REPORT ON THE 2020 PENSIONER MORTALITY STUDY OF IRISH SELF-ADMINISTERED PENSION SCHEMES

10TH SEPTEMBER 2020

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1. Introduction

The Demography Committee of the Society of Actuaries in Ireland ("Society") is pleased to present the results of a study into the pensioner mortality experience of Irish self-administered pension schemes (SAPS). The last such study was commissioned in 2012.

Objectives of the study

The objectives of the study were to:

(i) carry out research that would assist pension scheme actuaries when setting mortality assumptions generally

(ii) provide a basis for updating mortality assumptions in relevant Actuarial Standards of Practice (ASPs)

(iii) quantify changes in Irish SAPS pensioner mortality experience since the last study.

The experience period underlying this study is 2012-2017 with the delay in publication being due to challenges with the collection process such that all data was not available to us until late 2019. For consistency with previous SAPS studies undertaken by the Demography Committee, the current study will be referred to by the year of publication, i.e. the "2020 study".

Data Contributors

The Demography Committee would like to thank the participating pension consultancies and their clients who supported this investigation by contributing their data for analysis. Participating consultancies collated deaths and exposure data at scheme level and submitted their analysis in a standard template (see appendix C2) for aggregation by the SAPS working party. No individual member or client identifying details were requested as part of the investigation.

The Committee would also like to thank the Department of Public Expenditure and Reform (DPER) for their considerable assistance in collating and analysed public sector data.

Governance and Authorship

This report has been prepared in accordance with ASP PA-2 General Actuarial Practice[1] and the Code of Professional Conduct[2]. Authors of the report consist of members of the Demography Committee who are Fellows of the Society. The Governance Document, retained by the Society, outlines or references, as appropriate, the governance and associated process controls of the SAPS project. The working party members are noted in the Governance paper.

Peer review

In line with best practice, this report, together with the Governance Document, has been peer reviewed by Caroline Twomey FSAI (chair of the demography committee) and Tony Jeffery FSAI. The peer review encompassed a review of the analysis and commentary in the final report only.

References to gender

In this report the analysis has been subdivided into the genders of males and females. In this respect no attempt has been made to ascertain the definition used by data providers but the classification used has been accepted. We do not believe that any distortion to results from use of potentially inconsistent definitions of genders would be significant.

[1] https://web.actuaries.ie/standards/asp/asp-pa-2
[2] https://web.actuaries.ie/standards-regulation/code-professional-conduct

Audience
In preparing this paper, we have assumed that the audience will be, in the majority, actuaries working in the Irish market. This paper is written for experienced actuaries and demographers who will understand the technical terms used without further explanation. It is not intended for general public consumption. Users of the information presented in this paper must consider the credibility and appropriateness of the analysis at any given level of granularity to the scenario in which they are seeking to apply it.

Disclaimer
Whilst care has been taken to ensure the accuracy of the information in this document, the Society does not accept any responsibility or liability for any errors and/or omissions, including any errors and/or omissions in the data on which this document is based. This document does not constitute advice and should not be relied upon as such. The Society does not accept any responsibility or liability for any loss to any person or body as a result of any action taken, or any decision taken not to act, on foot of any statement, fact, figure, expression of opinion or belief contained in this document.

Impact of Covid-19
The coronavirus (SARS-CoV-2) was identified in December 2019 in Wuhan, Hubei, China and spread around the world at a rapid rate. Covid-19 was declared a global pandemic by the World Health Organisation (WHO) on 11 March 2020. The exposure period covered by this study pre-dates the virus so it will be the next study that will capture the impact. Clearly huge uncertainty exists with a possible outcome being excess mortality in the short term and greater life expectancy experienced by survivors. The Society has established a Covid-19 action group to (i) collate and share with members relevant information on the implications of COVID-19 with a particular focus on matters in the Irish market and Irish context, and (ii) considering what actions the Society can take to contribute to the response to COVID-19.

Next study
It is recommended that future studies are carried out at least every five years, with the next study being commissioned in 2022 (i.e. 5 years after the end of the data period for the current study), so that Irish SAPS pensioner mortality assumptions can continue to reflect emerging experience.

Further Information
The Demography Committee welcomes feedback on the report and suggestions for improvements. Comments or questions can be submitted to info@actuaries.ie.

2. Data

Pension consultancies based in Ireland and the Department of Public Expenditure and Reform (DPER) for pension schemes managed within the public service were asked to contribute data to the study based on the following specifications:

- Include all Irish occupational pension schemes with at least 250 pensioners (under which pensions are paid directly from scheme resources, for funded schemes).
- Provide data for the beginning and end of the most recent inter-valuation period (and the two intermediate scheme anniversaries, if available).
- Data should include date of birth, sex, and annual pension amount.
- Dates should also be provided (as far as possible) for entrants and exits over the period
- Pensioners should be distinguished by type if possible: normal retirement, ill-health retirement or dependant.
- Industry sector and exposure period should be stated.

More details on data and coverage period are given in Appendix E. The working party consider that data collection is unlikely to have introduced significant bias, so that the results may be considered as a fair representation of Pensioner Mortality in SAPS for the period. However, users should note that smaller schemes have been excluded and this may have different typical pensions in payment which will be associated with differences in mortality experience.

Data provided

Data was provided by 4 pension consultancies and DPER. In total, data in respect of 51 separate occupational pension schemes (excluding public sector data) was submitted, broken down as follows:

Data Source	Contribution	Exposure	
		Lives	Amounts €'000s
Consultancy 1	2 schemes	2,197	34,057
Consultancy 2	26 schemes	123,892	2,139,873
Consultancy 3	11 schemes	31,431	359,730
Consultancy 4	12 schemes	62,595	1,207,582
Public sector	4 files	344,360	7,665,949
Total – 2020 study	51 schemes + 4 files	564,476	11,407,191
Total – 2013 study[3]	45 schemes + 7 Dept of Finance schemes	387,087	4,536,000*
Total – 2008 study[4]	45 schemes + 4 Dept of Finance schemes	252,078	4,474,000

*Amounts exposure data was not available for approximately 20% of lives

For the 2020 study the public sector data was provided in 4 separate files but it was not possible to further analyse this data by sector source e.g. civil service, health, education, defence, etc

It is evident that the investigation has grown significantly due to the maturing of the DB pensions sector. Appendix E puts some context on the maturing of the DB sector by noting statistics published annually by the Pensions Authority.

[3] https://web.actuaries.ie/sites/default/files/member_story/2013/12/sai_mortality_report_final_nov_2013.pdf

[4] https://web.actuaries.ie/sites/default/files/member_story/2008/05/may_2008_mortality_report.pdf

The study covered an investigation period between 1 January 2012 to 31 December 2017. The exposure mid-point (weighted by lives) was October 2015, with a spread of data by calendar year as follows:

Exposure year	% of total lives exposure
2012	1%
2013	5%
2014	23%
2015	26%
2016	24%
2017	21%

The previous study spanned the period 2006 to 2012 with an exposure mid-point of March 2010, giving a time interval between midpoints of 5.583 years.

There was minimal overlap of experience with the previous study.

Similar to the 2013 study, approximately 60% [33 of 55] of the data submissions covered a 3 year period, i.e. between triennial valuations. 31% [17 of 55] of submissions were for periods longer than 3 years (average 4.7 years) and 9% [5 of 55 of submissions were for periods shorter than 3 years (average 2.0 years).

A significant amount of data was provided by DPER in respect of pension schemes for public servants and the table below sets out the relevant split:

Data source	Number of Schemes	Exposure	
		Lives	Amounts
Consultancies	51	220,116 (39%)	3,741,243 (33%)
DPER	4 files	344,360 (61%)	7,665,949 (67%)
Total		564,476	11,407,191

The next table below shows an estimate of the distribution of schemes by membership numbers. The 4 public sector files in the table above have been consolidated and presented as one scheme in the table below.

