CENTRAL BANK

EUROSYSTEM

Pension fund statistics
Compilation guide

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Contents

1 Aim of this guide

Pension funds (PFs) are financial corporations and quasi-corporations that are mainly engaged in financial intermediation as a consequence of the pooling of the social risks and needs of their members and beneficiaries (social insurance). As social insurance schemes, PFs provide income in retirement and often provide benefits in the event of death and disability. PFs in Europe are highly diverse in terms of their legal and regulatory set-ups, corresponding to their roles in the various countries' social protection systems. Occupational pension plans are often negotiated by social partners and subject to national social and labour law.

PFs play an important role in the economy. They invest pension savings in financial and non-financial assets and transform those assets into a post-employment income at a later stage. Moreover, those investments help to ensure economic innovation and growth. The financial crisis, the low-interest rate environment and the ageing population in Europe all highlight the need for higher-quality, more granular and more comparable data on this sector. Harmonised and comparable data on the PF sector are hard to collect. This stems from the many different types of PF and the fact that their characteristics vary across countries (see Section 3.4). The current gaps in the available data make it difficult to establish a comprehensive understanding of the cash flows and risks associated with pension obligations.

Regulation ECB/2018/2 on statistical reporting requirements for pension funds[1] (hereinafter, "the Regulation") was adopted on 26 January 2018. The first harmonised information that PFs will report under the Regulation will be quarterly data for the third quarter of 2019 and annual data for 2019. In order to minimise the reporting burden for the industry, the European Insurance and Occupational Pensions Authority (EIOPA) and the ECB have worked closely together in order to derive statistical reporting requirements from supervisory reporting. This gives national authorities the option of implementing a single reporting flow for common reporters. Decision EIOPA-BOS/18-114 of the Board of Supervisors on EIOPA's regular information requests towards NCAs regarding provision of occupational pensions information[2] (hereinafter, "the BoS Decision") set out reporting templates and formats in accordance with the provisions of Directive (EU) 2016/2341 on the activities and supervision of institutions for occupational retirement provision (IORPs)[3] (hereinafter, "the IORP II Directive").

Annex I to the BoS Decision specifies reporting tables, while Annex II contains explanations regarding reporting templates. Derogations, reporting deadlines and transitional measures are specified in Part 1 of the BoS Decision ("General requirements"). The reporting requirements set out in Annex I are reflected in the

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[1] Corrigendum to Regulation (EU) 2018/231 of the European Central Bank of 26 January 2018 on statistical reporting requirements for pension funds (ECB/2018/2) (OJ L 45, 17.2.2018).

[2] The BoS Decision.

[3] Directive (EU) 2016/2341 of the European Parliament and of the Council of 14 December 2016 on the activities and supervision of institutions for occupational retirement provision (IORPs) (Text with EEA relevance).

annotated templates in the technical reporting framework on the basis of the Data Point Model (DPM) and the Extended Business Reporting Language (XBRL) taxonomy. "ECB add-ons" are also included in those annotated templates to this end. Those "ECB add-ons" are items that pension funds have to provide for statistical purposes, in addition to the supervisory requirements. Section 2 of this guide shows how those various items relate to one another.

Where PFs do not report quarterly data on liabilities, national central banks (NCBs) are required to derive estimates of PFs' quarterly liabilities from other data provided by reporting agents.[4] In this context, the ECB Working Group on Monetary and Financial Statistics (WG MFS) agreed to set up an Expert Group on Pension Funds' Liabilities[5] comprising representatives of NCBs, national competent authorities (NCAs), the ECB, EIOPA, PensionsEurope (PE) and the European Association of Paritarian Institutions (AEIP). The Expert Group was tasked with: (i) defining the scope of that estimation in terms of balance sheet items on the basis of available data and reporting at national level; (ii) preparing methodologies with a view to estimating quarterly liabilities, taking account of the main differences across jurisdictions; and (iii) carrying out any other work or assignments required by the WG MFS in relation to the derivation of PFs' quarterly liabilities.

This guide does not impose any additional requirements over and above those set out in the Regulation and Guideline ECB/2019/18[6], and it is not binding in itself. Section 3 of the guide provides guidance on central bank statisticians' preferred approach to the derivation of quarterly liabilities where international statistical standards have yet to be established, or are not sufficiently precise, supplementing the information contained in the ECB's aforementioned legal acts. In particular, it provides NCB statisticians with a comprehensive point of reference on the requirements imposed by ECB legislation in respect of the derivation and estimation of PFs' quarterly liabilities. Furthermore, the guide also contains various supplementary explanations and recommendations with a view to helping with the implementation of those requirements and thereby further improving the comparability of statistics. Statisticians working in national statistical offices and European and international organisations may use the guide in their own statistical work, and it may also help the suppliers of the underlying data at PFs to understand how their work is used and why the various requirements take the form that they do. Users of these data – both in central banks and in other organisations – may benefit from knowing more about the conceptual basis for the data that they are analysing and using, and knowing what is done to the raw information to make it usable for policy purposes. This is a wide audience, so the guide seeks to explain technical issues in a way that interested but non-specialist readers can understand, while also satisfying specialist needs.

This compilation guide is composed of two main sections. Section 2 details the mapping of statistical and supervisory requirements in respect of quarterly and annual data (mainly for assets). Section 2 is divided into five main sections:

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[4] Article 4(2) of the Regulation states: "NCBs shall derive quarterly estimates for liabilities of PFs based on data provided on an annual basis by the reporting agents pursuant to Article 4(1)(b)."

[5] A list of members of the Expert Group can be found in Section 5.

[6] Guideline ECB/2019/18 of 7 June 2019 amending Guideline ECB/2014/15 on monetary and financial statistics.

- 2.1 Introduction

- 2.2 Statistical concepts and calculation methods

- 2.3 Mapping of quarterly requirements

- 2.4 Mapping of annual requirements

- 2.5 Outstanding issues

Section 3 then details the Expert Group's work on guiding and harmonising the various different methodologies for the estimation of quarterly liabilities. Section 3 is also divided into five main sections:

- 3.1 Regulation ECB/2018/2

- 3.2 Estimates of PFs' quarterly liabilities

- 3.3 Conclusions regarding the estimation of quarterly liabilities

- 3.4 Valuation and country-specific approaches to PFs' quarterly liabilities

- 3.5 Results of the temporal disaggregation test

The guide then concludes with a glossary (Section 4) and a list of authors and Expert Group members (Section 5).

2 Mapping

2.1 Introduction

2.1.1 Introduction to the annotated templates

The overview table for the annotated templates[7] provides details of various "entry points". Entry points are combinations of templates that are usually reported together. For example, all templates in column C refer to entry point 24 and are to be reported annually by individual EIOPA reporters only. Entry points 24 to 29 are pure EIOPA templates. These templates are used by reporting agents that only report XBRL supervisory data where statistical information is collected outside of XBRL. In IORP reporting, one set of data is sent from the reporting agent to the NCA (called "level 1" reporting) and a different set of data is sent from the NCA to EIOPA (called "level 2" reporting). NCAs and NCBs are free to decide whether the XBRL taxonomy is used for level 1 reporting, whereas for level 2 reporting NCAs are obliged to send data in XBRL (as stipulated in "EIOPA's explanations for L2" in the annotated templates).

Entry points 30 to 32 are EIOPA templates with ECB add-ons (similar to the templates used for insurance corporations' statistical reporting; see entry points 16 to 18). Common supervisory and statistical reporters that report in XBRL use these templates for level 1 reporting. NCBs are required to send PF data to the ECB in SDMX, which is the usual format for reporting statistical data to the ECB.

Each template has a template code and a template name.

The template code comprises four parts, separated by dots.[8]

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[7]　EIOPA annotated templates.

[8]　More specific information can be found in EIOPA's Solvency II filing rules.

Table 1

Template code structure

	Indicator of	Explanation	Possible values
Part 1	Global reporting package	A template can be used for: - supervisory reporting only (**PF**); - both supervisory and statistical reporting, with the PF template amended to include ECB add-ons (**PFE**); - statistical reporting only (**EP**).	PF/PFE/EP
Part 2	Template group	Templates containing similar information are grouped together (e.g. group 01 containing "basic information" or group 02 containing "balance sheet" information).	xx, where x is a digit (e.g. 01)
Part 3	Numeric code for the specific template in question	The number of the template within its template group	0x, where x is a digit (e.g. 01)
Part 4	Variant	A template may differ slightly when comparing entry points. The variant shows the entry point in which it has changed. (e.g. template PF.01.02.24 is slightly different from PF.01.02.25 and PF.01.02.26. The variant PF.01.02.25 is used for entry points 25 and 28. Because the template used for entry point 25 and 28 are identical, the variant does not change for entry point 28.)	24/25/26/27/28/29/30/31/32

2.1.2 Valuation principles for statistical and supervisory reporting

Article 6 of the Regulation states: "Unless otherwise provided for in this Regulation, the accounting rules followed by PFs for the purposes of reporting under this Regulation shall be those laid down in the relevant national law implementing Directive 2003/41/EC of the European Parliament and of the Council[9] or in any other national or international standards that apply to PFs based on instructions provided by NCBs."

As a result, unless otherwise indicated, data on assets will be collected using the Solvency II valuation (i.e. either market or fair values). A fair value is an approximation of the relevant market value and is calculated by using a present value model to discount the expected future cash flow.[10]

Liability data for supervisory purposes will be collected using values in statutory accounts.

2.2 Statistical concepts and calculation methods

2.2.1 Calculation of financial transactions

According to ESA 2010, a transaction is "an economic flow that is an interaction between institutional units by mutual agreement". Transactions (as opposed to "other changes") measure economic activity. It is important to distinguish between

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[9] Directive 2003/41/EC of the European Parliament and of the Council of 3 June 2003 on the activities and supervision of institutions for occupational retirement provision (OJ L 235, 23.9.2003, p. 10).

[10] ECB, *Fair Value Accounting in the Banking Sector*, Frankfurt am Main, 2000.

transactions and other factors affecting outstanding amounts over a given reference period. Such other factors can include (i) valuation effects arising from changes to prices, interest rates or exchange rates, (ii) reclassifications, and (iii) write-offs and write-downs of loans.

For PFs, financial transactions can be calculated as the difference between outstanding amounts at end-of-period reporting dates, minus the effect of changes stemming from influences other than transactions, using the formula below:

$$F_t = (L_t - L_{t-1}) - R_t - V_t - E_t \tag{1}$$

where:

F_t = flow (financial transactions)

L_t = stock at the end of the period

L_{t-1} = stock at the end of the previous period

R_t = reclassification adjustment

V_t = revaluation adjustment

E_t = exchange rate adjustment

In this context, please note that, according to ESA 2010, para. 7.39(d), "market value = nominal value + revaluations arising from market price changes".

2.2.2 Calculation of exchange rate adjustments

The derivation of the exchange rate adjustment for instruments that are denominated in currencies other than the euro (but reported in euro) can be broken down into three steps:

Step 1: Outstanding amounts are converted back into the original currency of denomination – i.e. outstanding amounts at the end of the previous and current reporting periods are converted using the exchange rate at the time (nominal euro/foreign currency exchange rate). The list of assets template specifies the currency of denomination in column C0220 ("currency").

$$L_t^{FC} = \frac{L_t^{EUR}}{e_t}$$

$$L_{t-1}^{FC} = \frac{L_{t-1}^{EUR}}{e_{t-1}}$$

where:

L^{FC} = outstanding amount converted to the original currency of denomination FC

L^{EUR} = outstanding amount expressed in euro, having FC as the original currency of denomination

e = nominal euro/FC exchange rate

Step 2: The change in outstanding amounts between $t-1$ and t, denominated in foreign currency, is converted back into euro using the average of the daily exchange rates observed during the reporting period:

$$Avg(e_t) * (L_t^{FC} - L_{t-1}^{FC})$$

where $Avg(e_t)$ is the average of the daily nominal exchange rates during the period from $t-1$ to t.

Using the average rate for this conversion assumes that the transactions were evenly spread over the period.

Step 3: The exchange rate adjustment is calculated as the difference between the change in outstanding amounts in euro and the change in outstanding amounts converted into euro (as calculated in step 2):

$$E_t = (L_t^{EUR} - L_{t-1}^{EUR}) - [Avg(e_t) * (L_t^{FC} - L_{t-1}^{FC})]$$

where E is the exchange rate adjustment.

2.3 Mapping of quarterly requirements

2.3.1 Assets

Annotated templates PFE.02.01 "balance sheet", PFE.06.02 "list of assets" and EP.02.01 "pension fund reserves" are needed to derive quarterly ESCB requirements. These are collected on a quarterly basis through entry point 31.

2.3.1.1 Currency and deposits

Nominal values are collected for currency and deposits. In line with ESA 2010 (para. 7.39), interest accrued on deposits should be allocated to the nominal amount as it accrues. For cash (CIC 71), no nominal amounts are collected. Only the market value is reported, which can be assumed to be equal to the nominal amount.

The counterparty country is not reported for cash (CIC 71). One possible way forward as regards geographical allocation is to allocate cash in euro to the domestic counterparty country and allocate other currencies to the countries issuing the relevant currencies.

Currency and deposits – Stocks

Table 2

Currency and deposit stocks: breakdown requirements, templates and derivation

	Description of ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
1	Total – Domestic; euro area countries other than domestic (total and per country); rest of world (total and per main counterparty outside the EU); non-participating EU Member States (per country)	Template used: PFE.06.02 C0230 (CIC): CIC 71, CIC 72, CIC 73, CIC 74, CIC 79 C0070 (par amount) C0090 (accrued interest) C0100 (market asset value) C0210 (issuer country) + CIC 8#, if counterparty sector according to ESA 2010 (EC0172) is MFI sector and original maturity is less than or equal to one year (derived from issue date (EC0271) and maturity date (C0280)) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3# , CIC 5# and CIC 6#	For all lines where CIC is 72, 73, 74 or 79, add par amounts (C0070) and accrued interest (C0090), grouped by issuer country (C0210). For all lines where CIC is 8#, issuer sector is MFI sector and original maturity is less than or equal to one year, add par amounts and accrued interest, grouped by issuer country. For CIC 71, add market asset values. Instrument classification according to ESA 2010: Depending on EC0232, some instruments which are classified as debt securities/equity according to their CIC code may be classified differently for statistical purposes.
2	MFI/non-MFI breakdown – Domestic; euro area countries other than domestic (total); rest of world (total)	Everything mentioned in row 1, plus: EC0172 (counterparty sector according to ESA 2010)	Same as in row 1, plus: Breakdown into MFIs and non-MFIs
3	Of which transferable deposits – Domestic; euro area countries other than domestic (total); rest of world (total)	Template used: PFE.06.02 C0230 (CIC): CIC 72 C0070 (par amount) C0090 (accrued interest) C0100 (market asset value) C0210 (issuer country) + CIC 8#, if counterparty sector according to ESA 2010 (EC0172) is MFI sector and original maturity is less than or equal to one year (derived from issue date (EC0271) and maturity date (C0280)) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3# , CIC 5# and CIC 6#	For all lines where CIC is 72, add par amounts (C0070) and accrued interest (C0090), grouped by issuer country (C0210). For all lines where CIC is 8#, issuer sector is MFI sector and original maturity is less than or equal to one year, add par amounts and accrued interest, grouped by issuer country. Instrument classification according to ESA 2010: Depending on EC0232, some instruments which are classified as debt securities/equity according to their CIC code may be classified differently for statistical purposes.
4	Of which transferable deposits – MFI/non-MFI breakdown – Domestic; euro area countries other than domestic (total); rest of world (total)	Everything mentioned in row 3, plus: EC0172 (counterparty sector according to ESA 2010)	Same as in row 3, plus: Breakdown into MFIs and non-MFIs

Currency and deposits – Transactions and revaluation adjustments

In line with para. 6.48 et seq. of ESA 2010, nominal holding gains and losses on currency and deposits are always zero. Holdings of foreign currency and deposits denominated in other currencies will register nominal holding gains and losses due to changes in exchange rates. Thus, changes in nominal value that are not accounted for by exchange rates always reflect financial transactions.