Number of pensioners	Number of Schemes
0 to 200	2
200 to 300	11
300 to 400	5
400 to 500	9
500 to 1000	12
1000 to 2000	3
2000 to 5000	7
5000 +	3
Total	52

Actual Exposures and deaths

Actual exposures and deaths by amounts / lives and by gender were:

2020 study	Male	Female	Total
Lives Exposure	298,999	265,477	564,476
Lives Deaths	8,227	5,724	13,951
Amounts Exposure €'000s	6,699,934	4,737,257	11,407,191
Amount Deaths €'000s	142,797	91,346	234,142

The corresponding statistics from the previous two studies were as follows:

2013 study	Male	Female	Total
Lives Exposure	234,741	152,356	387,097
Lives Deaths	7,536	4,598	12,134
Amounts Exposure €m	3,386	1,150	4,536
Amount Deaths €m	90	38	128

2008 study	Male	Female	Total
Lives Exposure	160,723	91,355	252,078
Lives Deaths	5,061	2,892	7,953
Amounts Exposure €m	2,904	1,570	4,474
Amount Deaths €m	81	39	119

Although of limited use given changes in scheme and age structure profile, the following table notes the trend in the overall crude rates:

Study	M – lives	F – lives	Combined – lives	M – Amounts	F – Amounts	Combined – Amounts
2020	2.75%	2.16%	2.47%	2.14%	1.93%	2.05%
2013	3.21%	3.02%	3.13%	2.66%	3.30%	2.82%
2008	3.15%	3.17%	3.15%	2.79%	2.48%	2.68%

Excluding DPER data, the statistics for the latest study were:

	Male	Female	Total
Lives Exposure	150,758	69,357	220,116
Lives Deaths	4,948	1,974	6,922
Amounts Exposure €'000s	2,889,126	852,117	3,741,243
Amount Deaths €m	69,151	20,513	89,665

Data constraints

The analysis was constrained by the quality of data provided. In particular:

- Data was not subdivided by type of pensioner (e.g. ill-health, dependant).
- Date of death was not recorded in many cases and in these instances death mid-way through the inter-valuation period was assumed.
- Where date of entry was not recorded a similar assumption was made for consistency.

Although the associated impact cannot be quantified, the same constraints applied to the previous study.

3. Methodology

The methodology adopted was as follows:

- The census method was used, based on a life year rate interval.
- Crude mortality rates were derived by age and gender.
- Ill-health and dependant lives were included but not analysed separately due to insufficient data.
- A number of mortality tables were considered when determining the most appropriate basis for expressing the study results.

More detail on the methodology employed is contained in appendix C1.

In addition, for consistency with the mortality basis in ASP PEN-2 Retirement Benefit Schemes Transfer Values version 5.6:

- The impact of data provided by DPER was assessed. Tables excluding DPER data can be considered to represent the mortality experience of the private sector (including the commercial state companies)
- Crude rates were also calculated excluding ages below 60.

The tables considered are described below:

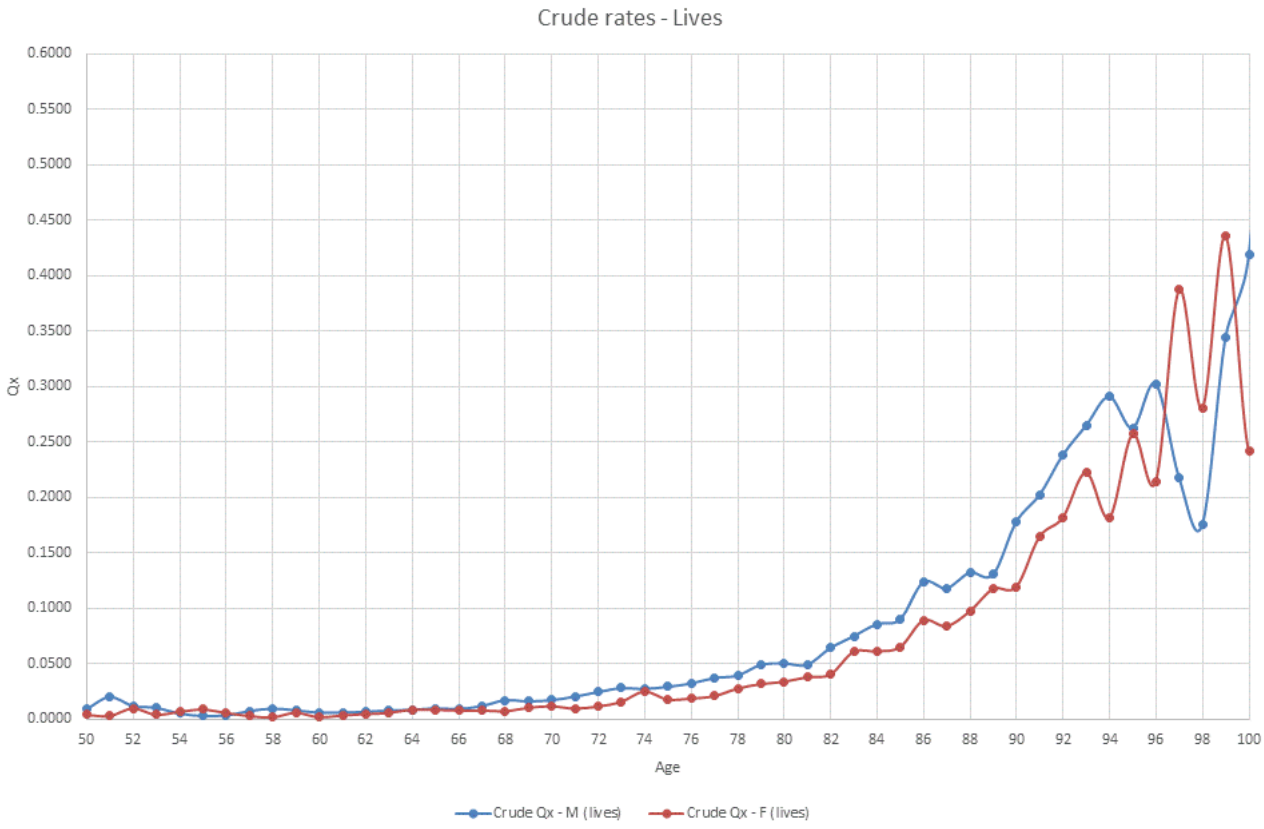
Mortality tables	Data set / source	Data Period	Central exposure year	Type of lives
S2PL	CMI working paper 71	2004-2011	2007	UK SAPS pensioners (excluding dependants)
S3PL	CMI working paper 113	2009-2016	2013	UK SAPS pensioners (excluding dependants)
ILT 15	CSO Irish Population (census)	2005-2007	2006	Irish population
ILT 16	CSO Irish Population (census)	2010-2012	2011	Irish population
ILT 17	CSO Irish Population (census)	2015-2017	2016	Irish population
PN00	CMI working paper 22	1999-2002	2000	UK Life office pensioners (normal retirements only)