Thus, the flow is calculated as the change in nominal value minus exchange rate effects (E_t) and reclassification adjustments (R_t).

Table 3

Currency and deposit transactions: templates and derivation

	Relevant templates and cells	Derivation for ESCB purposes
5	Template used: PFE.06.02 C0070 (par amount) C0090 (accrued interest) C0100 (market asset value) for CIC 71 C0220 (currency) EC0141 (write-offs/write-downs) for CIC 8#	For each breakdown by counterparty country (issuer country (C0210)) and ESA sector (counterparty sector according to ESA 2010 (EC0172)), calculate: $F_t = (N_t + A_t) - (N_{t-1} + A_{t-1}) - E_t - R_t - (-W_t)$ where: $E_t = 0$ if the currency (C0220) is the euro (otherwise, E_t should be calculated as shown in Section 2.2.2) F_t = financial transactions N_t = nominal amount reported under par amount (C0070) A_t = accrued interest (C0090) R_t = reclassification adjustment (as discussed in Section 2.3) W_t = write-offs/write-downs (EC0141)

2.3.1.2   Debt securities

Debt securities – Stocks

Fair values are collected for debt securities. Thus, data are collected under C0100 (market asset value).

The market asset value is calculated as follows:

The "market asset value" (C0100) is equal to "par amount" (C0070) multiplied by "unit percentage of par amount price" (C0380) plus "accrued interest" (C0090). Since the market asset value includes accrued interest, it is a dirty price. The dirty price includes accrued interest accumulated between coupon payments. After a coupon payment, dirty and clean prices are the same.

In PF statistics (by contrast with BSI statistics), accrued interest should be reported with the financial instrument (in line with ESA 2010) and not as part of remaining assets.

Table 4

Debt securities stocks: breakdown requirements, templates and derivation

	ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
6	Total, broken down by geographical location of counterparties and by ESA sector	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 1#, CIC 2#, CIC 5# and CIC 6# C0100 (market asset value) EC0172 (counterparty sector according to ESA 2010) C0210 (issuer country) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#	Add market asset values together, taking into account the following: Where ISIN codes are available, derive geographical and sector breakdown from the CSDB. Where ISIN codes are not available, information on geographical and sector breakdown to be derived from PFE.06.02. For all lines where CIC is 1#, 2#, 5# or 6#, add market asset values together, grouped by issuer country and counterparty sector. The geographical breakdown can, in principle, be derived from either the CSDB or PFE.06.02 (irrespective of whether ISIN codes are available). Instrument classification according to ESA 2010: Depending on EC0232, some instruments which are classified as debt securities/equity according to their CIC code may be classified differently for statistical purposes.
7	Broken down by original maturity (up to one year; one to two years; over two years), by geographical location of counterparties (total) and by ESA sector	Everything mentioned in row 6, plus: EC0271 (issue date) C0280 (maturity date)	Add market asset values together, taking into account the following: Where ISIN codes are available, derive maturity breakdown and geographical and sector breakdown from the CSDB. Where ISIN codes are not available, information on maturity, geographical and sector breakdown to be derived from PFE.06.02. For all lines where CIC is 1#, 2#, 5# or 6#, add market asset values together, grouped by issuer country and counterparty sector according to ESA. Derive original maturity from issue date[11] and maturity date. The geographical breakdown can, in principle, be derived from either the CSDB or PFE.06.02 (irrespective of whether ISIN codes are available). Instrument classification according to ESA 2010: Depending on EC0232, some instruments which are classified as debt securities/equity according to their CIC code may be classified differently for statistical purposes.
8	Broken down by original maturity (up to one year; over one year), by geographical location of counterparties (per country for euro area and non-participating EU Member States) and by ESA sector (MFIs; non-MFIs; general government; other residents)	Everything mentioned in row 7	Everything mentioned in row 7
9	Broken down by original maturity (up to one year; over one year) for main counterparties outside the EU	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 1#, CIC 2#, CIC 5# and CIC 6# C0100 (market asset value) C0210 (issuer country) EC0271 (issue date) C0280 (maturity date) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#	Add market asset values together, taking into account the following: Where ISIN codes are available, derive maturity breakdown and geographical breakdown from the CSDB. Where ISIN codes are not available, information on maturity and geographical breakdown to be derived from PFE.06.02. For all lines where CIC is 1#, 2#, 5# or 6#, add market asset values together, grouped by issuer country according to ESA. Derive original maturity from issue date and maturity date. The geographical breakdown can, in principle, be derived from either the CSDB or PFE.06.02 (irrespective of whether ISIN codes are available). Instrument classification according to ESA 2010: Depending on EC0232, some instruments which are classified as debt securities/equity according to their CIC code may be classified differently for statistical purposes.

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[11] Initially, it might be not feasible to report the issue date for some securities. In this case, the issue date should be the same as the reporting date the first time those securities are reported.

Debt securities – Transactions

Accrued interest is included in market values and nominal values, in line with paras. 7.38 and 7.39 of ESA 2010. Accrued interest is not part of holding gains and losses/revaluation adjustments because an increase in the value of a bill owing to the accumulation of accrued interest is caused by an increase in the principal outstanding rather than a change in the price of the asset.

Table 5

Debt securities transactions: templates and derivation

	Relevant templates and cells	Derivation for ESCB purposes
10	Template used: PFE.06.02 C0070 (par amount) C0090 (accrued interest) C0380 (unit percentage of par amount) C0100 (market asset value)	For each breakdown by original maturity (based on issue date (EC0271) and maturity date (C0280)), counterparty country (issuer country (C0210)) and ESA sector (counterparty sector according to ESA 2010 (EC0172)), calculate transactions for debt securities using average clean prices (calculated in accordance with current guidance on insurance corporation statistics): $$F_t = (N_t - N_{t-1})\left(\frac{(CP_{t-1} + CP_t)}{2}\right) + IN - R_t$$ $$IN_t = A_t - A_{t-1}$$ $$CP_t = \left(\frac{S_t - A_t}{N_t}\right)$$ where: F_t = financial transactions R_t = reclassification adjustment N_t = debt securities (aggregated nominal amount) at time t [C0070 (par amount)] CP_t = clean price of debt securities in euro at time t [C0380 (unit percentage of par amount)] IN_t = interest income from time $t - 1$ to time t The clean price CP_t is available from PFE.06.02.C0380 and corresponds to $$\frac{S_t - A_t}{N_t}$$ where: S_t = total market asset value (C0100) of debt securities at time t A_t = accrued interest (C0090) at time t Using the security-by-security template PFE.06.02, interest income can be derived as follows: $$IN_t = A_t - A_{t-1}$$

2.3.1.3   Loans

Nominal values are collected for loans. Loans are mostly made up of CIC code 8# ("mortgages and loans"). However, CIC category 75 ("deposits to cedants") is also included in loans, as ESA 2010 regards deposit guarantees as financial claims of reinsurance corporations on ceding corporations and thus part of loans.

In line with ESA 2010 (para. 7.39), interest accrued on loans should be allocated to the nominal amount as it accrues.

Loans – Stocks

Loans do not have an ISIN code, as they are, by definition, not traded on an active market. According to ESA 2010, loans that are securitised need to be reclassified as

debt securities. As a result, information provided cannot be enhanced using additional data from the CSDB.

Table 6

Loan stocks: breakdown requirements, templates and derivation

	ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
11	Broken down by original maturity (up to one year; one to five years; over five years) and by geographical location of counterparties (domestic; euro area countries other than domestic (total); rest of world (total))	Template used: PFE.06.02 C0230 (CIC): CIC 8# C0070 (par amount) C0090 (accrued interest) C0210 (issuer country) EC0271 (issue date) C0280 (maturity date) For original maturities of up to one year (derived from issue date (EC0271) and maturity date (C0280)), deduct CIC 8# if issuer sector (C0170) is MFI sector. Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#.	For all lines where CIC is 8#, add par amounts (C0070) and accrued interest (C0090), grouped by issuer country (C0210). For original maturities of up to one year, deduct all lines where CIC is 8# and issuer sector is MFI sector. Instrument classification according to ESA 2010: Depending on EC0232, some instruments which are classified as debt securities/equity according to their CIC code may be classified differently for statistical purposes. Deposits to cedants: The issuer country is not reported for this item. The question of how deposits to cedants can be subdivided in all breakdowns still needs to be decided.
12	Broken down by original maturity (up to one year; one to five years; over five years), by geographical location of counterparties (domestic; euro area countries other than domestic (total)) and by ESA sector	Everything mentioned in row 11, plus: EC0172 (counterparty sector according to ESA 2010)	For all lines where CIC is 8#, add par amounts (C0070) and accrued interest (C0090), grouped by issuer country (C0210) and counterparty sector according to ESA 2010 (EC0172). For original maturities of up to one year, deduct all lines where CIC is 8# and issuer sector is MFI sector. Instrument classification according to ESA 2010: Depending on EC0232, some instruments which are classified as debt securities/equity according to their CIC code may be classified differently for statistical purposes. Deposits to cedants: The issuer country is not reported for this item.

Loans – Financial transactions

Table 7

Loan transactions: templates and derivation

	Relevant templates and cells	Derivation for ESCB purposes
13	Template used: PFE.06.02 C0070 (par amount) C0090 (accrued interest) EC0141 (write offs/write-downs)	For each breakdown by original maturity (based on issue date (EC0271) and maturity date (C0280)), counterparty country (issuer country (C0210)) and ESA sector (counterparty sector according to ESA 2010 (EC0172)), calculate financial flows for loans at nominal value by applying the following formula: $$F_t = (N_t + A_t) - (N_{t-1} + A_{t-1}) - E_t - R_t - (-W_t)$$ $$= (N_t - N_{t-1}) + (A_t - A_{t-1}) - E_t - R_t - (-W_t) \qquad (2)$$ where: F_t = financial transactions N_t = aggregated nominal value of loans at time t [C0070 (par amount)] A_t = accrued interest (C0090) at time t W_t = write-offs/write-downs (EC0141) R_t = reclassification adjustment E_t = exchange rate adjustment Please note that, for nominal values, E_t price adjustments are equal to 0.

2.3.1.4   Equity

Fair values are collected for "listed equity", "unlisted equity" and "other equity". All CIC codes that start with a country code (which denotes the country in which the listing stock exchange is resident) or "XV" (which means that the instrument is listed on more than one stock exchange) should be classified as "listed". All equity that is not traded on a regulated market or via a multilateral trading facility is classified as "XL" and is, for statistical purposes, regarded as "unlisted". "Other equity" is defined by the Regulation as "all forms of equity other than listed shares and unlisted shares". Thus, all remaining equity reported under CIC 3# should be included there.

Equity – Stocks

Table 8

Equity stocks: breakdown requirements, templates and derivation

	ESCB requirement	Relevant templates and cells
14	Equity – total Broken down by geographical location (domestic; euro area countries other than domestic (total); rest of world)	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 3# C0100 (market asset value) C0210 (issuer country) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#.
15	Equity – total Broken down by geographical location (domestic; euro area countries other than domestic (total)); and ESA sector of counterparties	Everything mentioned in row 14, plus: EC0172 (counterparty sector according to ESA 2010)
16	Equity – of which, listed shares Broken down by geographical location and ESA sector of counterparties	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 3#, excluding XL3# (assets that are not listed on a stock exchange) and XT3# (assets that are not exchange-tradable) C0100 (market asset value) EC0172 (counterparty sector according to ESA 2010) C0210 (issuer country) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#.
17	Equity – of which, unlisted shares Broken down by geographical location and by ESA sector of counterparties	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): XL31, XL32, XL33, XL34, XL39, XT31, XT32, XT33, XT34 and XT39 C0100 (market asset value) EC0172 (counterparty sector according to ESA 2010) C0210 (issuer country) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#.
18	Equity – of which, other equity Broken down by geographical location and by ESA sector of counterparties	Template used: PFE.06.02 C0010 (asset ID code and type of code): non-ISINs, thus not code "1" or "99/1" C0230 (CIC): XT31, XT32, XT33, XT34 and XT39 C0100 (market asset value) EC0172 (counterparty sector according to ESA 2010) C0210 (issuer country) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#.
19	Equity – broken down by geographical location (per country for euro area countries other than domestic and non-participating EU Member States), by ESA sector of counterparties (MFIs; non-MFIs; general government; other residents) and by type of equity (listed equity; unlisted equity; other equity)	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 3# Use breakdown into listed, unlisted and other equity as defined in row 16 (listed), row 17 (unlisted) and row 18 (other equity). C0100 (market asset value) EC0172 (counterparty sector according to ESA 2010) C0210 (issuer country) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#.
20	Equity – broken down by geographical location (per country for main counterparties outside the EU) and by type of equity (total; listed equity; unlisted equity; other equity)	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 3# Use breakdown into listed, unlisted and other equity as defined in row 16 (listed), row 17 (unlisted) and row 18 (other equity). C0100 (market asset value) C0210 (issuer country) Check EC0232 (instrument classification according to ESA 2010) for CIC 1#, CIC 2#, CIC 3#, CIC 5# and CIC 6#.

Equity – Financial transactions

Under ESA 2010 (para. 5.155 et seq.), transactions in equity are specified as follows: "New shares are recorded at issue value, which is nominal value plus the issue premium. Transactions in shares in circulation are recorded at their transaction value. When the transaction value is not known, it is approximated by the stock exchange quotation or market price for listed shares and by the market-equivalent value for unlisted shares."

The market asset value (C0100) of equities is calculated by multiplying C0060 (quantity) by C0370 (unit price).

Table 9

Equity transactions: templates and derivation

	Relevant templates and cells	**Derivation for ESCB purposes**
21	Template used: PFE.06.02 C0060 (quantity) C0370 (unit price)	For each breakdown by counterparty country (issuer country (C0210)), each split into listed, unlisted and other equity, and for each breakdown by ESA sector (counterparty sector according to ESA 2010 (EC0172)), calculate transactions on the basis of average market prices (calculated in accordance with current guidance on insurance corporation statistics): $$F_t = (Q_t - Q_{t-1})\left(\frac{P_{t-1} + P_t}{2}\right) - R_t$$ where: F_t = financial transactions Q_t = number of assets [C0060 (quantity)] P_t = unit price (C0370) R_t = reclassifications

Treatment of bonus shares and stock splits

Bonus shares (also referred to as "stock dividends" or "scrip issues") and stock splits involve companies increasing the number of shares in existence by either further subdividing existing stocks (stock splits) or distributing more shares as dividends. In other words, shares are restructured and shareholders are offered a number of new shares for each share previously held. For example, a two-for-one scrip issue (i.e. two new shares in addition to one old share) is equivalent to a three-for-one stock split. By contrast with a situation where new shares are issued in return for additional funds, no new resources are provided in these instances. Furthermore, these situations do not involve active portfolio decisions, given that the shareholder does not have the option of receiving cash. Thus, stock splits and the issuance of bonus shares do not represent transactions.

Bonus shares and stock splits both increase the number of shares, and both reduce the value per share, all other things being equal. The distinction between the two is a technical one: a bonus share is shown in the accounts of the company as a transfer from retained earnings to equity capital, whereas a stock split is shown as a reduction in the par value of each share.