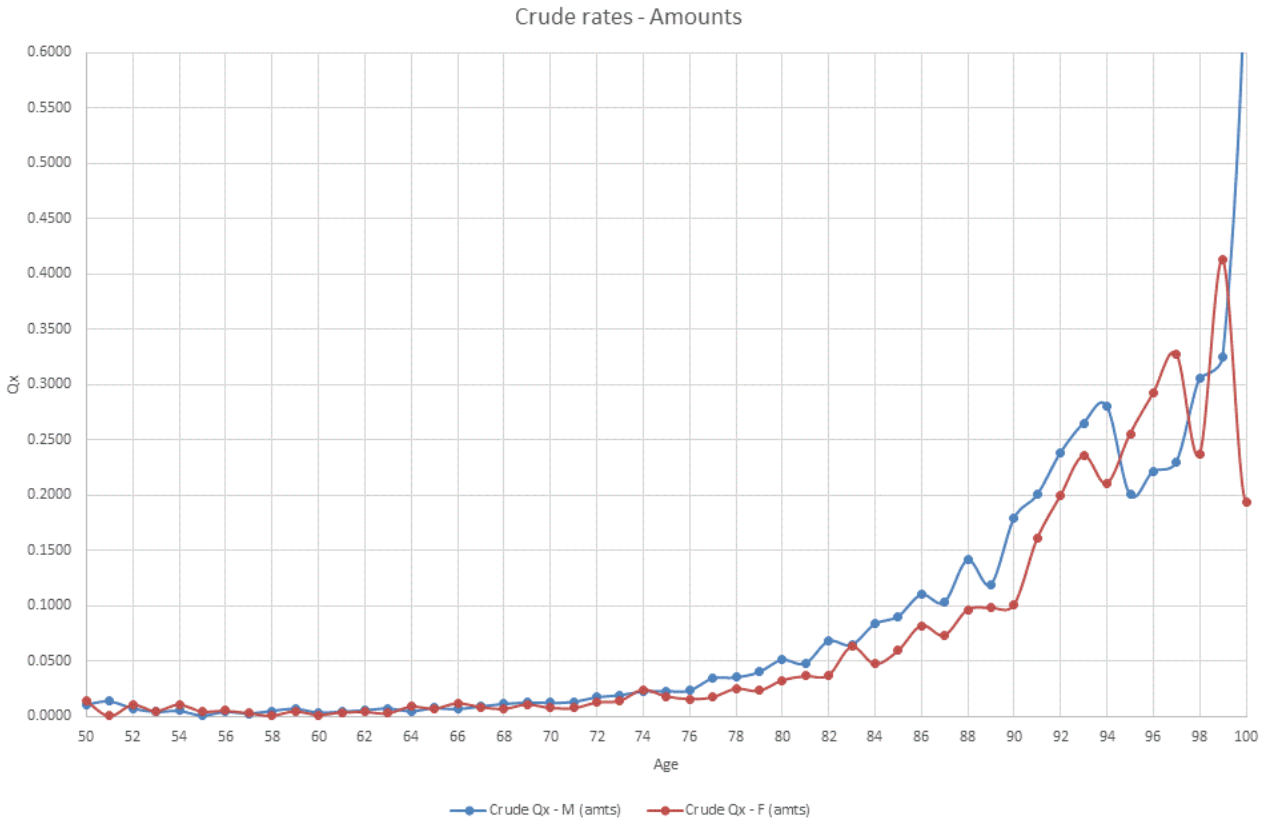
Allowance for mortality improvements

The standard tables used in the **A**ctual versus **E**xpected (A/E) comparisons are based on data for earlier years than the period covered by this study (2012-2017). Therefore, to allow for the impact of mortality improvements over the intervening period the A/E comparisons were repeated using the standard tables adjusted to reflect mortality improvements. The improvements applied to the standard tables were obtained from the CMI_2016 mortality projection model. More detail on the methodology to allow for improvements is set out in appendix C1.

4. Graphical analysis

A graph of the crude rates by age (50+), gender and lives versus amounts is shown below:





Appendix B1 and B2 contains graphs which compare the crude rates derived from the study against the mortality tables (excluding ILT17) identified in Section 3.

In order to better illustrate the differentials, graphs are included for the following age ranges separately:

- 50 to 100
- 50 to 70
- 70 to 90
- 90 to 100

The purpose of this study is not to graduate mortality rates but rather to assess the level of adjustment (scaling) that might be applied to a standard table to arrive at a good fit.

We have made the following observations:

- In respect of male lives
  - From ages 50 to 56 the crude rates are higher than the nearest comparator table (ILT15M). This is mostly likely due to the impact of ill health early retirements at these younger ages with the heavier experience diminishing as age increases
  - Between ages 56 to 60 the crude rates oscillate between ILT15M and ILT16M / S2PML
  - Between ages 60 to 70 the crude rates track S3PML quite closely
  - This experience of tracking S3PML relatively closely is also apparent between ages 70 to 90
  - At higher ages (90+) the volume of data is lower so experience is more variable; however the crude rates track reasonably close to ILT16M (at least to age 96).

- In respect of female lives
  - From ages 50 to 59 the crude rates are higher than the nearest comparator table (ILT15F). As for males this is mostly likely due to the impact of ill health early retirements at these younger ages with the heavier experience diminishing as age increases
  - Between ages 60 to 64 the crude rates oscillate between PNFL00 and S3PFL while from ages 65 to 70 the crude rates track S3PFL quite closely
  - Again, as for males, this experience of tracking S3PFL relatively closely is also apparent between ages 70 to 90
  - At higher ages (90+) the volume of data is lower so experience is more variable; however the crude rates track reasonably close to ILT16F (at least to age 98).

The remainder of this report focuses on the study results expressed in terms of:

- ILT15, as this Irish population table is the current base table used (with appropriate scaling factors) for the purposes of calculating transfer values on the standard section 34 statutory basis and money purchase projections when preparing statements of reasonable projection (under ASP Pen 12)
- ILT16, as until recently, was the most recent version of an Irish specific mortality (population) table
- ILT17, an updated Irish population mortality table that was hot off the presses at the time of writing (see note below)
- the PN00 tables (UK life office pensioners – normal retirements), for the purposes of comparison with the 2008 and 2013 study results
- the S2 tables, for the purposes of comparison with the 2013 study and as based on the experience of SAPS pensioners (albeit in the UK)
- the S3 tables, as the most recent version of the UK SAPS study with a central exposure year (2013) of all the tables considered that is closest to the central date of this study

At the time of finalising this paper the CSO released Irish Life Table No. 17. This table was constructed from census data and deaths recorded over the three-year period 2015-2017 and reflects Irish population mortality experience centred around 2016. This year broadly equates to the midpoint of the SAPS study. It is therefore instructive to analyse the SAPS experience against this table in some depth. Appendix B3 graphs the crude rates from age 50+ against ILT17 while section 5.4 below sets out an A/E comparison. It is evident that a scaling factor of 90% applied to the mortality rates underlying ILT17 provides a good fit.

5. Numerical analysis

The tables in this section set out the Actual / Expected (A/E) mortality rate statistics by age-band and gender, by reference to several standard tables and with and without mortality improvements between the central exposure year of the standard table and the approximate midpoint of the current study (2016); the impact of DPER data is also quantified.

5.1 Exposure data

Appendix A sets out the underlying Exposure data, by lives and amounts, and recorded deaths, also by lives and amounts. The summary data is also broken down by age bands and gender and including/excluding DPER data.

The following sections present the results of the current study against various standard tables without any allowance for improvements and with allowance for improvement between the central year of the standard table and the experience.

The improvements applied to the standard tables were obtained from the CMI_2016 mortality projection model. This provides smoothed estimates of the mortality improvements for the population of England and Wales by age, gender and calendar year up to 31 December 2015. Details of the CMI mortality projection model and the smoothing method applied can be found in CMI working papers 97[5], 98[6] and 103[7]. For this analysis the model's core (default) parameter values were used. The model is primarily designed to support estimates of projected improvements and therefore requires the user to input a long-term rate in order to produce an output. However, the mortality improvements used for analysis in this paper are based on actual, historic improvements and consequently are not dependent on the user provided long-term rate of improvement required by the model. Separate improvements were calculated for males and females. This allowance for mortality improvements enables a comparison of the IILMI experience relative to the CMI standard tables on a consistent basis over time.

No allowance for mortality improvements

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	140.8%	223.5%	129.4%	139.9%
60-69	65.0%	69.4%	67.8%	75.2%
70-79	65.2%	64.7%	70.4%	74.1%
80-89	71.1%	71.4%	71.7%	75.4%
90+	96.4%	94.8%	93.6%	93.7%
All ages	72.0%	78.3%	73.6%	80.4%
60+	70.6%	75.3%	73.1%	79.7%
95% CI lower – all ages	70.4%	76.3%	71.6%	76.9%
95% CI upper – all ages	73.5%	80.4%	75.7%	84.0%

[5] CMI WP 97 - https://www.actuaries.org.uk/documents/cmi-working-paper-97-cmi-mortality-projections-model-cmi2016

[6] CMI WP 98 - https://www.actuaries.org.uk/documents/cmi-working-paper-98-cmi-mortality-projections-model-methods

[7] CMI WP 103 - https://www.actuaries.org.uk/learn-and-develop/continuous-mortality-investigation/cmi-working-papers/mortality-projections/cmi-working-paper-103

With allowance for CMI_2016 mortality improvements from 2006

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	162.3%	255.2%	149.5%	159.8%
60-69	80.6%	82.6%	84.1%	89.5%
70-79	86.4%	83.5%	93.4%	95.9%
80-89	88.4%	84.9%	89.2%	89.6%
90+	101.4%	97.2%	98.6%	96.4%
All ages	89.6%	91.1%	91.7%	93.5%
60+	88.0%	87.6%	91.0%	92.6%

5.2.1 Comparison with current standard transfer value mortality basis

The derivation of the mortality basis for use in standard transfer value calculations is detailed in the SAI Report 'Retirement Benefits Scheme Transfer Values – Mortality Bases Review' of June 2014. Essentially scaling factors applicable to standard mortality tables were derived to produce a transfer value amount (in respect of a 'typical' member) that equated to a transfer value calculated used the observed mortality rates emerging from the 2013 SAPS study. The calculation made allowance for future mortality improvements in line with those used by the CSO in its 2013 population and labour force projections (i.e. initial rates of 3% (males) and 2.5% (females) tending to a long-term rate of improvement of 1.5% p.a. by 2036).