The CSDB contains two attributes that can be used to derive accurate data on transactions in the event of a stock split, namely the "last split date" and the "last split

factor". The last split date is used to determine whether a stock split occurred during the reporting period. And then, if a stock split did occur, the last split factor is used to adjust the number of shares and the price of period t1 holdings in the basic formula above in order to calculate transactions. The amended formula for the calculation of transactions taking into account stock splits is:

$$F_t = (Q_t * SF - Q_{t-1}) * \frac{\left(P_{t-1} + \frac{P_t}{SF}\right)}{2} \tag{3}$$

where:

F_t = financial transactions

Q_t = number of assets [C0060 (quantity)]

P_t = unit price (C0370)

SF = last split factor from the CSDB or the template [EC0300 (split factor)]

2.3.1.5   Investment fund shares/units

Fair values are collected for investment fund shares.

Investment fund shares/units – Stocks

Table 10

Stocks of investment fund shares/units: breakdown requirements, templates and derivation

	ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
22	Investment fund shares Broken down by geographical location of counterparties (domestic; euro area countries other than domestic (total and per country); rest of world (total and per main counterparty outside the EU); non-participating EU Member States (per country))	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 4# C0100 (market asset value) EC0211 (country of residence of collective investment undertakings)	Where ISIN codes are available, derive geographical breakdown from the CSDB. Where ISIN codes are not available, information on geographical breakdown to be derived from PFE.06.02 by adding together market asset values for CIC 4#, grouped by country of residence of collective investment undertakings.
23	Investment fund shares, of which MMF shares Broken down by geographical location of counterparties (domestic; euro area countries other than domestic (total); rest of world (total))	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 43 C0100 (market asset value) EC0211 (country of residence of collective investment undertakings)	Where ISIN codes are available, derive geographical breakdown from the CSDB. Where ISIN codes are not available, information on geographical breakdown to be derived from PFE.06.02 by adding together market asset values for CIC 43, grouped by country of residence of collective investment undertakings.

	ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
24	Investment fund shares, of which non-MMF shares Broken down by geographical location of counterparties (domestic; euro area countries other than domestic (total); rest of world (total))	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 41, CIC 42, CIC 44, CIC 45, CIC 46, CIC 47, CIC 48, CIC 49 (i.e. CIC 4# excluding CIC 43) C0100 (market asset value) EC0211 (country of residence of collective investment undertakings)	Where ISIN codes are available, derive geographical breakdown from the CSDB. Where ISIN codes are not available, information on geographical breakdown to be derived from PFE.06.02 by adding together market asset values for CIC 4# other than CIC 43, grouped by country of residence of collective investment undertakings.
25	Investment fund shares, of which equity funds, bond funds, mixed funds, real estate funds, hedge funds and other funds – total and broken down by geographical location of counterparties (domestic; euro area countries other than domestic (total); rest of world (total))	Template used: PFE.06.02 C0010 (asset ID code and type of code) C0230 (CIC): CIC 41, CIC 42, CIC 44, CIC 45, CIC 46, CIC 47, CIC 48, CIC 49 (i.e. CIC 4# excluding CIC 43) C0100 (market asset value) EC0211 (country of residence of collective investment undertakings)	Where ISIN codes are available, derive breakdown by type of fund (for CIC 4# other than CIC 43) from the CSDB on the basis of CSDB attribute "fund asset structure type". Where ISIN codes are not available, information on the breakdown by type of fund may be derived by (i) grossing up the information derived from investment fund shares with ISIN codes and/or (ii) using the information available via the Solvency II templates. In the case of option (ii), the following mapping could potentially be used to derive proxies: CIC 41 (equity funds) → equity funds CIC 42 (debt funds) → bond funds CIC 44 (asset allocation funds) → mixed funds CIC 45 (real estate funds) → real estate funds CIC 46 (alternative funds) → equity funds* CIC 47 (private equity funds) → equity funds/other funds** CIC 48 (infrastructure funds) → other funds CIC 49 (other) → other funds Note: Given that it is expected that the majority of investment fund shares/units will be included in the CSDB, approach (i) should be sufficient. (*) Alternative funds can sometimes be regarded as being equity funds rather than hedge funds. (**) In the context of investment fund statistics, it has agreed that private equity funds should be allocated to subsectors on the basis of their primary form of investment. Currently, NCBs mainly classify private equity funds as "other funds" (especially if they invest in unlisted companies by granting loans or participations), or as "equity funds" if they primarily invest in equity. One option here could be to follow the national approach in the case of private equity funds resident in euro area/EU countries. (RIAD can provide information on the classification of these funds.) This information is not, however, available for non-EU countries.

Investment fund shares/units – Financial transactions

Financial transactions for investment funds are calculated in the same way as financial transactions for equity.

Table 11

Investment fund share/unit transactions: templates and derivation

	Relevant templates and cells	Derivation for ESCB purposes
26	Template used: PFE.06.02 C0060 (quantity) C0370 (unit price)	For each breakdown by counterparty country (issuer country (C0210)), and for MMF shares/units, non-MMF shares/units, bond funds, equity funds, mixed funds, real estate funds, hedge funds and other funds, calculate transactions using average market prices (calculated in accordance with current guidance on insurance corporation statistics): $$F_t = (Q_t - Q_{t-1})\left(\frac{P_{t-1} + P_t}{2}\right) - R_t$$ where: F_t = financial transactions Q_t = number of assets [C0060 (quantity)] P_t = unit price (C0370) R_t = reclassifications

Please also bear in mind the information on bonus shares and stock splits in Section Equity – Financial transactions.

2.3.1.6   Pension fund reserves – Stocks and financial transactions

According to the Regulation, this category includes PFs' claims on pension managers (F.64) as defined in ESA 2010, paras. 5.186 and 17.78, and PFs' financial claims against reinsurance corporations connected with pension reserves (reinsurance recoverables) (F.61). Reinsurance recoverables, despite being defined as financial claims only against reinsurance corporations, should include reinsurance business done by other insurance corporations as well. In addition, "insurance contracts/policies" should be recorded under "pension fund reserves" (EP.02.01 – ER0250; EC0010) but do not fall under the subcategory "claims of pension funds on pension managers" (EP.02.01 – ER0260; EC0010) or the subcategory "reinsurance recoverables" (EP.02.01 – ER0270; EC0010). "Insurance contracts/policies" are unit-linked policies/contracts that invest in assets at the request of pension fund trustees, with assets ultimately owned by the insurance company. Total reinsurance recoverables (ER0270) and total claims of pension funds on pension managers (ER0260) are available on a quarterly basis from EP.02.01.30, including all breakdowns needed.

Table 12

Stocks and transactions for pension fund reserves: breakdown requirements, templates and derivation

	ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
27	Pension fund reserves and related claims Broken down by geographical location of counterparties	Template used: EP.02.01.30 ER0250 (pension fund reserves) ER0260 (claims of pension funds on pension managers) ER0270 (reinsurance recoverables)	One-to-one mapping The Z axis defines the type of data: Stocks: X6000 Reclassification adjustments: X130 Revaluation adjustments (including exchange rate adjustments): X6002 Financial transactions: X6003

2.3.1.7   Financial derivatives

Financial derivatives – Stocks

Table 13

Financial derivative stocks: breakdown requirements, templates and derivation

	ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
28	Financial derivatives – total	Template used: PFE.02.01 R0190/C0040 (derivatives) or alternatively, if reported: PF.08.01 C0240 (market value)	Take total derivatives from balance sheet template PFE.02.01 Or alternatively PF.08.01: Add all market values which are positive, i.e. sum(PF.08.01.C0240/R…) if PF.08.01.C0240/R…>0

EIOPA in its taxonomy update 2.5.0 allows for reporting of financial derivatives in template PF.08.01. The use however is not mandatory and up to the discretion of the NCAs.

Financial derivatives – Financial transactions

The ECB is currently working on the calculation of financial transactions for statistical purposes. The insights will feed into this mapping document. In the meantime, it is proposed that financial transactions for derivatives be calculated as the change in stocks, adjusted for known reclassifications: $F_t = (S_t - S_{t-1}) - R_t$

2.3.1.8   Other accounts receivable/payable

Other accounts receivable/payable, despite being defined as "financial assets and liabilities created as counterparts to transactions where there is a timing difference between these transactions and the corresponding payments" as per ESA 2010, paras. 5.230, will actually be used as remaining assets. Differences between assets and liabilities will be included there. The Regulation states that accrued interest receivable on deposits, loans and debt securities should not be included there and should instead be mapped to the relevant instrument.

Other accounts receivable/payable – Stocks

Table 14

Stocks for other accounts receivable/payable: breakdown requirements, templates and derivation

	Description of ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
29	Total	Templates used: PFE.02.01; PFE.06.02 PFE.02.01 – R0270/C0040 (total assets) PFE.06.02 – C0090 (accrued interest)	Total assets minus all other derived assets (currency and deposits, debt securities, loans, equity, investment fund shares, pension fund reserves, financial derivatives and non-financial assets) Compensating item if total assets are greater than total liabilities Accrued interest (identified via template PFE.06.02) can be deducted from this figure.

Other accounts receivable/payable – Financial transactions

Financial transactions are calculated as the change in stocks, adjusted for reclassifications.

2.3.1.9   Non-financial assets

Non-financial assets – Stocks

Table 15

Stocks of non-financial assets: breakdown requirements, templates and derivation

	Description of ESCB requirement	Relevant templates and cells	Derivation for ESCB purposes
30	Total	Template used: PFE.06.02 C0230 (CIC): CIC 9# C0100 (market asset value)	For all lines where CIC is 9#, add market asset values together. (Please note that PFE.02.01 R0020/C0040 excludes properties for own use.)

Non-financial assets – Financial transactions

Table 16

Non-financial asset transactions: templates and derivation

	Relevant templates and cells	Derivation for ESCB purposes
31	Template used: PFE.06.02 C0230 (CIC): CIC 9# C0100 (market asset value)	Financial transactions are calculated using the following formula: $$F_t = (S_t - S_{t-1}) - V_t - R_t \qquad (4)$$ where V_t is the value derived when, for the same holdings of non-financial assets, a difference is observed between the market asset values at t-1 and t. Thus, for existing non-financial assets that existed at t-1, $V_t = S_t - S_{t-1}$ For new holdings of non-financial assets, the difference between t-1 and t is treated as a transaction: $$F_t = S_t - S_{t-1}$$ where: F_t = financial transactions S_t = stocks R_t = reclassifications

2.3.2   Calculation of reclassifications

Reclassifications for the assets side are reported only at the level of template PFE.02.01, which results in two types of limitation: (i) amounts cannot be allocated to required breakdowns as required by the ECB, and (ii) reclassifications within a financial instrument cannot be seen there.

While for limitation 1, an additional template would be needed to calculate reclassifications, limitation 2 could be overcome using PFE.06.02:

NCBs can calculate this information (i.e. information on limitation 2) themselves by comparing changes in the relevant variables between two quarters. The relevant variables for the purpose of compiling reclassification adjustments seem to be "asset ID code", "issuer sector according to ESA 2010", "issuer country", "country of residence for collective investment undertakings", "CIC", "instrument classification according to ESA 2010", "holdings in related undertakings, including participations", "unit price", "unit percentage of par amount price", "market asset value", "issue date" and "maturity date". In addition, reference information for securities with ISIN codes is extracted from the CSDB instead of being reported by the reporting agent. Reclassification adjustments for these assets can only be derived by the NCB.

In insurance corporation statistics, some NCBs deal with limitations 1 and/or 2 by requesting additional information outside of the XBRL taxonomy.

2.4   Mapping of annual requirements

Annual data are reported on (i) liabilities (ii) members of PFs (by not derogated reporters) (iii) assets as specified in Article 4(1)(a) and (iv) assets as specified in

Article 7(1)(d). For all data on (i), (ii) and (iii) entry point 30 templates should be used, while for data on (iv) entry point 32 should be used.

2.4.1 Liabilities

Article 5 of the Regulation requires PFs to provide liabilities side data on PFs' end-of-year stocks, revaluation adjustments and financial transactions on an annual basis. While many overlaps in the collection on assets exist between supervisory and statistical reporting, supervisory data on liabilities does not suffice to satisfy statistical needs. This prompted the ECB to introduce pure ECB add-on templates. Thus, the ECB collects the annual data needed for liabilities using pure ECB templates (EP.03.01 and EP.04.01), which gather information on stocks (EZ0010=x6000), reclassifications (EZ0010=x130), financial transactions (EZ0010=x6003) and revaluation adjustments (EZ0010=x6002). The stock data that are collected for ECB purposes need to be compatible with the few data points that are collected for EIOPA purposes (see Section 2.4.1.1 for details).

2.4.1.1 Links between ECB add-on template EP.03.01 and EIOPA template PFE.02.01

The data points on liabilities that are collected for supervisory purposes are compared with statistical data using validation checks PEV50, 51, 52, 53 and 54, which compare PFE.02.01 with EP.03.01.

The table below provides an overview of the statistical concepts in EP.03.01 that can be found in EIOPA/ECB template PFE.02.01:

Table 17

Liabilities data: ECB and EIOPA template references (ECB groupings)

ECB template EP.03.01	EIOPA/ECB template PFE.02.01
Loans received (EP.03.01 – ER0020/EC0010)	Any other liabilities not elsewhere shown (PFE.02.01 – R0310/C0040)
Debt securities issued (EP.03.01 – ER0060/EC0010)	Any other liabilities not elsewhere shown (PFE.02.01 – R0310/C0040)
Equity (EP.03.01 – ER0070/EC0010)	Excess of assets over liabilities (PFE.02.01 – ER0321/C0040)
Technical reserves (EP.03.01 – ER0080/EC0010)	Technical provisions (PFE.02.01 – R0280/C0040) Margin for adverse deviation (PFE.02.01 – R0290/C0040) Any other liabilities not elsewhere shown (PFE.02.01 – R0310/C0040)
Financial derivatives (EP.03.01 – ER0140/EC0010)	Any other liabilities not elsewhere shown (PFE.02.01 – R0310/C0040)
Other accounts receivable/payable (EP.03.01 – ER0150/EC0010)	Any other liabilities not elsewhere shown (PFE.02.01 – R0310/C0040) Reinsurance payables (PFE.02.01 – R0300/C0040)
Net worth (EP.03.01 – ER0160/EC0010)	Excess of assets over liabilities (PFE.02.01 – ER0321/C0040)

At the same time, the following mapping also applies in the opposite direction:

Table 18

Liabilities data: ECB and EIOPA template references (EIOPA groupings)

EIOPA/ECB template PFE.02.01	ECB template EP.03.01
Technical provisions (PFE.02.01 – R0280/C0040)	Technical reserves (EP.03.01 – ER0080/EC0010)
Margin for adverse deviation (PFE.02.01 – R0290/C0040)	Technical reserves (EP.03.01 – ER0080/EC0010)
Reinsurance payables (PFE.02.01 – R0300/C0040)	Other accounts receivable/payable (EP.03.01 – ER0150/EC0010)
Any other liabilities not elsewhere shown (PFE.02.01 – R0310/C0040)	Loans received (EP.03.01 – ER0020/EC0010) Debt securities issued (EP.03.01 – ER0060/EC0010) Financial derivatives (EP.03.01 – ER0140/EC0010) Other accounts receivable/payable (EP.03.01 – ER0150/EC0010) Technical reserves (EP.03.01 – ER0080/EC0010)
Excess of assets over liabilities (PFE.02.01 – ER0321/C0040)	Equity (EP.03.01 – ER0070/EC0010) Net worth (EP.03.01 – ER0160/EC0010)

The ECB items "loans received" (EP.03.01 – ER0020/EC0010), "debt securities issued" (EP.03.01 – ER0060/EC0010), "financial derivatives" (EP.03.01 – ER0140/EC0010) and "other accounts receivable/payable" (EP.03.01 – ER0150/EC0010) are part of the EIOPA items "any other liabilities not elsewhere shown" (PFE.02.01 – R0310/C0040) and "reinsurance payables" (PFE.02.01 – R0300/C0040)[12].