The recommended basis was 88% ILT15 (males) and 91% (ILT15) with CSO (2013 version) improvements from 2011. In practice, a proxy basis (58% ILT15 (males) / 62% ILT15 (female) in conjunction with annual improvement loadings (for each year between 2014 and year of retirement) was derived as an approximation to a two-dimensional generation-based table.

Comparison with 88% ILT15 / 91% ILT15

No allowance for mortality improvements

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	160.0%	245.6%	147.1%	153.7%
60-69	73.9%	76.3%	77.0%	82.6%
70-79	74.1%	71.1%	80.0%	81.4%
80-89	80.8%	78.5%	81.5%	82.9%
90+	109.5%	104.1%	106.4%	103.0%
All ages	81.8%	86.1%	83.7%	88.4%
60+	80.3%	82.8%	83.0%	87.5%
95% CI[8] lower – all ages	80.0%	83.8%	81.4%	84.5%

[8] Confidence intervals at the 95% level are included – see appendix D for more detail on the calculation methodology. The confidence intervals only capture statistical fluctuations from the central position based on the size of the dataset. There are many factors which impact mortality that can change over time which are not captured in this simple statistical based confidence interval.

95% CI upper – all ages	83.6%	88.3%	86.0%	92.3%

With allowance for CSO (2013 version) mortality improvements from 2011 (year of use = 2016)

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	189.7%	283.5%	174.4%	177.5%
60-69	87.6%	88.1%	91.3%	95.4%
70-79	87.8%	82.1%	94.8%	94.0%
80-89	95.8%	90.6%	96.6%	95.7%
90+	123.4%	114.2%	119.9%	113.4%
All ages	96.5%	98.1%	98.7%	100.9%
60+	94.7%	94.4%	97.9%	99.9%

It is evident that actual experience is quite close to that expected by reference to the standard transfer value mortality incorporating the assumed level of improvements to 2016. The fit is closer still when public sector data is excluded. The result also suggests that the assumed rate of mortality improvements have been a reasonably good fit to the underlying experience.

5.3 Comparison with ILT16

No allowance for mortality improvements

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	163.7%	254.6%	150.7%	159.3%
60-69	75.5%	79.0%	78.6%	85.5%
70-79	76.4%	73.2%	82.6%	83.7%
80-89	83.4%	81.6%	84.1%	86.2%
90+	99.5%	96.7%	96.9%	95.8%
All ages	83.1%	86.8%	85.1%	89.1%
60+	81.6%	83.4%	84.4%	88.2%
95% CI lower – all ages	81.3%	84.6%	82.7%	85.2%
95% CI upper – all ages	84.9%	89.1%	87.4%	93.15%

IILMI comparison – all ages	**Male: 75%**	**Female: 86%**

With allowance for mortality improvements from 2011

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	173.6%	268.6%	160.1%	168.0%
60-69	81.5%	83.9%	84.9%	90.9%
70-79	85.8%	81.1%	92.7%	92.9%
80-89	92.7%	89.1%	93.5%	94.1%
90+	100.9%	96.5%	98.3%	95.7%
All ages	91.2%	92.4%	93.4%	95.0%
60+	89.6%	88.8%	92.7%	94.0%

5.4 Comparison with ILT17

On 7 July 2020 the CSO released the Irish Life tables No.17 report. The life tables in this report are representative of mortality experience in Ireland in 2016 as they use 2015, 2016 and 2017 estimates and census of population and deaths recorded in the three years. As this central year in this base table closely coincides with the midpoint of the SAPS experience no allowance for improvements over the intervening period is necessary.

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	193.2%	278.7%	177.8%	175.1%
60-69	87.4%	85.5%	91.1%	92.5%
70-79	84.9%	79.1%	91.6%	90.4%
80-89	86.0%	84.0%	86.7%	88.7%
90+	102.3%	96.3%	99.0%	95.5%
All ages	**89.6%**	**90.2%**	91.2%	92.2%
60+	87.8%	86.6%	90.3%	91.2%
95% CI lower – all ages	87.7%	87.8%	88.6%	88.1%
95% CI upper – all ages	91.6%	92.5%	93.7%	96.3%

5.4.1

It is interesting to trace the development of the Irish Life tables over time relative to the SAPS experience. When the older ILT tables are adjusted for intervening improvements the results are very similar.

Including DPER data	**Comparison of unadjusted base tables**		**Comparison of adjusted base tables – with allowance for improvements**	
All ages	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
ILT17	89.6%	90.2%	89.6%	90.2%
ILT16	83.1%	86.8%	91.2%	92.4%
ILT15	72.0%	78.3%	89.6%	91.1%

5.5.1 Comparison with PNL00

No allowance for mortality improvements

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	215.1%	306.2%	194.1%	192.6%
60-69	76.8%	82.3%	80.0%	89.1%
70-79	70.4%	63.8%	75.9%	72.8%
80-89	80.5%	78.7%	81.3%	83.2%
90+	116.3%	105.9%	113.7%	105.4%
All ages	81.7%	85.8%	83.3%	87.8%
60+	79.8%	82.2%	82.4%	86.7%
95% CI lower – all ages	79.9%	83.6%	81.0%	83.9%
95% CI upper – all ages	83.4%	88.0%	85.6%	91.7%

IILMI comparison – all ages	**Male: 73%**	**Female: 84%**

With allowance for mortality improvements from 2000

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	291.5%	397.9%	264.9%	250.0%
60-69	117.5%	116.6%	122.4%	126.3%
70-79	116.2%	97.6%	125.3%	111.3%
80-89	113.9%	103.2%	114.8%	109.0%
90+	130.0%	113.4%	127.2%	113.3%
All ages	119.9%	111.4%	121.8%	113.4%
60+	117.2%	106.7%	120.6%	112.0%

IILMI comparison – all ages	**Male: 100%**	**Female: 104%**

5.5.2 Comparison with PNA00

No allowance for mortality improvements

	Including DPER data		Excluding DPER data	
Age Band	**Male Amounts**	**Female Amounts**	**Male Amounts**	**Female Amounts**
Under 60	192.6%	324.7%	147.7%	213.9%
60-69	75.5%	88.4%	72.8%	100.1%
70-79	68.9%	63.5%	73.0%	71.5%
80-89	79.1%	79.7%	84.6%	83.2%
90+	112.9%	111.5%	114.3%	112.7%
All ages	79.8%	88.6%	81.9%	91.4%
60+	78.1%	84.3%	81.2%	89.8%

IILMI comparison* – all ages	**Male: 84%**	**Female: 92%**

*Amounts date was not used in the IILMI investigation due to credibility concerns. Therefore the A/E ratios quoted in the IILMI report reflect expected deaths as determined using amounts derived standard tables Qxs applied to lives data.

With allowance for mortality improvements from 2000

	Including DPER data		Excluding DPER data	
Age Band	**Male Amounts**	**Female Amounts**	**Male Amounts**	**Female Amounts**
Under 60	261.9%	422.7%	202.0%	277.6%
60-69	115.2%	124.8%	111.3%	141.2%
70-79	113.9%	97.2%	120.7%	109.4%
80-89	111.6%	104.7%	119.2%	108.9%
90+	126.2%	119.3%	128.0%	121.1%
All ages	117.1%	115.5%	120.4%	117.8%
60+	114.8%	109.9%	119.5%	115.6%

5.6.1 Comparison with S2PL

No allowance for mortality improvements

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	161.7%	231.3%	149.0%	143.8%
60-69	79.5%	83.1%	82.9%	89.9%
70-79	80.5%	73.8%	86.9%	84.3%
80-89	86.7%	85.5%	87.4%	90.4%
90+	109.8%	106.3%	107.5%	106.0%
All ages	87.5%	91.1%	89.6%	93.8%
60+	86.0%	87.9%	88.9%	93.1%
95% CI lower – all ages	85.6%	88.8%	87.1%	89.7%
95% CI upper – all ages	89.4%	93.5%	92.1%	98.0%

IILMI comparison – all ages	**Male: 79%**	**Female: 90%**

With allowance for mortality improvements from 2007

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	182.7%	259.3%	168.7%	161.3%
60-69	95.5%	96.2%	99.7%	104.2%
70-79	102.9%	92.3%	111.2%	105.6%
80-89	105.4%	99.9%	106.3%	105.5%
90+	114.5%	108.1%	112.2%	108.1%
All ages	105.8%	103.9%	108.4%	107.0%
60+	104.1%	100.2%	107.7%	106.2%

5.6.2 Comparison with S2PA

No allowance for mortality improvements

	Including DPER data		Excluding DPER data	
Age Band	**Male Amounts**	**Female Amounts**	**Male Amounts**	**Female Amounts**
Under 60	161.4%	219.6%	125.7%	141.2%
60-69	81.2%	81.2%	78.4%	91.8%
70-79	77.0%	69.2%	81.7%	77.9%
80-89	88.1%	82.0%	94.2%	85.5%
90+	107.8%	106.1%	109.4%	107.4%
All ages	86.7%	88.4%	89.2%	91.5%
60+	85.2%	84.9%	88.8%	90.5%

IILMI comparison* – all ages	**Male: 92%**	**Female: 93%**

*Amounts date was not used in the IILMI investigation due to credibility concerns. Therefore the A/E ratios quoted in the IILMI report reflect expected deaths as determined using amounts derived standard tables Qxs applied to lives data.