Therefore, EIOPA's "any other liabilities not elsewhere shown" (PFE.02.01 – R0310/C0040) + "reinsurance payables" (PFE.02.01 – R0300/C0040) ≥ the sum of ECB items "loans received" (EP.03.01 – ER0020/EC0010), "debt securities issued" (EP.03.01 – ER0060/EC0010), "claims of pension funds on pension managers" (EP.03.01 – ER0120/EC0010), "entitlements to non-pension benefits" (EP.03.01 – ER0130/EC0010), "financial derivatives" (EP.03.01 – ER0140/EC0010) and "other accounts receivable/payable" (EP.03.01 – ER0150/EC0010).

Remaining parts of EIOPA's "any other liabilities not elsewhere shown" (PFE.02.01 – R0310) are expected to be part of the ECB's "technical reserves" (EP.03.01 – ER0080/EC0010).

Thus, EIOPA's "technical provisions" (PFE.02.01 – R0280/C0040) + "margin for adverse deviation" (PFE.02.01 – R0290/C0040) + parts of "any other liabilities not elsewhere shown" (PFE.02.01 – R0310/C0040) are expected to be equal to the ECB's "technical reserves" (EP.03.01 – ER0080/EC0010).

Those parts of "any other liabilities not elsewhere shown" in PFE.02.01 include the equivalents of "claims of pension funds on pension managers" (EP.03.01 – ER0120/EC0010), "entitlements to non-pension benefits" (EP.03.01 – ER0130/EC0010) and other parts of "technical reserves".

EIOPA's "total liabilities" do not match "total assets". "Excess of assets over liabilities" (PFE.02.01 – ER0321/C0040) was added to PFE.02.01 for ECB purposes. "Total assets" (PFE.02.01 – R0270/C0040) = "total liabilities" (PFE.02.01 – R0320/C0040) + "excess of assets over liabilities" (PFE.02.01 – ER0321/C0040). This relationship is checked by validation check PEV36.

"Excess of assets over liabilities" is expected to include "equity" (EP.03.01 – ER0070/EC0010) and "net worth" (EP.03.01 – ER0160/EC0010). This relationship is checked by validation check PEV54.

2.4.1.2 Links between ECB add-on template EP.03.01 and EIOPA template PF.29.05 on defined contribution pension entitlements

"Pension entitlements" (EP.03.01 – ER0090) may be defined contribution (DC) pension entitlements (PEs) (EP.03.01 – ER0100) or defined benefit (DB) PEs (EP.03.01 – ER0110).

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[12] Check PEV52 (currently deactivated) will be as follows in taxonomy update 2.5.0: {PFE.02.01, r0310,c0040} + {PFE.02.01, r0300,c0040} ≥ {EP.03.01, er0020,ec0010} + {EP.03.01, er0060,ec0010} + sum({EP.03.01, (er0120-0150),ec0010}).

While details about DC schemes are described in Section 3.1.1, DB schemes will be described in this section so that links between supervisory template PF.29.05 and ECB add-on template EP.03.01 can be provided.

Para. 17.57 of ESA 2010 states:

"A defined benefit scheme 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."

For DB PEs, the endowment to be paid out to beneficiaries is thus independent of the performance of the underlying assets, and technical reserves are not revalued on the basis of the market value of assets, but they may be affected by changes to actuarial/modelling assumptions. In order to form a better understanding of what should be reported as a transaction in EP.03.01, reported data in PF.29.05 can be attempted to be categorised into statistical concepts "transaction" and "revaluation adjustments". While more additional work needs to be done in this context, a first attempt may result in the following guidance.

Transactions may be approximated by changes in stocks, net of changes to actuarial/modelling assumptions (e.g. non-transactional effects, where applicable). For PEs, important non-transactional effects (which need to be identified and treated as an adjustment) stem from:

- changes to actuarial/modelling assumptions;

- changes in the assumed discount rate;

- changes to wage and price assumptions;

- changes to demographic assumptions (e.g. mortality tables).

Some of this information is available in EIOPA's IORP templates (e.g. template PF.29.05.24), but it is reported on an annual basis and is dependent on national specificities:

Table 19

Treatment of items in EIOPA IORP template PF.29.05.24 as transaction or non-transaction

	Item	Description	Expert Group assessment –Estimates involved
C0010-C0040/R0010	Opening technical provisions	Value of technical provisions in the opening balance sheet of the reporting period	Outstanding amount at the beginning of the period: (S_{t-1})
C0010-C0040/R0020	Past service cost	Accrual of obligations during the reporting period	Transactions (T_t)
C0010-C0040/R0030	Change in discount rate	Effect of unwinding[13] of the discount rate and any change in the discount rate used	Unwinding: Transactions (T_t) Change in the discount rate: Non-transactions (V_t)
C0010-C0040/R0040	Experience adjustments	Changes in assumptions based on experience	Change in wage/inflation assumptions: Non-transactions (V_t) Change demographic assumptions: Non-transactions (C_t)
C0010-C0040/R0050	Other changes	Other changes not mentioned elsewhere	Non-transactions (C_t)
C0010-C0040/R0060	Closing technical provisions	Value of technical provisions at the end of the reporting period	Outstanding amount at the end of the period (S_t)
C0010-C0020/R0070	Discount rate	Discount rate used for the valuation of technical provisions at the end of the reporting period	Background information: discount rate used
C0010-C0020/R0080	Range of discount rates	If more than one discount rate is used, range of discount rates used for the valuation of technical provisions at the end of the reporting period	Background information: range of discount rates used

With that in mind, it is suggested that transactions for annual DB schemes may be approximated by changes in stocks net of changes to actuarial/modelling assumptions:

$$T_t = (S_t - S_{t-1}) - V_t - C_t - E_t \tag{5}$$

2.4.1.3   Estimation of quarterly liabilities

While PF report data on the liabilities side on an annual basis only, NCBs are requested to provide this data on a quarterly basis. The ECB and NCBs have, as a

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[13]   ESA 2010, para. 17.66: "There are four sources of change in pension entitlements in a defined benefit pension scheme. The first of these, the current service increase, is the increase in entitlement associated with the wages and salaries earned in the current period. The second source, the past service increase, is the increase in the value of the entitlement due to the fact that for all participants in the scheme, retirement (and death) are one year nearer. The third change in the level of entitlement is a decrease due to the payment of benefits to retirees of the scheme. The fourth source of change comes from other factors, factors that are reflected in the other changes in assets account."
ESA 2010, para. 17.68: "At the end of an accounting period, the level of the pension entitlements due to past and present employees can be calculated by estimating the present value of the amounts due to be paid in retirement using actuarial calculations. One element in the increase of this amount year by year is the fact that the present value of the entitlements existing at the beginning of the year, and still due at the end of the year, has increased because the future is one year nearer and so a discount factor less must be used to calculate the present value. It is this unwinding of the discount that accounts for the past service increase in entitlements."

result, worked on estimation procedures to derive these missing data. These procedures are described in Section 3.

2.4.2   Member data

Member data are reported both for EIOPA purposes and for ECB purposes. While EIOPA also collects data on beneficiaries, for the ECB total members are calculated as follows:

"Members" (PFE.50.01.30 – ER0001/C0040) = "active members" (PFE.50.01.30 – R0010/C0040) + "deferred members" (PFE.50.01.30 – R0020/C0040) + "retired members" (PFE.50.01.30 – ER0031/C0040)

Alternatively, if the ECB add-on "retired members" (PFE.50.01.30 – ER0031/C0040) is not reported for derogated pension funds, the approximate number of members can, as a second-best solution, be calculated as the sum of "active members" (PFE.50.01.30 – R0010/C0040), "deferred members" (PFE.50.01.30 – R0020/C0040) and "beneficiaries" (PFE.50.01.30 – R0030/C0040).

Members of a pension scheme are the people covered by the services provided by that scheme. It is important that members are not counted twice, so that figure should relate to the number of people, rather than the number of contracts.

Where members fall into more than one category, so have more than one pension contract in different categories, the members should be assigned to the category that represents the best fit.

2.4.3   Derogated reporters (annual reporters)

The Regulation takes account of the principle of proportionality and seeks to streamline reporting requirements, especially for smaller PFs. In particular, NCBs may grant derogations to small PFs in accordance with Article 7(1), which requires NCBs to gross up their quarterly PF data to achieve 100% coverage. For those PFs that are exempted, data can be collected in accordance with Article 7(1)(a) to (d) of the Regulation.

Exempted PFs report data either as specified in Article 4(1)(a) or as specified in Article 7(1)(d). The former must report, on an annual basis, data on stocks, revaluation adjustments and financial transactions for assets. Annual data on PFs' assets can be mapped in the same manner as the quarterly data. For more details on this mapping, see Section Error! Reference source not found..

The latter, exempted pension funds that are subject to Article 7(1)(d), must report, on an annual basis, data on total assets broken down into debt securities, equity, investment fund shares/units and other accounts receivable/payable. PFE.02.01.32, which collects information for all of the necessary breakdowns on an annual basis, can be used for this purpose.

3   Estimation of quarterly liabilities

With a view to minimising the reporting burden on PFs, as indicated in Article 4(2) of the Regulation, where data are not reported directly on a quarterly basis, NCBs need to derive quarterly estimates of the liabilities of PFs on the basis of the annual data provided. In order to derive their first quarterly estimates of the liabilities of PFs, which relate to 2019, NCBs may use annual data on liabilities for 2018, which (if they do not hold such data themselves) in most cases is available from the relevant NCA. The reporting of annual data on liabilities and the number of pension scheme members within the IORPs framework will only begin for reporting period 2019. Reporting agents are required to transmit the required annual data, in accordance with country-specific arrangements, to the relevant NCB/NCA no later than 20 weeks after the end of the year to which the data relate. EIOPA has granted an 8 weeks delay for the transmission of annual data to NCAs. The annual data can therefore be used for the first time in order to derive 2020 Q2 data. At that time, the annual data can be used to derive quarterly estimates for the historical data as of 2019 Q3, and to derive quarterly data until the next annual data are received.

Until the first annual data become available, alternative national solutions must be used to derive best estimates for the quarterly data.

NCBs are required to send the ECB quarterly estimates of the liabilities of PFs derived from annual data on end-of-year stocks, revaluation adjustments or financial transactions, as applicable. As regards the revision of data, during the regular annual production period (i.e., for a given reference year, from the specified deadline to the day the data are disseminated back to the NCBs), NCBs may revise data covering the previous reference year.

As part of the phasing-in period, this deadline will be brought forward by two weeks per year thereafter and will be 14 weeks from 2022 onwards.

Section 3.1 looks at a methodological framework governing this derivation process while Section 3.2 will provide a qualitative assessment of the proposed derivation process.

3.1 Estimates of PFs' quarterly liabilities

End-of-year stocks

The Regulation states that if quarterly data on PFs' liabilities are not reported, NCBs must derive estimates of PFs' quarterly liabilities on the basis of other data provided by reporting agents.[14]

The estimation techniques and methodologies that are adopted by NCBs in this regard should be guided by the ECB, which is one of the main objectives of this guide. As a starting point for this analysis, the main instruments should be defined and measured, in order to ensure that the most appropriate techniques are used for each item. In this context, a schematic representation of PFs' balance sheet liabilities is shown in Table 20 below.

Table 20

Balance sheet liabilities of euro area PFs

PFs' liabilities	% of total balance sheet (Q4 2018)
Other items	
Loans received	2%
Debt securities issued	0%
Equity (and net worth*)	7%
Financial derivatives	2%
Other accounts receivable/payable	1%
Pension entitlements	
DC	11%
DB (and hybrid schemes)	77%

Note: *Net worth is calculated as zero or as a balancing entry for DB. Equity is normally calculated as zero.

The main item to be estimated on the liabilities side is pension entitlements (PEs). At the end of 2018, these accounted for 88% of the total liabilities of PFs in the euro area.[15] These are made up of DB liabilities[16] (77% of PFs' total liabilities) and DC liabilities (11% of PFs' total liabilities).

Para. 7.84 of ESA 2010 states:

"In a defined contribution scheme the benefits paid are dependent on the performance of the assets acquired by the pension scheme. The liability of a defined contribution scheme is the current market value of the funds' assets."

Thus, for DC plans (11% of PFs' total liabilities), total PEs should match the market value of total assets, which is to be reported on a quarterly basis.

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[14] Article 4.2 reads: "NCBs shall derive quarterly estimates for liabilities of PFs based on data provided on an annual basis by the reporting agents pursuant to Article 4(1)(b)."

[15] Source: ECB short-term approach for PFs.

[16] Notional DC schemes (DC schemes with guarantees and hybrid schemes) are grouped together with DB schemes (ESA 2010, para. 17.59).

In the case of DB PEs (77% of PFs' total liabilities), the endowment to be paid out to beneficiaries is independent of the performance of the underlying assets and the technical reserves are not revalued.

Para. 7.83 of ESA 2010 states:

"In a defined benefit pension scheme the level of pension benefits promised to participating employees is determined by a formula agreed in advance. The liability of a defined benefit pension scheme is equal to the present value of the promised benefits."

The other items in the balance sheet are equity[17] and net worth (7%), financial derivatives (2%), loans received (2%), remaining liabilities (1%) and debt securities (0%). For equity, financial derivatives, loans, remaining liabilities and debt securities, estimating them on a quarterly basis as a stable share of total liabilities can provide a good approximation. Alternatively, repetition of the latest available annual data can also provide a good approximation.

Since the liabilities of a DC plan are equal to the current market value of its assets (minus other liabilities), it cannot be overfunded or underfunded. Consequently, net worth will always be zero in DC plans. However, a DB plan can be over- or underfunded because the liabilities in terms of PEs are determined by a formula agreed in advance and are not related to the underlying assets. In some cases, employers have a legal responsibility to make up any shortfalls or recover any surpluses. This leads to a liability or an asset being recorded vis-à-vis the employer in the PF's balance sheet in the item "claims of pension funds on pension managers" (item F.64 in ESA 2010). If the employer/sponsor has no legal responsibility for making up a shortfall or recovering a surplus, a non-zero figure will be recorded for net worth, or additional PEs or specified items (e.g. equity held by the PF's owners) will be recorded. Details of the recommended course of action in each instance can be found in Table 21 below:

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17   Normally, equity in pension funds is reported as zero.

Table 21

Recording of net worth where employers/sponsors have no legal responsibility for making up shortfalls or recovering surpluses

Employer/sponsor's responsibility	Shortfall/surplus	PF overfunded	PF underfunded
Employer has legal responsibility for making up a shortfall or recovering a surplus		Liability recorded vis-à-vis the employer in "claims of pension funds on pension managers" (F.64)	Asset recorded vis-à-vis the employer in "claims of pension funds on pension managers" (F.64)
Employer only has legal responsibility for making up a shortfall	Shortfall/surplus of funding specified	Recording of additional PEs or specified items (e.g. equity held by PF's owners)	Asset recorded vis-à-vis the employer in "claims of pension funds on pension managers" (F.64)
	Shortfall/surplus of funding not specified	**Positive net worth**	
Employer has no legal responsibility for making up a shortfall or recovering a surplus	Shortfall/surplus of funding specified	Recording of additional PEs or specified items (e.g. equity held by PF's owners)	**Negative net worth**
	Shortfall/surplus of funding not specified	**Positive net worth**	

Revaluation adjustments and financial transactions

Under the Regulation, NCBs should not only report outstanding amounts to the ECB; they should also report separate data on **revaluation adjustments (covering both price and exchange rate changes) and reclassification adjustments**, in accordance with ECB Guideline ECB/2019/18[18]. **Financial transactions**, including adjustments, should be derived in accordance with ESA 2010. According to ESA 2010, a transaction is "an economic flow that is an interaction between institutional units by mutual agreement". Thus, transactions measure economic activity, as opposed to other factors, which include:

- valuation effects arising from changes in prices/interest rates or exchange rates;

- write-offs and write-downs of loans;

- reclassifications.