With allowance for mortality improvements from 2007

	Including DPER data		Excluding DPER data	
Age Band	**Male Amounts**	**Female Amounts**	**Male Amounts**	**Female Amounts**
Under 60	182.5%	246.2%	142.4%	158.5%
60-69	97.4%	93.8%	94.2%	106.1%
70-79	98.4%	86.5%	104.4%	97.6%
80-89	107.1%	96.1%	114.5%	99.8%
90+	112.3%	107.9%	114.1%	109.5%
All ages	104.8%	101.0%	108.1%	104.1%
60+	103.2%	97.0%	107.7%	102.9%

5.7.1 Comparison with S3PL

No allowance for mortality improvements

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	186.5%	309.6%	173.5%	192.9%
60-69	98.8%	105.3%	103.1%	114.0%
70-79	98.6%	93.0%	106.3%	106.1%
80-89	98.1%	96.3%	98.8%	101.7%
90+	110.7%	105.8%	108.5%	105.7%
All ages	101.7%	103.6%	103.7%	105.8%
60+	100.0%	99.6%	103.0%	104.6%
95% CI lower – all ages	99.5%	101.0%	100.9%	101.1%
95% CI upper – all ages	103.9%	106.3%	106.6%	110.4%

With allowance for mortality improvements from 2013

	Including DPER data		Excluding DPER data	
Age Band	**Male Lives**	**Female Lives**	**Male Lives**	**Female Lives**
Under 60	192.8%	319.3%	179.6%	198.9%
60-69	102.7%	108.6%	107.2%	117.6%
70-79	105.2%	98.5%	113.4%	112.4%
80-89	104.4%	101.7%	105.2%	107.4%
90+	111.6%	105.3%	109.4%	105.4%
All ages	107.1%	107.3%	109.4%	109.6%
60+	105.3%	103.1%	108.6%	108.5%

5.7.2 Comparison with S3PA

	Including DPER data		Excluding DPER data	
Age Band	**Male Amounts**	**Female Amounts**	**Male Amounts**	**Female Amounts**
Under 60	190.4%	338.5%	149.5%	219.1%
60-69	103.9%	116.1%	100.3%	131.3%
70-79	98.3%	96.7%	104.2%	108.8%
80-89	101.5%	96.0%	108.5%	99.7%
90+	111.8%	106.8%	113.5%	108.3%
All ages	103.9%	106.8%	106.9%	108.5%
60+	102.2%	101.9%	106.4%	106.8%

With allowance for mortality improvements from 2013

	Including DPER data		Excluding DPER data	
Age Band	**Male Amounts**	**Female Amounts**	**Male Amounts**	**Female Amounts**
Under 60	197.0%	349.3%	154.9%	226.0%
60-69	107.9%	119.6%	104.3%	135.3%
70-79	104.9%	102.3%	111.2%	115.2%
80-89	108.0%	101.4%	115.5%	105.1%
90+	112.6%	106.3%	114.4%	108.0%
All ages	109.4%	110.5%	112.7%	112.3%
60+	107.6%	105.5%	112.2%	110.5%

6. Mortality improvement rates

The following table shows Actual / Expected experience measured against the PNL00 tables arising from both the current and previous studies, for all schemes (including DPER data):

	2020 study		2013 study	
Age Band	**Male Lives PNML00**	**Female Lives PNFL00**	**Male Lives PNML00**	**Female Lives PNFL00**
Under 60	215.1%	306.2%	193%	249%
60-69	76.8%	82.3%	90%	99%
70-79	70.4%	63.8%	81%	77%
80-89	80.5%	78.7%	104%	94%
90+	116.3%	105.9%	124%	111%
All ages	81.7%	85.8%	96%	96%
60+	79.8%	82.2%	95%	94%

Based on the time interval of 5.583 years between exposure mid-points for both studies (March 2010 and October 2016), the implied improvement rates are:

Age Band	Male Lives PNML00	Female Lives PNFL00
All ages	2.9% p.a.	2.0% p.a.
60+	3.1% p.a.	2.4% p.a.

The 2013 study reported an annual rate of improvement (all ages) between the 2008 and 2013 studies of 2.2% and 2.0% for males and females respectively. The 2020 study suggests that the rate of improvement in male mortality has accelerated slightly while female mortality improvement rates have remained stable.

Analysis by reference to PNXA00 tables

	2020 study		2013 study	
Age Band	**Male Amounts PNMA00**	**Female Amounts PNFA00**	**Male Amounts PNMA00**	**Female Amounts PNFA00**
Under 60	192.6%	324.7%	178.00%	311.00%
60-69	75.5%	88.4%	89.00%	129.00%
70-79	68.9%	63.5%	82.00%	88.00%
80-89	79.1%	79.7%	101.00%	97.00%
90+	112.9%	111.5%	121.00%	122.00%
All ages	79.8%	88.6%	96.00%	107.00%
60+	78.1%	84.3%	95.00%	104.00%

Age Band	Male Amounts PNMA00	Female Amounts PNFA00
All ages	3.3% p.a.	3.3% p.a.
60+	3.4% p.a.	3.7% p.a.

Analysis by reference to S2PL tables

	2020 study		2013 study	
Age Band	**Male Lives S2PL**	**Female Lives S2PL**	**Male Lives S2PL**	**Female Lives S2PL**
Under 60	161.7%	231.3%	145.00%	184.00%
60-69	79.5%	83.1%	92.00%	99.00%
70-79	80.5%	73.8%	92.00%	88.00%
80-89	86.7%	85.5%	111.00%	102.00%
90+	109.8%	106.3%	117.00%	111.00%
All ages	87.5%	91.1%	102.00%	102.00%
60+	86.0%	87.9%	101.00%	101.00%

Age Band	Male Lives S2PL	Female Lives S2PL
All ages	2.7% p.a.	2.0% p.a.
60+	2.8% p.a.	2.5% p.a.

Analysis by reference to S2PA tables

	2020 study		2013 study*	
Age Band	**Male Lives S2PA**	**Female Lives S2PA**	**Male Lives S2PA**	**Female Lives S2PA**
All ages	86.7%	88.4%	104%	107%
60+	85.2%	84.9%	103%	105%

*As reported in the SAI Report 'Retirement Benefits Scheme Transfer Values – Mortality Bases Review' of June 2014

Age Band	Male Lives S2PA	Female Lives S2PA
All ages	3.2% p.a.	3.4% p.a.
60+	3.3% p.a.	3.7% p.a.

The analysis of improvements by reference to the S2 lives tables confirms a similar trend to the implied rates from the change in A/E ratios derived from the PNL00 comparison.

Similarly, an analysis of improvements by reference to the PNA00 and S2 amounts tables confirms a similar trend as their lives-based equivalents. However, the 2013 study noted that amounts-based data for 20% of lives was not available and a large percentage of this missing data was for female primary lives – hence the A/E ratios from 2013, which is a baseline for the rate of improvements over the intervening period, should be treated with a degree of caution.