The general formula for transactions is:

$$T_t = (S_t - S_{t-1}) - V_t - C_t - E_t \qquad (5)$$

where:

- T_t = transactions

- S_t = outstanding amounts

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[18] Guideline ECB/2019/18 of 7 June 2019 amending Guideline ECB/2014/15 on monetary and financial statistics.

- V_t = revaluation adjustments (e.g. changes in discount rates, prices or wages), loan write-offs/write-downs,[19] etc.[20]

- C_t = reclassifications and other changes (e.g. changes to mortality tables[21])

- E_t = changes in exchange rates affecting assets and liabilities denominated in foreign currencies

- t = end of the period

- t-1 = end of the previous period

Transactions should allow the correct derivation of growth rates used for economic analysis. To avoid having to collect such complex data, it is possible to estimate transactions by simply calculating the differences between successive outstanding amounts in balance sheets. In some cases, this may provide researchers with high-quality results; however, in other cases this will produce misleading data on flows. For instance, since securities are carried at market value, whether a flow is positive or negative will depend on developments in market prices. PFs' liabilities can be divided into two main groups, as indicated in Table 20:

1. Items other than pension entitlements

    A1. Loans received

    A2 Debt securities issued

    A3 Equity (and net worth)

    A4 Financial derivatives

    A5 Other accounts receivable/payable

2. Pension entitlements

    B1 Defined contribution (DC)

    B2 Defined benefit (DB[22])

Given the small weight of the other items (Group A) in the total balance sheet, quarterly transactions could be approximated as the first difference in quarterly stocks,

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[19] In monetary financial institution (MFI) statistics, loan write-offs are treated as "revaluation adjustments", whereas in ESA 2010 (para. 6.14) and in the international investment position they are regarded as "changes in volume" (Part 1, Section 2 of Annex IV to Guideline ECB/2014/15). However, since write-offs (and write-downs) are the only revaluation item affecting the instrument category "loans", MFI balance sheet data can easily be converted to the ESA 2010 approach for inclusion in financial accounts or for comparison with the international investment position.

[20] ESA 2010, para. 6.61: "The liabilities to policy holders and beneficiaries change as a result of transactions, other volume changes and revaluations. Revaluations are due to changes of key model assumptions in the actuarial calculations. Those assumptions are the discount rate, the wage rate and the inflation rate."

[21] ESA 2010, para. 6.14(c): "changes of life insurance, annuity entitlements and pension entitlements due to changes in demographic assumptions"

[22] Notional DC schemes (DC schemes with guarantees and hybrid schemes) are grouped together with DB schemes (ESA 2010, para. 17.59).

adjusted for any known statistical factors which may be relevant for the period in question. For example, revaluations of assets which will lead to overfunding or underfunding of PFs can affect the derivation of financial transactions (for information on net worth, see the above references to net worth and claims of pension funds on pension managers (item F.64 in ESA 2010) and Table 19). Quarterly stocks on group A financial instruments (including net worth) can be derived by the procedures further described in Sections 3.1.2 and 3.1.3.

3.1.1 Transactions and revaluations, broken down into DC and DB schemes

This section presents various different methodologies for estimating Group B, which comprises liabilities for DC schemes (B1) and DB schemes (B2). It is important to note that a PF can operate both types of scheme. However, data for DC and DB schemes should be provided separately. This will allow compilers to make separate calculations for the two types of scheme. The two subsections below (B1 and B2) explain the different approaches for DC and DB schemes.

B1. Defined contribution schemes

In principle, stocks, transactions and revaluation adjustments for assets held for DC plans should be equivalent to those in DC PEs. Total technical provisions are provided on a quarterly basis in PFE.02.01, however no split into DC and DB is available. A split into DC and DB can be constructed through PFE.06.02 "list of assets". The list of assets, is reported on a quarterly basis where assets held in DC and DB schemes can be identified through C0030 "Portfolio/pension scheme type". Each asset held in a DC scheme is reported as "2 – DC scheme". By adding up all C0100 "Market Asset Value", the total outstanding amounts for DC PEs can be calculated. Summing up all transactions and revaluation adjustments derived through the mapping of quarterly requirements as described in 2.3 can account for total financial transactions and revaluation adjustments in DC PEs.

Alternatively, if the PFE.06.02 is not available or is deemed to be of insufficient quality especially in the initial reporting periods, transactions for DC PEs can be approximated by changes in quarterly stocks net of valuation changes (derived from the assets side) by means of two approaches:

1. Indirect approach: Quarterly transactions could be approximated as changes in stocks net of valuation changes (derived from the assets side) and reclassifications:

$$T_t = (S_t - S_{t-1}) - V_t - C_t - E_t \tag{5}$$

Valuation changes are derived by calculating the valuation change for each asset held by a DC scheme and adding them together:

$$V_t = (S_t - S_{t-1}) - C_t - E_t - T_t \tag{6}$$

Actuarial/modelling assumptions do not apply to derive valuation adjustments for DC schemes.

2. Direct approach: Transactions could be derived from EIOPA template PF.29.05.24,[23] but that is only available ex post on an annual basis.

Since the benefits paid out by a DC scheme are dependent on the current market value of the fund's assets, the fund cannot be underfunded or overfunded. Thus, net worth and claims on pension fund managers (F.64) will always be zero for DC schemes.

Relevant counterparty country and counterparty sector splits can be derived in a further step through interpolation (see Section 3.1.2) and extrapolation techniques (see Section 3.1.3).

B2. Defined benefit schemes

Outstanding amounts of PEs will be reported in template "liabilities for statistical purposes" (EP.03.01 – ER0110) to NCBs on an annual basis. However, quarterly data estimates still need to be undertaken and may be undertaking by means of interpolation (see Section 3.1.2) when annual data is available and by my means of extrapolation (see Section 3.1.3) where annual data are not yet available. In addition, quarterly stocks for DB and DC PEs may be also derived using data on contributions, benefit payments and the discount rate (see Section 3.1.4) and/or by mapping EIOPA's IORP requirements to the ECB's statistical requirements (see Section 3.1.5).

3.1.2   Estimation of quarterly data: interpolation

There are several interpolation methods that can help to address situations where not all of the variables described above are available on a quarterly basis. These types of technique involve what is known as temporal disaggregation (TD) – that is to say, the conversion of a low-frequency time series to a higher-frequency time series. In our case, we need to convert an annual series to a quarterly one. The estimated values are also restricted by means of a process known as benchmarking: when dealing with balance sheet stocks, we want estimates for the fourth quarter to be equal to the annual value, and when deriving transactions (for other flows), we want the sum of all quarterly values to be equal to the annual data point. In addition to the temporal constraints present in the benchmarking process, there may also be contemporaneous constraints for each reference date.

In the case of quarterly liabilities transactions, we can apply either a direct or an indirect approach:

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[23]   See EIOPA, "Technical instructions regarding reporting templates for Pension Funds".

1. Direct: Apply TD techniques to annual transactions for total liabilities, and then estimate each component.

2. Indirect: Estimate annual transactions for each individual component and then apply TD techniques to each of them. (The sum of quarterly transactions will be equal to the annual liabilities transactions.)

The European Statistical System (ESS) guidelines[24] in this regard are as follows:

1. For each level of disaggregation, choose the most appropriate strategy by comparing the performance of the direct approach (supplemented with reconciliation techniques) and the indirect approach.

2. Use either the direct approach (supplemented with reconciliation techniques) or the indirect approach, without any comparison of their relative performance, but using expert judgement.

In this context, it is important to note that TD methods are not only able to estimate stocks; they can also be used to estimate transactions. As quarterly transactions in pension entitlements are an important contributor to households' financial transactions in the system of national accounts, using available quarterly indicators for the TD process is strongly recommended.[25] For example, data on quarterly transactions in assets can be used as indicators in the estimation of quarterly transactions in liabilities or PEs, from which stocks can be derived. This approach is preferable if transactions in assets and liabilities are closely linked, as can generally be assumed in the case of DC schemes. However, in the case of DB schemes, too, asset transactions may improve the estimation of liabilities transactions, as asset transactions need to be financed by liabilities transactions, although the contemporaneous correlation is probably smaller. However, all of the caveats and precautionary measures that are described for stocks also apply to transactions.

One group of TD methods is non-parametric. These do not use any high-frequency indicators that could explain the annual values, but instead assume that the unknown trend is a smooth function of time, taking into account the aforementioned restrictions. The simplest of these methods is a standard linear interpolation, which assumes a linear trend connecting the two annual values. Other methods in this subset include that devised by Boot, Feibes and Lisman (1967)[26], which minimises the sum of squared first or second differences between successive disaggregated values, or cubic spines, third-order polynomials that pass through a set of control points (that is to say, annual values).

However, these methods do not add any economic intuition to the high-frequency movements in the data, as it becomes impossible to properly estimate seasonal and

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24 See European Statistical System (ESS) guidelines on temporal disaggregation, benchmarking and reconciliation – 2018 edition.

25 At its May 2019 meeting, the Working Group on Financial Accounts (WG FA) emphasised the need for good quarterly estimates of transactions in pension entitlements and welcomed the use of estimation methods for quarterly liabilities transactions that were based on available quarterly asset transactions.

26 Boot, J.C.G., Feibes, W. and Lisman, J.H., "Further Methods of Derivation of Quarterly Figures from Annual Data", *Applied Statistics*, Vol. 16, No 1, 1967, pp. 65-75.

cyclical movements. That is why most TD methods have at least one high-frequency indicator variable linked to the low-frequency one using a generalised least squares (GLS) framework. The vast majority of TD techniques are based on the work of Chow and Lin (1971)[27] (including models devised by authors such as Fernández (1981)[28] and Litterman (1983)[29]) with extra restrictions on the residuals. When choosing high-frequency indicators, the main points to bear in mind are as follows:

- High-frequency indicators should closely approximate the expected short-term movement of the target variable and show a good correlation with the original target variable when converted to the lower frequency.

- High-frequency indicators should be sufficiently regular, not too volatile and available non-seasonally adjusted and seasonally adjusted as required.

- Using all candidate variables in the TD process is not generally recommended, especially when static regression models are used (owing to the risk of collinearity).

The ESS guidelines[30] in this regard are as follows:

"Select the most appropriate set of indicators for the temporal disaggregation exercise using graphical and statistical methods and variable selection techniques if needed, limiting the presence of collinearity among the selected indicators and fixing the number of selected indicators using the principle of parsimony."

It is important to note, in the context of PFs' liabilities, that the time series available (especially annual time series) can be very short. This means that statistical tests can be more uncertain and one should take extra care when deciding on high-frequency indicators (especially when doing so on the basis of such tests).

The limited amount of data also has an impact on the number of high-frequency indicators that we can choose from, as we cannot estimate a large number of parameters. One possible solution would be to use dimensionality reduction techniques such as principal components analysis (PCA) or partial least squares (PLS). For example, one option in the case of PF liabilities would be to use PCA to summarise the interest rate term structure[31] in one or two factors[32] that can be included in the TD model where using the whole matrix in the TD model would not be feasible.

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[27] Chow, G.C. and Lin, A.-L., "Best Linear Unbiased Interpolation, Distribution, and Extrapolation of Time Series by Related Series", The Review of Economics and Statistics, Vol. 53, No 4, 1971, pp. 372-375.

[28] Fernández, R.B., "A methodological note on the estimation of time series", *The Review of Economics and Statistics*, Vol. 63, No 3, 1981, pp. 471-476.

[29] Litterman, R.B., "A random walk, Markov model for the distribution of time series", *Journal of Business & Economic Statistics*, Vol. 1, No 2, 1983, pp. 169-173.

[30] European Statistical System (ESS) guidelines on temporal disaggregation, benchmarking and reconciliation – 2018 edition.

[31] This approximation is only suitable for countries that use market interest rates to discount pension entitlements. See Section 3.4 for a description of the discount rates being used.

[32] It is important to be aware, though, that the relationship between the value of marked-to-market pension entitlements (using interest rates) and the interest rates themselves is non-linear, so using one or two factors will result in an approximation at best.

These methods have been tested against the quarterly PEs (total, DB and DC) of the Netherlands – the country that accounts for the largest percentage of euro area PFs' total assets. That country also has high-quality and high-frequency reporting of actual quarterly data, which allows it to act as a control group after the disaggregation techniques are applied. For full details of the results and the code (in R) used for this test exercise, see Section 3.5.

The **models** tested included, among others:

1. linear interpolation model (Model 1);

2. Chow-Lin model with total assets as indicator variable (Model 2);

3. Chow-Lin model with total assets and the term structure of the interest rate as indicator variables (Model 3).

As indicated above, owing to the availability of data, Model 3 included a factorised version of the term structure of the interest rate, reducing the full matrix to two factors through PCA.

Models 2 and 3 (especially the latter) proved to be clearly superior to linear interpolation via the mean squared error (MSE). This does not mean that the same specification will provide better results for all countries and time series, particularly given the interest rates used in the valuation process (see Section 3.5). It does show, however, that standard linear interpolation can be improved using temporal disaggregation techniques, and different approaches should be tested and studied using expert judgement.

3.1.3   Estimation of quarterly data: extrapolation

We can use extrapolation techniques to estimate quarters falling after the last available annual data point. And then, when the next annual data become available, we can revise those previous quarters by applying interpolation. However, the TD methods described above are better suited to TD than forecasting, with forecasts tending to become imprecise after one or two quarters. In that situation, it might be better to switch directly to forecasting methods such as the autoregressive integrated moving average (ARIMA) family[33], as referred to in Sections 3.6 to 3.8 of the ESS guidelines.[34]

The models discussed in the previous section were also tested for extrapolation purposes using Dutch data, this time comparing them with extrapolation using the growth rate of total assets in the four quarters following the last annual reporting. Again, Model 3 (as specified in Section 3.1.2) proved to be the best forecaster across different time samples. However, there is an important caveat here: if an inappropriate interest rate is used – one that is not directly related to the one used for the valuation

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[33]   Stram, D.O. and Wei, W.W., "Temporal aggregation in the ARIMA process", *Journal of Time Series Analysis*, Vol. 7, 1986, pp. 279-292, doi:10.1111/j.1467-9892.1986.tb00495.x.

[34]   European Statistical System (ESS) guidelines on temporal disaggregation, benchmarking and reconciliation – 2018 edition.

of liabilities – forecasts could actually turn out to be worse than the benchmark. The conclusion here is the same as in the interpolation exercise: expert judgement and attention to revisions are key when deciding on the specifications for models.

3.1.4 Estimation using data on contributions, benefit payments and the discount rate

In this section, we discuss several ways of estimating quarterly technical provisions for DB and DC schemes. These methods vary as regards the quarterly data that are required to calculate them and their assumptions regarding the quarter-to-quarter evolution of specific series.

For DB schemes, technical provisions are calculated annually using actuarial methods such as the projected unit credit (PUC) method or the traditional unit credit (TUC) method.

The PUC method takes expected future pay increases into account in the calculation of liabilities (defined as projected benefit obligations (PBOs) and normal service costs). PBOs reflect the amount that a PF needs at the present time to cover future pension liabilities. It assumes stability for the foreseeable future in the sense that plans will not terminate and is adjusted to reflect expected compensation in the years ahead.

The TUC method, on the other hand, does not take future salary increases into account in the calculation of liabilities. Unlike PBOs, accumulated benefit obligations (ABOs) reflect the present value of the accrued retirement benefits earned by employees using current compensation levels.

Three different methods can be used to derive quarterly technical provisions for DB plans:

1. method based on the change in technical provisions (Method 1);

2. method based on proportional variation in technical provisions (Method 2);

3. Fouret's method (Method 3).

These methods are based on cash flows and the following information available in the annual accounts:

- technical provisions from previous years;

- contributions;

- benefit payments;

- discount rate.