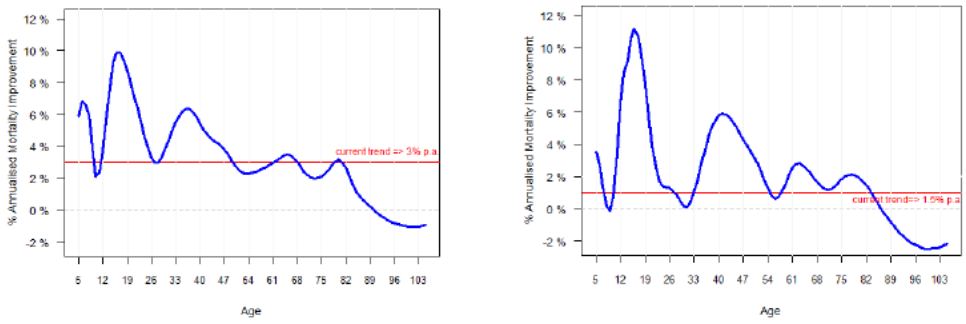
Overall it is evident that Irish mortality has continued to improve. For comparison purposes, the following rates of improvement have been noted in recent times by Rabia Naqvi and Shane Whelan based on data supplied by the CSO:

Period	Males p.a.	Females p.a.
2005 to 2015	2.9%	2.4%
2010 to 2015	3.0%	1.5%
2012 to 2015	2.6%	1.6%

Source: Table II from Future Life expectancies in Ireland: Rabia Naqvi & Shane Whelan, UCD

The trend of recent reductions in the rate of mortality improvement has been noted in previous work. Rabia Naqvi and Shane Whelan note in their paper "Future Life Expectancies in Ireland" that

- there has been a significant shift in the trend of mortality improvements internationally since about 2011
- the CMI (March 2018[9]) reported that average mortality improvements over the six years since 2011 have been 0.5% p.a. for males and 0.1% p.a. for females, significantly lower than for any other six-year period. However, the briefing note also commented "There is considerable debate about the causes of this slowdown, whether low improvements will persist and for how long. The latest data provides increasing evidence that the low level of recent mortality improvements may be due to medium- or long-term influences, rather than just short-term events such as influenza in early 2015. However almost all users of the CMI Model expect that mortality will continue to improve, even if this is at a slower rate than in the first decade of this century"
- there is a broad, albeit uneven, pattern of mortality improvements reducing as age increase, with those aged above 90 years (both male and female) recording increasing mortality rates over the period
- graphs showing annual rates of improvement by age 2010-2015 relative to a trend line of 3% p.a. (males) and 1.5% p.a. (females)



(a) Male (b) Female

Figure 2. Percentage annual rate of mortality improvement by gender and age, Ireland, 2010-2015
Source: Authors' calculations based on data supplied by the CSO (see CSO (2018) and CSO (2013)).

The CSO, in preparing population and labour force projections, make assumptions about future mortality rates using a 'targeting' approach. This approach involves estimating the current rate of improvement for each sex and assuming that this rate of improvement will decline over a twenty-five year period to a long-term average improvement rate not dissimilar to the rates observed in the long-term past. The current short term (or initial) rates of mortality have been reduced in recent times as noted below while the long-term rate of improvement has been maintained at 1.5% p.a.

CSO Population & Labour Force projections Report	Males p.a.	Females p.a.
2011-2041	5.0%	3.5%
2016-2046	3.0%	2.5%
2017-2051	2.5%	2.0%

The results outlined above from this 2020 SAPS study above do not appear to be inconsistent with the CSO's recent experience although this study also suggests that the decline in female improvements has appeared to have been arrested.

[9] Briefing note issued alongside the release of the 2017 update to the CMI mortality projections model

7. Results by pension amount

The 2008 SAPS study and previous work by the CMI identified an inverse relationship between pension amount and mortality experience; this link becomes weaker at older ages.

The following table shows the results of our study broken down by pension band and expressed as a percentage of the S3 tables. The analysis including DPER data showed an anomalous result in the amount band €10-20k, possibly due to a data error in how the data was compiled for this purpose. Consequently we have conducted this analysis by omitting the DPER data.

This study introduced an additional pension band relative to the previous study, namely pensions of €1,000 and below. However, the results for this band would not appear to provide any additional insight, possibly due to small data volumes and that the small pensions are likely attributable to short pensionable service.

The results confirm that markedly lighter mortality is exhibited by males as pension amounts increase while heavier mortality is evident for both genders in respect of smaller pension amounts.

Pension Band	Males Actual / Expected S3PML	Females Actual / Expected S3PFL	Proportion of lives
€1,000 and below	100.5%	107.1%	7.5%
€1,000 to €2,500	111.4%	125.5%	10.3%
€2,500 to €5,000	121.2%	118.1%	11.6%
€5,000 to €10,000	112.7%	102.5%	15.8%
€10,000 to €20,000	114.0%	96.5%	22.6%
€20,000 to €30,000	93.6%	100.7%	14.1%
€30,000 or above	75.6%	98.8%	18.2%
Overall	103.7%	105.8%	100.0%

The amounts exposures (€m) are given in the next table:

Pension Band	Male Exposure	Female Exposure	Total
€1,000 and below	7,774	7,356	15,129
€1,000 to €2,500	37,458	39,402	76,861
€2,500 to €5,000	88,652	102,624	191,276
€5,000 to €10,000	215,263	280,604	495,867
€10,000 to €20,000	1,072,830	792,699	1,865,528
€20,000 to €30,000	1,144,330	1,114,590	2,258,920
€30,000 or above	4,103,627	2,399,983	6,503,610
Overall	6,669,934	4,737,257	11,407,191

8. Results by industry classification

A rough split of schemes by industry type was as follows:

Industry	Number of Schemes	% of total lives	% of total lives (excl. public sector)
Consumer Goods	12	5%	12%
Industrials	7	7%	17%
Financials	9	6%	17%
Basic Materials	7	11%	28%
Oil & Gas	3	1%	2%
Healthcare	5	1%	2%
Public sector (excl. local authorities)	1	61%	-
Miscellaneous	2	1%	2%
Consumer services	2	5%	12%
Telecommunications	2	3%	8%
Utilities	1	0%	1%
Technology	1	0%	0%
Total	51	100%	100%

The table below sets out a comparison of A/E experience by industry for all ages by reference to the S3PL tables:

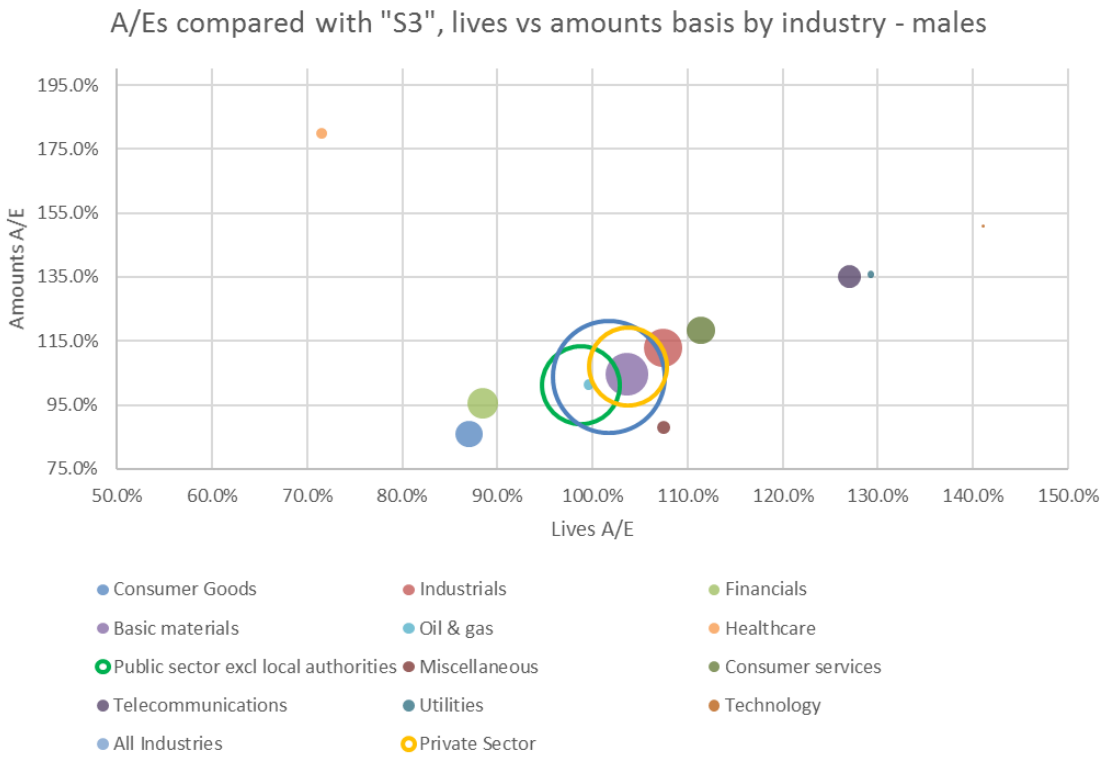
		A/E Deaths (lives)	
		A/E – S3PML	A/E – S3PFL
Industry	**Proportion of lives exposure**	**Males**	**Females**
Consumer Goods	4.5%	87.0%	90.9%
Industrials	6.5%	107.5%	112.5%
Financials	6.4%	88.4%	95.0%
Basic materials	11.0%	103.6%	109.9%
Oil & gas	0.7%	99.6%	85.1%
Healthcare	0.8%	71.5%	94.0%
Public sector (excl. local authorities)	61.0%	98.8%	102.6%
Miscellaneous	0.9%	107.5%	94.7%
Consumer services	4.7%	111.4%	117.8%
Telecommunications	3.1%	127.0%	126.3%
Utilities	0.3%	129.3%	101.3%
Technology	0.1%	141.1%	72.1%
Total	100.0%	101.7%	103.6%