The first two methods are based on the same principle: the estimate of quarterly technical provisions for quarter n of year t is calculated as the sum of the technical provisions in Q_4 of the previous year $(TP_{t-1}Q_4)$ and $\frac{n}{4}$ of the past service cost

(PSC_{t-1}). The difference between the two methods lies mainly in the definition of the past service cost.

In **Method 1**, PSC_{t-1} is defined as the change in technical provisions in the previous year. The estimate of technical provisions at the end of quarter n of year t is calculated as:

$$E(TP_tQ_n) = TP_{t-1}Q_4 + \frac{n}{4} \times PSC_{t-1} \tag{7}$$

where

$$PSC_{t-1} = TP_{t-1} - TP_{t-2} \tag{8}$$

$n = Q_1, Q_2, Q_3 \text{ or } Q_4$

In **Method 2**, PSC_{t-1} is defined as the proportional variation in technical provisions in the previous year. The estimate of technical provisions at the end of quarter n of year t is calculated as:

$$E(TP_tQ_n) = TP_{t-1}Q_4 + \frac{n}{4} \times PSC_{t-1} \times TP_{t-1}Q_4 \tag{9}$$

where

$$PSC_{t-1} = \frac{TP_{t-1}}{TP_{t-2}} - 1 \tag{10}$$

Note that, for these two first methods, the **past service cost** can be calculated using extrapolation (as presented above), or using interpolation when the next annual data become available.

- Method 1:

$$PSC_{t-1} = TP_t - TP_{t-1} \tag{11}$$

- Method 2:

$$PSC_{t-1} = \frac{TP_t}{TP_{t-1}} - 1 \tag{12}$$

Technical provisions can change as a result of several different factors: past service costs, changes in the discount rate, experience adjustments and other changes. When technical provisions for the next year are extrapolated, one assumption is that there are no changes to actuarial or modelling assumptions during the period in question (see also Table 19 above). Consequently, the estimate for non-transactional effects is zero. This means that the past service cost of $t - 1$ used in the extrapolation should only apply to transactions.

Method 3 (referred to as "Fouret's method") is a recurrent method and also allows technical provisions to be estimated on the basis of data from the previous period. However, in this third method more information is needed to estimate quarterly technical provisions, namely data on contributions, benefit payments and the discount rate. This method can also be described as a "roll forward calculation".

If cash flows (contributions and benefits paid) are assumed to occur, on average, in the middle of the period[35] and do not take account of the mortality effect, technical provisions at the end of quarter n of year t can be estimated as:

$$E(TP_t Q_n) = TP_t Q_{n-1} \times (1+i)^{\frac{1}{4}} + (CB_n - BP_n) \times (1+i)^{\frac{1}{8}}$$

where CB = contributions, BP = benefit payments, and i = discount rate

Depending on the data available, quarterly cash flows CB_n and BP_n can be based on:

- cash flows for the previous year;

- estimated cash flows for the current year;

- actual cash flows seen in each quarter.

Fouret's method has the following characteristics:

- The method can be applied at an individual level or at an aggregated level (on the basis of an assumption regarding the average discount rate).

- Exceptional contributions (e.g. in the case of a recovery plan) should not normally be taken into account.

- It should be assumed that no changes to the discount rate or other assumptions (i.e. the mortality table) have occurred during the period in question, and no special events have occurred.

- Using different actuarial methods for the calculation of technical provisions and contributions[36] can lead to over/under-estimation.

Thus, if data on cash flows and technical provisions for the year under review and subsequent years are available, linear interpolation could be used for the periods between successive annual data points, provided that no exceptional events have occurred, so available metadata and expert judgement will play a key role in this regard.

Note that the assumptions underpinning the above-mentioned roll forward calculation method and any other approximating methods should be updated where comparison of actual and expected developments indicates that significant changes have occurred during the quarter in question.

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[35] The formula can be simplified by applying simple interest, or by assuming that cash flows occur at the beginning or end of each quarter.

[36] Actuarial methods include the TUC method, the PUC method and the aggregate cost method.

The three methods presented above all assume that there are no changes to actuarial or modelling assumptions during the period under review. This means that we will not have any non-transaction effects in the quarterly estimates. There will only be a non-transaction effect where annual data on changes to actuarial or modelling assumptions are available (template PF.29.05.24). Consequently, quarterly estimates of transactions can be obtained as the first difference between estimated stocks of technical provisions.

For **DC schemes**, the calculation uses as an input the technical provisions at the end of the last available quarter. By incorporating all possible transactions, valuation differences and accrued interest, it produces technical provisions at the end of the current quarter. This method can be used as an alternative to the matching of total assets. This model can be described by the following equation:

Technical provisions at end of last quarter (1)

> \+ contributions (2)
>
> \- benefits (3)
>
> \- administrative expenses and costs charged to members and beneficiaries (4)
>
> \+ realised (paid) investment income (5)
>
> \- realised (paid) investment expenses (6)
>
> \+ profit/(loss) from sale of securities (7)
>
> \+ difference in fair value (8)
>
> \+ accrued interest and sundry accrued investment income (9)

= technical provisions at end of current quarter (10)

This model assumes that the above information is received on a quarterly basis.[37]

3.1.5   Estimation based on quarterly supervisory reporting requirements

The ECB and EIOPA have been working together to develop a common XBRL taxonomy which is able to capture both the reporting requirements specified in the Regulation and EIOPA's reporting requirements under the IORP II Directive. The current proposal for EIOPA's IORP reporting templates[38] is aligned in terms of content, timeliness and frequency[39] with the templates included in the Regulation.

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[37] This information might not be available via EIOPA's templates but it may be available from national supervisory data. Where individual elements are not available on a quarterly basis, NCBs should develop estimation processes tailored to their country-specific circumstances on the basis of available national data sources.

[38] For information, see EIOPA's DPM model and XBRL.

[39] See Decision EIOPA-BOS/18-114 of the Board of Supervisors on EIOPA's regular information requests towards NCAs regarding provision of occupational pensions information, dated 22 March 2018.

Templates 30 to 32 are EIOPA templates with ECB add-ons, allowing the collection of information required under the Regulation.

Another way of producing quarterly estimates of the various components of template EP.03.01.30 would be to use quarterly supervisory information (liabilities side of template PFE.02.01.30) if available. This information, combined with EIOPA's validations and certain assumptions based on national experience, could allow a reasonable estimate of some of PFs' quarterly liabilities.

Table 22 and Table 23 below show the liabilities items in the two templates:

Table 22

PFE.02.01.30 – balance sheet liabilities

		DB	DC	Total
		C0010	C0020	C0040
Liabilities				
Technical provisions	R0280			
Margin for adverse deviation	R0290			
Reinsurance payables	R0300			
Any other liabilities not elsewhere shown	R0310			
Total liabilities	R0320			
Excess of assets over liabilities	ER0321			
Regulatory own funds	R0330			
Reserves	R0340			
Statutory	R0350			
Free	R0360			
Profit reserves	R0370			

Table 23

EP.03.01.30 – balance sheet liabilities

		Total/domestic/euro area countries other than domestic								Rest of world (total)
			Non-MFIs – total							
				Other residents – total						
		MFIs (S.121+ 122+123)	General government (S.13)	Non-MMF investment funds (S.124)	Other financial intermediaries (S.125), financial auxiliaries (S.126), captive financial institutions and money lenders (S.127)	Insurance corporations (S.128)	PFs (S.129)	Non-financial corporations (S.11)	Households + non-profit institutions serving households (S.14+15)	
LIABILITIES (total)	ER0010									
10. Loans received[1]	ER0020									
Up to one year	ER0030									
Over one and up to five years	ER0040									
Over five years	ER0050									
11. Debt securities issued[2]	ER0060									
12. Equity[3]	ER0070									
13. Technical reserves[4]	ER0080									
Of which: Pension entitlements[5]	ER0090									
Defined contribution schemes	ER0100									
Defined benefit schemes	ER0110									
Of which: Claims of pension funds on pension managers[6]	ER0120									
Of which: Entitlements to non-pension benefits[7]	ER0130									
14. Financial derivatives[8]	ER0140									
15. Other accounts receivable/ payable[9]	ER0150									
16. Net worth[10]	ER0160									

1) ESA 2010: F.4; 2) ESA 2010: F.3; 3) ESA 2010: F.5, F.519; 4) ESA 2010: F.6; 5) ESA 2010: F.63; 6) ESA 2010: F.64; 7) ESA 2010: F.65; 8) ESA 2010: F.71; 9) ESA 2010: F.8; 10) ESA 2010: B.90.

Furthermore, Table 24 shows the validations (EIOPA) that govern the relationships between the various elements of the aforementioned templates:

Table 23

Cross-template validations between PFE.02.01.30 and EP.03.01.30

Validation	PFE.02.01.30		EP.03.01.30
PEV50	R0320 + ER0321	=	ER0020 + ER0060 + ER0070 + ER0080 + ER0140 + ER0150 + ER0160
PEV52[40]	R0310	≥	ER0020 + ER0060 + ER0120 + ER0130 + ER0140 + ER0150
PEV53	R0280 + R0290	≤	ER0080 – ER0120 – ER0130
PEV54	ER0321	=	ER0160 + ER0070

Using the tables above and adding certain assumptions, we can estimate the various quarterly liability items as follows:

- **Loans received (ER0020)**

    In many countries, the NCA will have this information on a quarterly basis. This instrument is normally only used to cover liquidity shortages, so the estimated value for maturities longer than one year should be zero.

- **Debt securities (ER0060)**

    In most countries, PFs cannot issue debt, so the most reasonable estimate is zero.

- **Equity (ER0070)**

    In most countries, PFs cannot issue shares. And if they do, the amount should, in principle, be fairly stable. Consequently, a good estimate could be zero or a repeat of the annual data.

- **Financial derivatives (ER0140)**

    If derivatives are reported under EIOPA's XBRL taxonomy, this liability item should have a negative value for the corresponding CIC code.

- **Other accounts receivable/payable (ER0150)**

    This item is difficult to obtain through validation rules. In some countries, NCAs will provide these data on a quarterly basis.

- **Net worth (ER0160)**

    On the basis of validation PEV54, and taking account of the fact that the figure for equity will be zero in many countries or a repeat of the data for the previous year, net worth could be calculated as the excess of assets over liabilities (ER0321) in template PFE.02.01.30.

- **Technical reserves (ER0080)**

    This item can be calculated as the sum of its components:

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[40] Deactivated on 11 February 2019 owing to the omission of item R0300 on the left-hand side of the inequality.

(a) **Pension entitlements (ER0090)**

The direct application of validation PEV53 could give rise to a good estimate, assuming that ER0080 – ER0120 – ER0130 is a good proxy for ER0090. The breakdown into DB and DC schemes would be obtained in the same way using template PFE.02.01.30.

(b) **Entitlements to non-pension benefits (ER0130)**

This will be zero in most cases.

(c) **Claims of pension funds on pension managers (ER0120)**

If all data are available, taking validation PEV52 and adding item R0300 from PFE.02.01.30 to the left-hand side of the inequality could allow us to obtain ER0120.

It is important to bear in mind that, since we are estimating the various components of the annual liability template, it is essential to use one of those components as a balancing item so that total liabilities matches the sum of its components. The best candidate for this is probably technical reserves, which is the most important item from a quantitative perspective. As indicated above, PEs make up around 90% of PFs' total liabilities in the euro area.

Outstanding amounts and transactions

- **Totals**

Reporting agents should, as a minimum, provide end-of-year stock data on the liabilities of PFs. In line with Article 5 of the Regulation, they should also provide details of annual revaluation adjustments or financial transactions for the liability items in Table 1b in Annex I to the Regulation. NCBs should estimate quarterly stocks and revaluations or transactions for totals and the various breakdowns required.

- **Allocation by place of residence**

Where there is a breakdown by place of residence, it is worth noting that most PFs do not have business abroad (unless there is clear evidence from additional sources), so a zero position can be assumed to be a good approximation when deriving estimates.

- **Allocation by counterparty sector**

Loans received: Most – if not all – of these will be granted by MFIs.

Claims of pension funds on pension managers: In the absence of further information from the NCA, the best approach is probably to allocate these on the basis of the weight of the relevant counterparty sector in the previous year. If there are no previous data to draw on, the NCA may be able to provide some indication on the basis of its experience.

- **Revaluations**

Obviously, for those items that are reported as zero by PFs or estimated as zero by NCBs, no revaluations will be allocated. For all other items, the validations table will, again, be very helpful when allocating the revaluations reported in template PFE.02.01.30.

There are two possible ways of allocating these revaluations. One involves using weights, and the other involves assigning them to the most important item from a quantitative perspective (which is technical provisions).

3.1.6 Revisions

Provisions concerning the revision of data are present in both legal frameworks – both (i) in Annex III to the Regulation[41] and Guideline ECB/2019/18,[42] and (ii) in Para. 1.10 of Decision EIOPA-BoS/18-114[43]. Those provisions are complemented by six basic principles set out in the "Common minimum standards for data revisions as agreed between the ECB, EIOPA, National Central Banks and National Competent Authorities",[44] which were published in June 2019 and govern the integrated reporting of data from insurance corporations with a view to achieving consistent data and a uniform understanding of revisions at all levels (EIOPA, the ECB, NCAs and NCBs). The application of those principles is set to be expanded to cover the integrated reporting of data from PFs at a later stage.

In this context, and depending on the capacity and resources of the relevant NCB, revised or updated input parameters for the models (e.g. total assets or yield curves) are expected to be taken into account on a quarterly basis. The back-testing of extrapolation and interpolation, as well as the calibration of input parameters for the models, must be evaluated at least once a year when annual liability data from reporting agents are due, with the majority of revisions expected to be received at ECB level. As regards the submission of revisions to the ECB when annual data are received at national level, the third principle in the aforementioned document must be taken into consideration. That principle regarding timeliness outlines the difference between routine and non-routine revisions. Routine revisions relate to the reference periods $t-1$ and t and should be received within a production period (the period between the start and end of NCBs' transmission of data to the ECB), whereas non-routine revisions relate to reference periods prior to $t-1$, should be received outside of production periods and should be announced to the ECB in advance.

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[41] Corrigendum to Regulation (EU) 2018/231 of the European Central Bank of 26 January 2018 on statistical reporting requirements for pension funds (ECB/2018/2) (OJ L 45, 17.2.2018).

[42] Guideline ECB/2019/18 of 7 June 2019 amending Guideline ECB/2014/15 on monetary and financial statistics.

[43] Consultation Paper on EIOPA's regular information requests towards NCAs regarding provision of occupational pensions information.

[44] Common Minimum Standards for Data Revisions as agreed between the ECB, EIOPA, National Central Banks and National Competent Authorities.

3.1.7   Harmonisation and guidance

As mentioned in previous sections, there is considerable diversity across Europe in terms of the structure of PFs, market conditions and the data collection systems that are used by the authorities (see also Section 3.4). First of all, PFs differ in terms of their legal and regulatory set-ups and their role in the social protection system. Second, the effects of the financial crisis, the socioeconomic environment (e.g. interest rates and other market indices) and the demographic context all vary significantly from country to country. And finally, the national authorities that are responsible for implementing EU regulations and compiling statistics on PFs are all organised differently. As a result, data are collected in different ways and with differing coverage of the reporting population. These conditions make it difficult to build harmonised and comparable datasets for PF statistics.

The Regulation was adopted with a view to overcoming this issue and developing a new set of higher-quality, more comparable and more transparent statistics across the euro area. Indeed, the ECB worked closely with the Member States to map out all existing differences and establish a benchmark for future reference. In the same vein, the Expert Group was set up in order to identify the best methodologies and provide guidance to the Member States on how to compile high-quality projections and estimates for PFs' quarterly liabilities.

As a starting point, and in order to better define the scope of this analysis, it should be noted that annual data on PFs' liabilities will be collected in a uniform manner by every Member State, as set out in the Regulation. Quarterly data on PFs, for which there will be no direct reporting in most Member States, should be estimated in the best possible way in order to simulate the various unknown quarterly series (outstanding amounts, transactions, adjustments, etc.).

The Expert Group has developed a methodological framework by looking at the underlying theory, studying possible estimation methods and testing the various options using actual data from supervisory sources (e.g. EIOPA's IORP templates and other supervisory sources). That framework aims to provide guidance to the NCBs on using the most appropriate technique to reflect and estimate missing quarterly data on PFs' liabilities. In practice, the methodological framework will also provide compilers and users with all available technical material (e.g. model codes, methodological explanations, references and mapping) with the aim of helping them to apply different tests and compilation methods in their own specific cases.

The Expert Group has agreed that Member States will not necessarily use the same method for their quarterly projections and estimations, with each choosing the approach that best suits its national specificities and best reflects actual data (i.e. the approach adopted must be consistent with the annual data reported by PFs).

This will produce high-quality statistics that would not be achieved if a "one size fits all" approach was applied by all countries, given that Member States vary in terms of their market and legal conditions. Thus, the proposed methodology will result in greater harmonisation, bringing together data from different authorities and countries and providing end users with more comparable data. The proposed methodology will also

reduce the complexity of data, as disparities will be mapped and organised and common estimation standards may be applied. Ultimately, these new statistics will result in higher-quality, more reliable aggregate data, which will better support monetary and financial analysis.

3.2 Conclusions regarding the estimation of quarterly liabilities

The ESCB's statistical function is based on a legal mandate to collect all necessary and relevant data in order to produce and disseminate impartial, reliable, appropriate, timely, consistent and accessible statistics in the areas under the ESCB's responsibility. Where appropriate, these statistics comply with standards, guidelines and good practices agreed at European and global level. The ESCB endeavours to perform its statistical function effectively and use resources efficiently when collecting, compiling and disseminating statistics.

In the performance of its statistical function, the ESCB is committed to good governance and the highest ethical standards, as well as striving to execute its tasks in a spirit of cooperation and teamwork. In short, ESCB statistics are, in line with the Eurosystem Mission Statement,[45] governed by a set of principles spanning the ESCB's institutional environment, statistical processes and statistical output.

This guide makes an essential contribution to the harmonisation and comparability of PF statistics (especially for quarterly liabilities), addressing a need for harmonisation that has been expressed by many users at European and national institutions. The report seeks to support producers and users of official PF statistics and complement other ESCB manuals by providing guidance on the use of estimation methods to derive estimates of PFs' quarterly liabilities and encouraging the documentation and dissemination of best practices.

There is increasing demand for quarterly data on PFs. However, as identified in the context of the merits and costs procedure and the public consultation[46] on the Regulation, quarterly reporting of PFs' liabilities can be very costly and difficult to achieve, sometimes resulting in low-quality results when the information set is not adequate. In such a situation, estimation methods may constitute feasible alternatives to the direct compilation of quarterly data on PFs' liabilities. This report looks at various methods of deriving stock and transaction data for quarterly PF liabilities. The ESCB, EIOPA and PFs' representatives have worked together to establish a few guidelines in order to help data producers to derive high-frequency (i.e. quarterly) data from low-frequency (i.e. annual) data and address related temporal and accounting constraints.

This report is aimed at everyone involved in the production and analysis of PFs' quarterly liabilities and corresponding country-specific PF statistics compiled by NCBs. The topics covered in the report and the proposed recommendations should be of interest to all institutions – both public and private – that are working to compile data

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[45] See the Eurosystem mission.

[46] Public consultation on the draft ECB regulation on statistical reporting requirements for pension funds.

on PFs' quarterly liabilities. They provide a framework for the derivation of quarterly liabilities, taking advantage of synergies in order to establish a common vocabulary and facilitate communication and comparison between compilers. They are aimed at both experts and laymen alike, seeking to provide information on complex methods in an accessible manner, and cover a wide range of important issues relating to the choice of methods, revisions and documentation. At the same time, these guidelines should not be applied blindly without reference to actual data. The objective of the guidelines is to help compilers to apply the best alternative method wherever possible. This should be a feasible objective for compilers and should be achievable with a reasonable amount of effort, unless some production or institutional constraints prevent it. Table 25 below provides a brief summary of the methods discussed.

Table 24

Methods available for the estimation of quarterly data on PFs' liabilities (stocks and transactions)

Situation	Methods suggested
a) Supervisory data available	Mapping of supervisory data (see Section 3.1.5)
b) Transactions in assets of DC PFs available	Direct link to transactions in DC PEs (see subsection B1 of Section 3.1.1)
c) Derivation of transactions	General formula: $T_t = (S_t - S_{t-1}) - V_t - C_t - E_t$ [Formula 5][47]
d) DB technical provisions assume no changes to actuarial or modelling assumptions	Method based on change in technical provisions Method based on proportional variation in technical provisions Fouret's method (See Section 3.1.4 for details of all three.)
e) Generally applicable	Temporal disaggregation,[48] ARIMA models, etc.

Generally speaking, the accuracy of estimates is important. However, one cannot expect an estimate to be more accurate than the variance that is caused by the assumptions that are used in the calculation of liabilities. After exploring various estimation techniques and methodologies, the Expert Group concluded that even very simple estimation techniques and methodologies can provide useful and robust estimates of the quarterly liabilities of PFs.

The heterogeneous nature of PFs' liabilities – both across and within countries – stems, in particular, from differences in the following areas:

1.   national social and labour law;

2.   nature of pension schemes;

3.   nature of benefits (final/average pay, annuities/lump sums, etc.);

4.   conditionality of benefits (with EIOPA distinguishing between unconditional benefits and other benefits (conditional and discretionary));

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[47]   See Section 3.2 for details.

[48]   Here, the selection of variables continues to be affected by national specificities.

5. discount factors for liabilities (as described in the presentation by EIOPA);

6. legal responsibilities of sponsors and the types of support provided;

7. availability of pension protection schemes in the various countries;

8. taxation.

Understanding that heterogeneity helps to ensure that calculations and estimates for the various countries and IORPs are as relevant and appropriate as possible. The IORP II Directive recognises and accepts these differences and acknowledges the major role played by national regulations.

3.3 Valuation and country-specific approaches to pension funds' quarterly liabilities

3.3.1 Background to the divergent approaches to valuing pension funds' liabilities

Europe's PFs are highly diverse in terms of their legal and regulatory set-ups, corresponding to their roles in the social protection systems of the various Member States. Most Member States have IORPs, which are subject to the IORP II Directive, as well as other PFs and pension providers (including asset managers, insurers and banks), which are often regulated at national level. Consequently, the schemes and products on offer are equally diverse in terms of their features, characteristics and inherent risks.

Roles of first, second and third-pillar pension plans

Pension schemes can be categorised as first-pillar, second-pillar and third-pillar pension plans. First-pillar pensions are organised by the government, second-pillar pension plans are occupational pension arrangements linked to employment (most of which are associated with a specific employer, group of employers, economic sector or social partner), and third-pillar pensions are personal pension products or savings. Only Member States can provide first-pillar pension plans, so such pension benefits are highly heterogeneous in terms of their level and nature, ranging from "poverty protection" in some Member States to replacement levels of up to 80% of final salaries.[49] The roles, size and nature of supplementary private pensions – the second and third pillars – are also highly diverse across Member States. It is worth noting that there are a few Member States with very low levels of first-pillar pensions, but significant private pension savings (particularly in the occupational pension sector),

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[49] See, for instance, European Commission, "Pension adequacy report 2018 – Current and future income adequacy in old age in the EU", April 2018.

with high asset values relative to the Member State's GDP.[50] Occupational pension plans are often negotiated by employers and social partners and are often subject to national social and labour law, which has an impact on the PFs' governance structures.

DB vs DC

There are two main categories of obligation: DB obligations (which include obligations stemming from hybrid schemes) and DC obligations.[51] DB obligations promise a certain retirement income – for example, 40% of the person's average salary or their salary at the time of retirement.[52] DC obligations represent a promise to contribute a specific amount (e.g. €100 per month) and leave the investment risk and the outcome of the savings to the consumer, member or beneficiary. Providing for long-term, funded DB pension obligations is challenging – particularly in a low-interest rate environment. In line with national arrangements, shortfalls in funding are usually addressed by means of mitigating mechanisms – e.g. by increasing the contributions of sponsors or members, by reducing benefits or, where available, by involving pension protection schemes. The impact of increasing a sponsor's contributions – and reducing benefits paid to members and beneficiaries – depends on the financial strength of the sponsor and the extent to which members and beneficiaries are dependent on the retirement income being paid by the PF in question, but it may be significant and may further affect already challenged financial markets.

Unsurprisingly, private PFs and products are responding to these economic challenges by shifting from DB to DC systems or substantially reducing – if not cancelling – guarantees provided by pure unit-linked life insurance contracts. At the same time, the values for the assets and liabilities of IORPs on national balance sheets are not comparable across Member States owing to differences in valuation standards, as the IORP II Directive does not specify a valuation method for assets and sets out only limited high-level principles on the valuation of technical provisions. For example, the IORP II Directive stipulates that discount rates used for the valuation of pension obligations should take account of (i) the market yields for high-quality or government bonds, (ii) IORPs' projected future investment returns or (iii) a combination of the two. As the IORP II Directive is a "minimum harmonisation directive", Member States are expected to tailor these principles to their national set-ups and develop more detailed requirements in their national prudential regulations.

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[50] In the Netherlands, for instance, around half of all pension income comes from the second and third pillars (with the first pillar acting as a safety net to prevent poverty). That is the main reason for the high ratio of pension assets to GDP in the Netherlands.

[51] However, there are also a number of highly diverse subsets with individual specificities, which can be difficult to categorise as DB or DC obligations.

[52] This is, of course, dependent on the number of years of pensionable service.

Impact of country-specific features

PFs' obligations can vary significantly. In some cases, PFs simply pass on payments from the sponsor, so the sponsor remains ultimately responsible for the pension plan and must make up any deficit. In other cases, pension promises are legally transferred to the PF, which is responsible for paying pension benefits and has no sponsor to ask for supplementary funding. PFs may be financed by means of regular or one-off contributions by members, sponsors or social partners, sponsor support (including supplementary financing by third parties or the state) and returns on assets. In some instances, PFs can define their own liabilities and are able to cut future pension benefits where needed. Sometimes external factors such as taxation rules on employer contributions, security mechanisms and the ability of the sponsor to reclaim surplus funding in the PF have an impact on the funding policy.

Features determined by national frameworks

National social and labour law can also help to shape pension obligations:

- In some countries, the sponsor can stop the plan at any moment, so members and beneficiaries are only entitled to the (accrued) withdrawal value.

- In some countries, benefits are mainly provided in the form of lump sums. This will shorten the duration of the liability, reduce sensitivity to the discount rate and reduce the longevity risk.

- In some countries, salaries have to be reviewed on an annual basis, so the valuation is subject to change.

- Social partners can agree to amend a plan and reduce their liability.

- Some IORPs set their discount rates on the basis of decisions by their governing bodies, while others use rates fixed by national legislatures or market interest rates.

Approaches to the valuation of PFs' assets and liabilities

In most countries, IORPs report the market (or marked-to-market) values of assets on their balance sheets.[53] Other valuation requirements allow the use of measurement approaches such as historical costs for all or specified assets. National valuation standards for technical provisions are much more heterogeneous, especially on account of differences in discount rates. In EIOPA's 2017 stress test, the majority of the IORPs in the sample used expected returns on assets, particularly in BE, ES, IT and the UK. Expected returns on assets can either be calculated as a long-term estimate or as a (risk-free) market yield plus a risk premium. Almost one-third of IORPs in the sample used a fixed discount rate, especially in DE, FI, IE, LU, NO and

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[53] This applies to all IORPs with the exception of Pensionskassen in DE, some IORPs in IT and all IORPs in FI and SI (see EIOPA, "2017 IORP Stress Test Report", 13 December 2017, p. 20).

SI. In DK, NL and SE, IORPs have to use a risk-free interest rate curve, with forward rates converging on an ultimate forward rate (UFR). In PT, IORPs use a high-quality corporate bond yield. The heterogeneity in discount rate requirements results in substantial differences in discount rates across countries – and sometimes within countries (as in the case of DE). The weighted average discount rates reported in the stress test ranged from 1.2% in NL to 4.2% in ES.[54]

Table 25
Overview of national conventions as regards the applicable discount rate

BE	Long-term expected return/fixed discount rate or market yield plus risk margin
CY	Expected return: market yield plus risk premium
DE	Pensionsfonds: expected return; Pensionskassen: contractually agreed discount rate
DK	Solvency II risk-free term structure plus volatility adjustment
ES	Maximum discount rate equals ES government bond yield
FI	Maximum discount rate fixed at 3.5%
IE	Accumulation: combination of fixed 7% blended with 4.5%; decumulation: market rates
IT	Expected return; maximum discount rate fixed at 5%
LI	Expected return on assets or yield on government bonds/high-quality corporate bonds
LU	Maximum discount rate fixed at 5%
NL	Risk-free term structure with UFR, which is based on moving average forward rate
NO	Contractually agreed discount rate
PT	Depending on the type of PF, fixed discount rate of 4.5% or AA corporate bond yield
SE	Risk-free term structure with UFR
SI	Contractually agreed discount rate
UK	Long-term expected return/fixed discount rate or market yield plus risk margin

Based on the survey carried out for the 2017 IORP stress test, supplemented by the survey used for EIOPA's advice on reforming the IORP Directive in 2014.

Longevity and mortality

Another key input in the valuation of DB obligations is assumptions about longevity and mortality. Generally speaking, experience with mortality is translated into a standard baseline mortality table, which is subsequently adjusted for assumptions regarding the mortality trend and allows for a margin for the purposes of additional prudence. Mortality tables are either prescribed by the national supervisory authority or society of actuaries or are provided in the form of "default tables", which can be adapted. A few Member States do not mandate specific mortality assumptions, as their population is too small for statistical significance.

Valuing financing and protection frameworks

Pension obligations are also shaped by the role of the sponsor in the pension promise and, in particular, by the "sponsor support" available. There are a wide range of arrangements that are associated with "sponsor support":

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[54]   See EIOPA, "2017 IORP Stress Test Report", 13 December 2017, pp. 19-23.

- legal, contractual or statutory provisions providing for automatic or discretionary recourse to the sponsor in the event that obligations cannot be met;

- mandatory increases in contributions;

- subsidiary liability on the part of the sponsor – i.e. the sponsor pays members or beneficiaries directly, instead of passing the money through the IORP;

- "contingent" assets held by the PF – i.e. the IORP holds collateral provided by the sponsor and ownership is transferred if need be;

- priority ranking in the event of a sponsor becoming insolvent;

- maintenance of rights in the event of a transfer or change of sponsor.

Other pension protection mechanisms can also be found, which will also affect the valuation of pension liabilities:

- Payments by national pension protection schemes that are triggered by the sponsor (or the IORP) becoming insolvent

    (a) Such replacements for sponsor contributions may be reduced, or the level of guaranteed benefits may be lowered or capped.

    (b) Pension protection schemes may potentially be partially unfunded.

- Mandatory or discretionary increases in members' contributions, and/or a right to reduce the benefits promised by the PF (subject to certain conditions)

Funding and capital requirements

National prudential regulations in Europe also vary in terms of funding requirements. The IORP II Directive stipulates that IORPs should have sufficient assets to cover technical provisions. National funding requirements and recovery plans seek to guarantee sufficient funding levels, thereby ensuring the availability of sufficient assets to cover liabilities (plus a buffer, potentially) over a recovery period of up to ten years (and even longer in some countries). IORPs that underwrite DB or hybrid obligations themselves are subject to the provision in Article 15(1) of the IORP II Directive requiring them to hold regulatory own funds totalling at least 4% of their technical provisions. Meanwhile, Article 15(3) of the IORP II Directive allows countries to lay down additional buffer requirements using national prudential regulation.