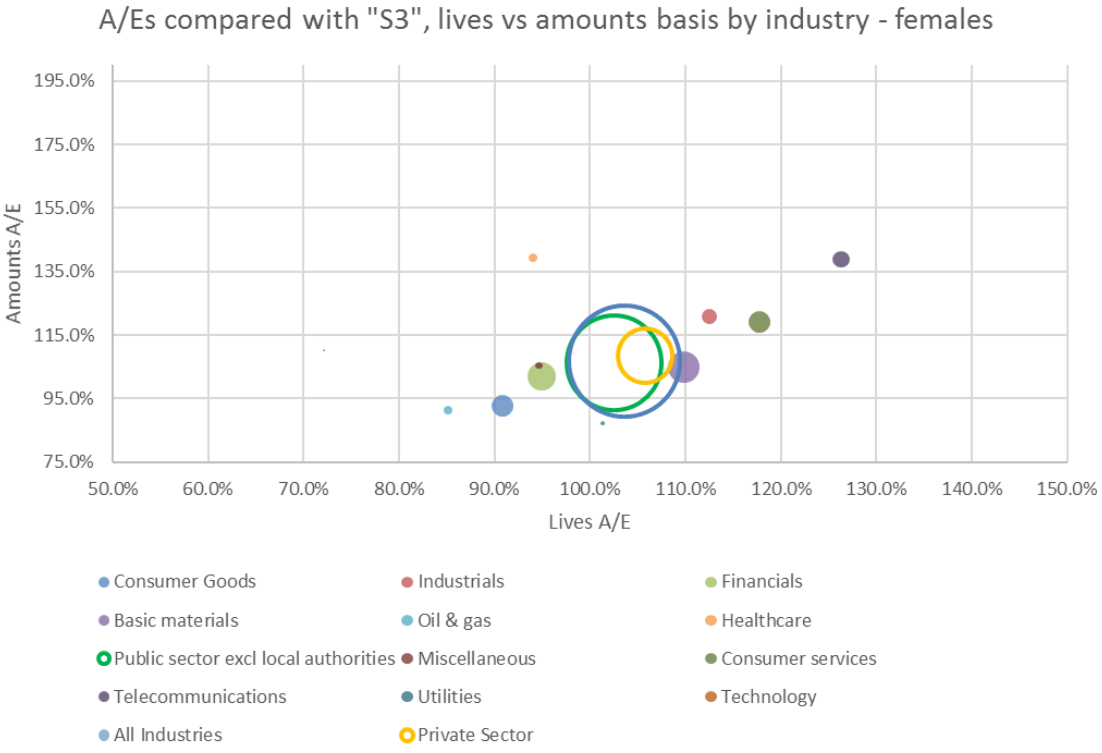
It is not particularly surprising that the Healthcare and Financial sectors exhibit lighter than average mortality while Industrials and Basic Materials show heavier experience (although the small proportion of exposed lives contained in the healthcare category should be noted). The Consumer Goods sector also appears to experience lighter than average mortality. The Other sectors contain insufficient data to draw meaningful conclusions.

A comparison of public sector versus private sector (including commercial State) is noted below.

		A/E Deaths (lives)			A/E Deaths (amounts)	
		A/E – S3PML	A/E – S3PML		A/E – S3PMA	A/E – S3PFA
Sector	**Proportion of lives exposure**	**Males**	**Females**	**Proportion of amounts exposure**	**Males**	**Females**
Private (incl. commercial state)	39%	103.7%	105.8%	33%	106.9%	108.5%
Public (excl. local authorities)	61%	98.8%	102.6%	67%	101.2%	106.3%
Total	100%	101.7%	103.6%	100%	103.9%	106.8%

Although an analysis of A/E by pension amount is not presented above in tabular format, the graphs below include amounts and lives in a pictorial format, where bubble size represents the lives exposure percentage.




A/Es compared with "S3", lives vs amounts basis by industry - females
195.0%
175.0%
155.0%
135.0%
115.0%
95.0%
75.0%
Amounts A/E
50.0%
60.0%
70.0%
80.0%
90.0%
100.0%
110.0%
120.0%
130.0%
140.0%
150.0%
Lives A/E
Consumer Goods
Industrials
Financials
Basic materials
Oil & gas
Healthcare
Public sector excl local authorities
Miscellaneous
Consumer services
Telecommunications
Utilities
Technology
All Industries
Private Sector

9. Conclusions

- It is clear that mortality rates in Irish self-administered pension schemes continues to improve and that rates of improvement are broadly in line with the experience seen in the 2013 study

- While other studies, notably by the CSO and consistently in the UK in recent years, have disclosed declining rates of improvement, the evidence in this study suggests that male rate of mortality improvements have accelerated marginally while female rates have remained stable

- The study confirms that actual experience is tracking quite closely to the mortality rates (when allowance is made for assumed improvements) underpinning the standard transfer value basis.

- The overall results are broadly consistent with those disclosed in the IILMI (Irish Insured Lives Mortality Investigation). In particular, actual over expected ratios relative to various standard tables are consistent for females while IILMI disclosed lighter mortality in respect of males. This is not particularly surprising given the well documented selection effect associated with annuitant mortality, notwithstanding that a large proportion of the insured lives population is likely to comprise of annuities secured by pension schemes that have wound up and therefore contained a mix of lives of varying health status.

- The 2013 study disclosed that Irish SAPS mortality experience was tracking reasonably closely to rates underlying the S2 tables derived from an analysis of UK occupational pension scheme mortality, albeit with a time lag. The A/E ratios (including public sector data) of the 2013 study relative to the S2PL tables (centred around 2007) were 102% (all ages) and 101% (60+). A similar picture has emerged in this 2020 study with Irish SAPS mortality closely matching rates underlying updated UK experience as set out in S3 tables (centred around 2013) – the corresponding A / E ratios are 102% (M) and 104% (F) for all ages and 100% for ages 60+. Again this result is based on including public sector data and is before adjusting for the 3 years' time gap between the respective studies' mid points. This result may assist Irish scheme actuaries in setting mortality assumption for ongoing funding valuation and accounting exercises subject to any adjustments appropriate for the membership profile of their schemes.

- At the time of finalising this report the CSO had just released Irish Life Tables No.17. The similar midpoint of these tables to the SAPS data is helpful and allows a direct comparison of Irish population and occupational pension scheme mortality over a common time period. In this context it is interesting that the SAPS experience approximates to 90% of population mortality with minimal differentiation by gender.

- The next step for the working party involved in the preparation of this report, subject to the approval of Council, is to refer it to another sub group of the demography committee to inform assumptions regarding future rates of mortality improvements in various ASPs as well as to the Pensions Committee for use in revising the base mortality tables employed in ASP PEN-12 (DC / PRSA projections) and ASP PEN-2 / s34 statutory guidance (transfer values).

- We recommend that the next SAPS study commence in 2022.

Appendix A – Data by age bands

The following tables outline the actual exposure and actual deaths by age-band and sex and by lives and amounts. The small amount of exposure after age 90 can be seen from the lives exposure.