All IORPs in DK, NL, NO, SE and SI are subject to the regulatory own funds requirement in Article 15(1), while none of the IORPs in BE, CY, DE, ES, FI, IE, LU, PT or the UK are. In IT, some IORPs have to comply with that regulatory own funds requirement, and some do not, depending on the strength and availability of sponsor support. In BE, DE, ES, IE and NL, some or all IORPs have to comply with additional national buffer requirements in line with Article 15(3). Some countries have minimum funding requirements. In BE, for example, the minimum funding requirement is related to certain short-term technical provisions, which total around 80% of long-term

technical provisions. In DE, the minimum funding requirement is set in line with Article 17(3) of Directive 2003/41/EC (the original IORP Directive). NL imposes the regulatory own funds requirement under Article 15(1) of the IORP II Directive as a minimum funding requirement.

IORPs that do not comply with the national funding requirement usually have to draw up a recovery plan in order to be approved by the NCA. That recovery plan explains how compliance with the funding requirement can and will be restored within a given period of time. The shortfall may be resolved by reducing risk through changes to the asset allocation or through hedging, additional sponsor contributions, suspension of conditional or discretionary benefits and benefit reductions. The extent to which IORPs will be able to implement the various measures depends crucially on national prudential regulation and the nature of the pension arrangement. The funding level at which IORPs have to submit a recovery plan naturally depends on national funding requirements and, implicitly, the valuation of the balance sheet. These funding requirements and valuation standards vary substantially between countries. In most cases, a recovery plan will trigger additional funding from the sponsor, additional contributions from members or reductions in pension benefits. In many countries, the maximum length of recovery periods is specified in national regulations, often with the proviso that NCAs may extend the recovery period in specific circumstances. In a substantial number of other countries, the length of the recovery period is subject to approval by the NCA, taking into account the specificities of the IORP in question.

Table 26

Countries where required sponsor support payments can/cannot be distributed over time (five years, ten years or unlimited)

Countries where payments can be distributed	Countries where payments cannot be distributed
BE, CY, DE, ES, IE (sponsor support not legally enforceable), IT, LI, LU, NL, PT, UK	DK, FI, NO, SE

See EIOPA, "2017 IORP Stress Test Report", 13 December 2017, pp. 82-84.

3.3.2   Current data

The ECB has been receiving quarterly PF statistics since 2016, collected under the "short-term approach" and reported under Guideline ECB/2019/18. These have replaced the PF statistics that used to be published by the ECB as part of a broader dataset on euro area insurance corporations and pension funds (ICPFs). Generally speaking, ICPF statistics are available for reference periods from the first quarter of 2008 to the second quarter of 2016, while the new PF dataset is available from the first quarter of 2016 onwards.

The discontinuation of ICPF data collection, which was triggered by the collection of harmonised insurance corporation statistics, necessitated the collection of separate PF data, even though PF statistics had not yet been harmonised. As a result, there were changes to the reporting schemes for both insurance corporation and PF statistics. To ensure continuity between the old ICPF statistics and the now separate insurance corporation statistics (harmonised) and PF statistics (non-harmonised),

those datasets are linked. As of the reference period Q3 2019, PF statistics will be collected by NCBs in accordance with the Regulation. The Regulation allows NCBs to collect the data needed to meet statistical requirements via the relevant NCA (which will already be collecting data on PFs) in accordance with local cooperation arrangements. However, the implementation of the Regulation varies across the EU. National authorities are organised differently, data are collected in different ways, and various different derogations may be applied. Against that background, the ECB has used a dedicated questionnaire to take stock of (i) the reporting population for PF data, (ii) the ways in which national institutions are organised, (iii) the chosen data flow and whether the XBRL format has been chosen, and (iv) the templates that are expected to be used. The paragraphs below summarise the main information collected through that ECB questionnaire.

As regards current reporting under the short-term approach, 12 of the 26 NCBs which answered the questionnaire (BG, CZ, DK, EE, LT, LV, NL, PL, RO, SE, SI and SK) report actual values for total quarterly liabilities. Moreover, some countries have actual data for the main liability items. Nine countries (BG, CZ, IT, LV, NL, RO, SE, SI and SK) have actual data on the value of DC schemes, while one (SE) has actual data on the value of DB schemes. Ten countries (CZ, DK, EE, GR, IT, LT, LV, NL, PL and SE) collect actual data on loans received, three (DK, GR and SE) collect data on debt securities issued, five (CZ, DK, LV, NL and SE) collect data on equity, ten (BG, CZ, DK, EE, GR, IT, LT, LV, NL and SE) collect data on financial derivatives, and 11 (BG, CZ, DK, EE, GR, IT, LT, LV, NL, RO and SE) collect data on other accounts receivable/payable.[55]

As regards future reporting under the Regulation, 16 NCBs have indicated that they will collect actual values for total quarterly liabilities (GR, HU, IT and MT, plus the 12 that already report actual values). Another NCB (ES) will collect actual data for DC schemes and equity.

Table 27
Summary of the methods used to obtain data on liability items

	Zero values or values not calculated	Estimated values	Actual data available
Loans received	BG, RO	CY, DE, ES, IE, LU, PT, SI	CZ, DK, EE, GR, IT, LT, LV, NL, PL, SE
Debt securities issued	BG, CY, CZ, DE, EE, ES, IT, LT, LV, NL, PL, PT, RO	IE, LU, SI	DK, GR, SE
Equity	BG, CY, EE, IT, LT, PL, PT, RO	BE, DE, ES, IE, LU, SI	CZ, DK, LV, NL, SE
Financial derivatives	BE, CY, DE, ES, PL, RO	IE, LU, PT, SI	BG, CZ, DK, EE, GR, IT, NL, LT, LV, SE
Other accounts receivable/payable	FI, PT	AT, CY, DE, ES, IE, LU, PL, SI	BG, CZ, DK, EE, GR, IT, LT, LV, NL, RO, SE

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[55] Some NCBs estimate values on the basis of other data sources. Seven NCBs (ES, CY, DE, IE, LU, PT and SI) do this for loans received, three NCBs (IE, LU and SI) do it for debt securities, six NCBs (BE, DE, ES, IE, LU and SI) do it for equity, four NCBs (IE, LU, PT and SI) do it for financial derivatives, and eight NCBs (AT, CY, DE, ES, IE, LU, PL and SI) do it for other accounts receivable/payable.

3.3.3 Estimation using annual liabilities

Under the short-term approach, five NCBs (CY, FI, IE, IT and LU) estimate quarterly liabilities using annual liabilities. As regards future reporting under the Regulation, three countries (FR, LT and LV) intend to estimate quarterly liabilities using annual data on the basis of ratios.

3.3.4 Estimation using quarterly assets

Under the short-term approach, one NCB (PT) estimates quarterly liabilities using quarterly data on assets. As regards the estimation of the main liability items, five NCBs (AT, ES, GR, PL and PT) estimate values for DC schemes on the basis of quarterly asset data, and two of those NCBs (AT and GR) also estimate values for DB schemes using quarterly assets.

As regards revaluations, the majority of the NCBs which estimate quarterly liabilities (using any approach) do not use a different method to derive revaluation data for quarterly liabilities. One NCB (ES) calculates revaluations as the stock figure times the revaluation percentage, while another (LV) reported that the revaluation of PEs was incorporated in the revaluation data for financial assets.

3.3.5 Mixed approach

As regards current reporting under the short-term approach, three NCBs (AT, BE and DE) have a mixed approach, using both annual liabilities and quarterly data on assets to estimate quarterly liabilities.

3.4 Results of the temporal disaggregation test

In this section, we detail the results of the test exercise that was used to compare the effectiveness of different TD models (as discussed in Section 3.1.2). We tried to predict quarterly PEs in the Netherlands using only the annual (Q4) PEs reported under the short-term approach and other quarterly (or higher-frequency) variables such as assets or the interest rate. We then compared the various models' efficacy in terms of interpolating and extrapolating data for different periods of time using the mean squared error (MSE), calculating the difference between actual and estimated values for every quarter and every model. We then squared that difference to produce a single positive measure, before adding together the results for the various quarters to obtain a single value per method.

Neither the results nor the variables used should be regarded as definitive or as proof that a methodology can be translated one-to-one to another country, especially given the differences in the valuation of liabilities (see Section 3.4). However, by comparing the estimates produced by different models with the data that were actually reported, it is possible to achieve a better understanding of the methodology used and the

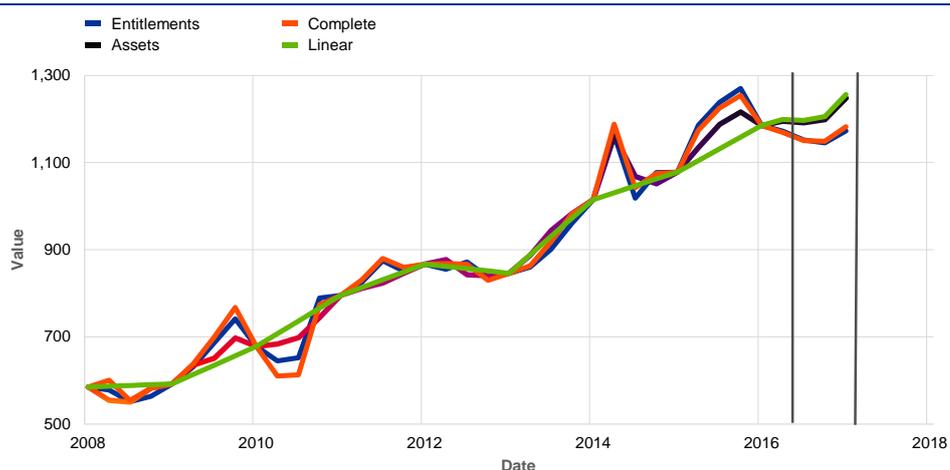interactions between the various different variables, as well as the limits of such techniques.

The two charts below summarise the results of the test exercise. The first chart shows the evolution of actual reported data ("entitlements") and the values derived from the three models:

1. linear interpolation/extrapolation model with growth rate of total assets ("linear" – Model 1);

2. Chow-Lin model with only total assets as an indicator variable ("assets" – Model 2);

3. Chow-Lin model with total assets and interest rates as indicator variables ("complete" – Model 3).

Data up to 2016 are interpolated, and the last four quarters (between the two vertical lines) are extrapolated.
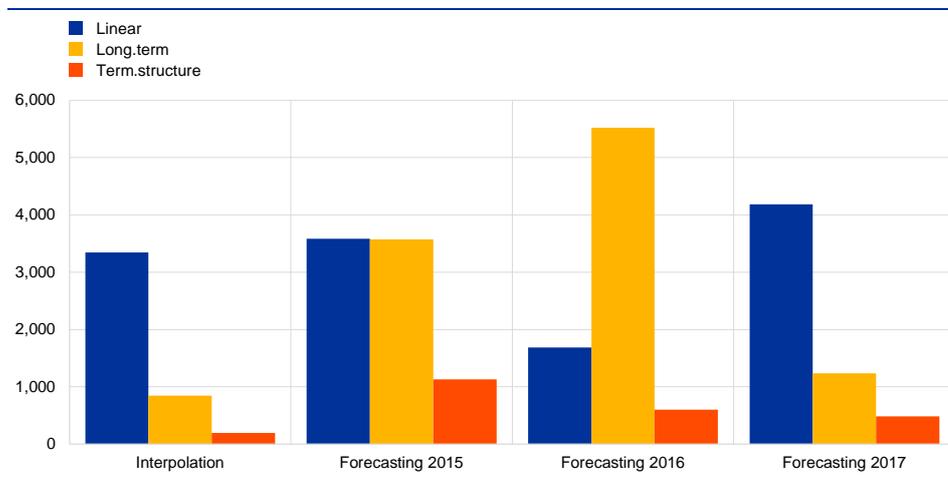
Chart 1
Reported and estimated PEs; EUR billions

The second chart summarises the results for various time periods in terms of the mean squared error. In this case, we are comparing (i) the linear model described above, (ii) the usual model involving the term structure of interest rates and (iii) a long-term model using a ten-year interest rate for the Netherlands. The "term structure" model in **Chart 2** is equivalent to the "complete" model in **Chart 1**, which used highly detailed and appropriate data on interest rates (in addition to total assets) as an indicator variable. The "linear" model is the same in both figures, whereas the "long-term" model is only displayed in **Chart 2.** Here, we can see that using an interest rate that is not appropriate for the discounting of liabilities (as applied in the "long-term" model) may not necessarily improve the estimation process at all stages, while using information on the term structure does, in this case, improve the results of the linear model.

Chart 2

Mean squared error by model and period; EUR billions squared

Although the results of this exercise may seem very clear, there are a couple of important caveats that need to be borne in mind:

1. The specific variables used here (e.g. the particular type of interest rate) may give rise to misleading results in other countries if they do not play a significant role in the valuation of liabilities in those countries.[56]

2. In this case, we were able to test the estimates against actual reported data, but that will not necessarily be the case for other countries. In addition, standard statistical tests such as the base t-statistic require large samples (or at least samples of more than 30 observations) for the "law of large numbers" to apply and to have reliable distributions.

Here is an example of the main R code[57] used for this exercise:

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[56] In addition to the question of whether other countries also use market interest rates to discount pension entitlements, the nature and character of those entitlements is also important. In the Netherlands, such entitlements are paid out in the form of annuities, whereas beneficiaries in other countries can receive lump sum payments on retirement, which have a substantially shorter duration and are therefore (i) less sensitive to the level of interest rates and (ii) much more sensitive to changes in interest rates.

[57] For information on the programming language used, see An introduction to R.

Figure 1

Sample code for temporal disaggregation

```
1.  # Assume the variables mentioned are stored in data frames and consist of numerical vec
    tors
2.   # In the following function td we:
3.
4.  # Interpolate with a constant, "regressing" "pension.entitlements" column of
5.  # "liab_annual" dataframe on "1", Denton-Cholette method used for this case
6.  # Convert to quarterly
7.  # Conversion = "last" for Q4 value to match annual data
8.  # Store the model in the variable pe_linear
9.
10. pe_linear <-
     td(liab_annual[,"Pension.entitlements"]~1, to = "quarterly", conversion = "last",
11.                method = "denton-cholette")
12.
13. # Obtain ("predict") linear interpolation values and store them in the variable
    linear_int
14.
15. linear_int <- predict(pens_dc1)
16.
17.
18. # Use Chow-Lin method, this time with total assets as regressor:
19. # Regress pension entitlements on "0"(no constant) + "Total.financial.assets" column
20. # From "assets_qt" dataframe
21.
22. pe_cl1 <-
     td(liab_annual[,"Pension.entitlements"]~0 + assets_qt[,"Total.financial.assets"],
23.                to = "quarterly", conversion = "last", method = "chow-lin-maxlog")
24.
25. # Predict to obtain the estimates
26.
27. pe_cl1_est <- predict(pe_cl1)
28.
29. # Chow-Lin with total assets and interest rate ("Interest.rate" column in data frame
    "assets_qt")
30.
31. pe_cl2 <-
     td(liab_annual[,"Pension.entitlements"]~0 + assets_qt[,"Total.financial.assets"] +
32.                assets_qt[,"Interest.rate"], to = "quarterly", conversion = "last", meth
    od = "chow-lin-maxlog")
33.
34. # Predict to obtain the estimates
35.
36. pe_cl2_est <- predict(pe_cl2)
```

For more information, and to test the "tempdisagg"[58] R package, see the demo[59].

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[58] Package 'tempdisagg'.

[59] tempdisagg: Methods for Temporal Disaggregation and Interpolation of Time Series.