(i) Including DPER data

Actual lives exposure by age-band

Age Band	Male	Female	Total
Under 60	38,016	38,107	76,123
60 to 70	124,252	123,158	247,410
70 to 80	92,892	61,551	154,443
80 to 90	39,053	34,186	73,239
Over 90	4,785	8,475	13,260
Total – all ages	298,999	265,477	564,476
Ages 60+	260,982	227,370	488,352

Actual number of deaths by age-band

Age Band	Male	Female	Total
Under 60	306	331	637
60 to 70	1,231	753	1,984
70 to 80	2,487	964	3,451
80 to 90	3,091	2,046	5,137
Over 90	1,112	1,630	2,742
Total – all ages	8,227	5,724	13,951
Ages 60+	7,921	5,393	13,314

Actual amounts (€'000s) exposure by age-band

Age Band	Male	Female	Total
Under 60	755,891	668,663	1,424,554
60 to 70	3,031,126	2,266,961	5,298,087
70 to 80	2,071,179	1,093,293	3,164,472
80 to 90	725,923	575,183	1,301,106
Over 90	85,815	133,156	218,971
Total – all ages	6,669,934	4,737,257	11,407,191
Ages 60+	5,914,043	4,068,594	9,982,637

Actual death amounts (€'000s) exposure by age-band

Age Band	Male	Female	Total
Under 60	4,998	5,970	10,968
60 to 70	23,673	12,837	36,510
70 to 80	42,928	15,309	58,237
80 to 90	51,895	31,467	83,362
Over 90	19,303	25,763	45,066
Total – all ages	142,797	91,346	234,143
Ages 60+	137,799	85,376	223,175

(ii) Excluding DPER data

Actual lives exposure by age-band

Age Band	Male	Female	Total
Under 60	11,026	8,668	19,694
60 to 70	58,735	25,395	84,130
70 to 80	52,956	18,996	71,952
80 to 90	25,096	13,307	38,403
Over 90	2,945	2,992	5,937
Total – all ages	150,758	69,358	220,116
Ages 60+	139,732	60,689	200,421

Actual number of deaths by age-band

Age Band	Male	Female	Total
Under 60	89	45	134
60 to 70	613	168	781
70 to 80	1,571	355	1,926
80 to 90	2,008	847	2,855
Over 90	667	559	1,226
Total – all ages	4,948	1,974	6,922
Ages 60+	4,859	1,929	6,788

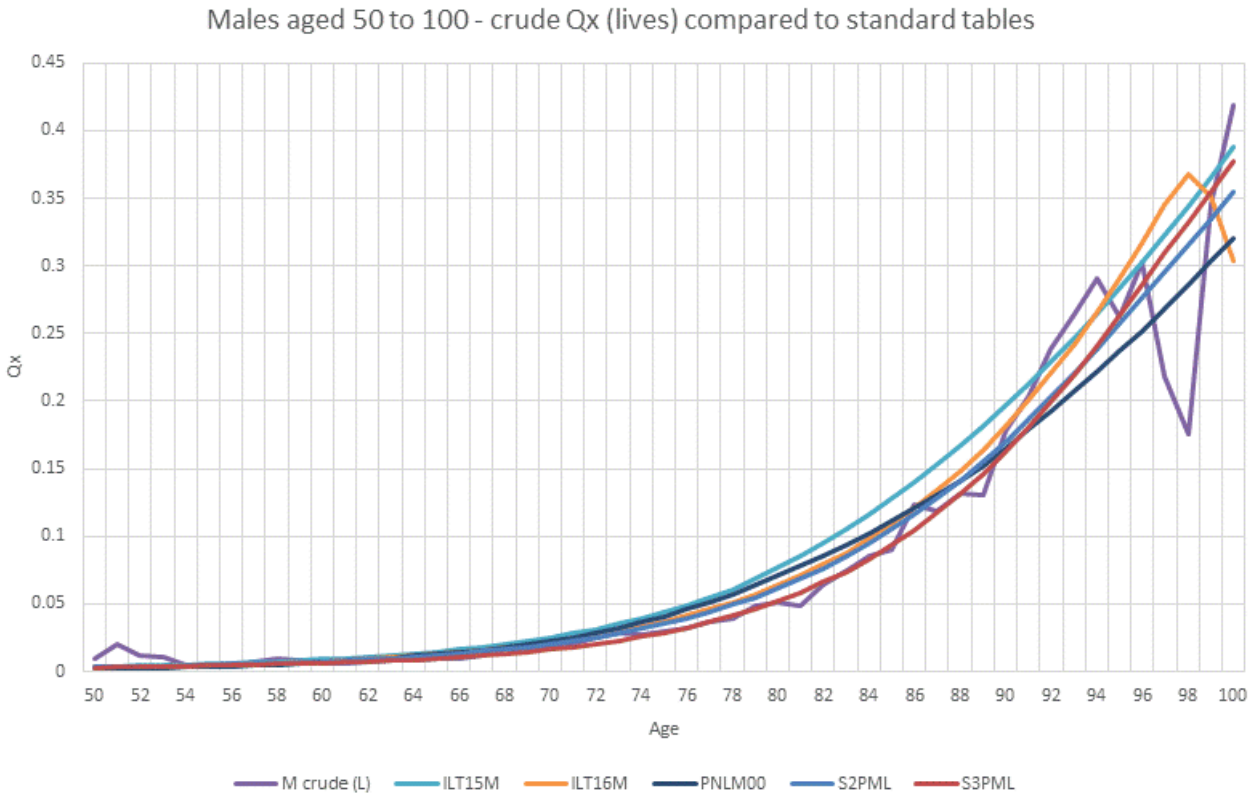
Actual amounts (€'000s) exposure by age-band

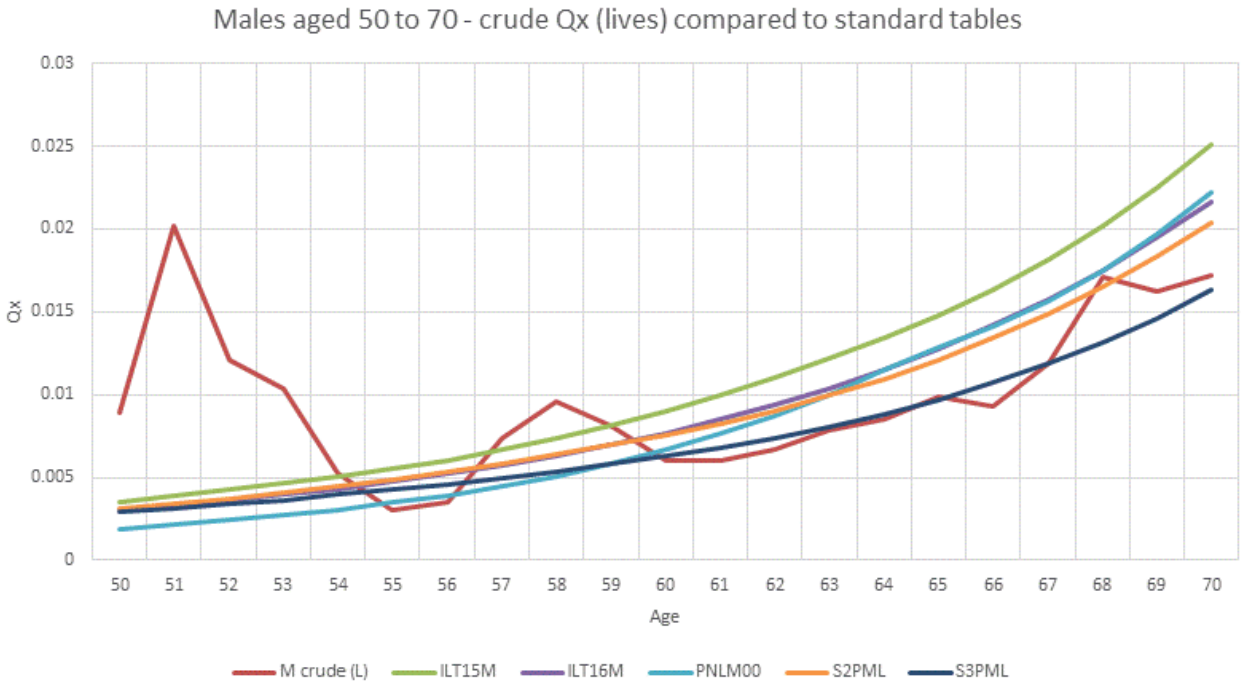
Age Band	Male	Female	Total
Under 60	207,455	118,540	325,995
60 to 70	1,292,677	353,715	1,646,392
70 to 80	996,261	208,961	1,205,222
80 to 90	353,549	138,377	491,926
Over 90	39,183	32,524	71,707
Total – all ages	2,889,125	852,117	3,741,242
Ages 60+	2,681,671	733,577	3,415,248

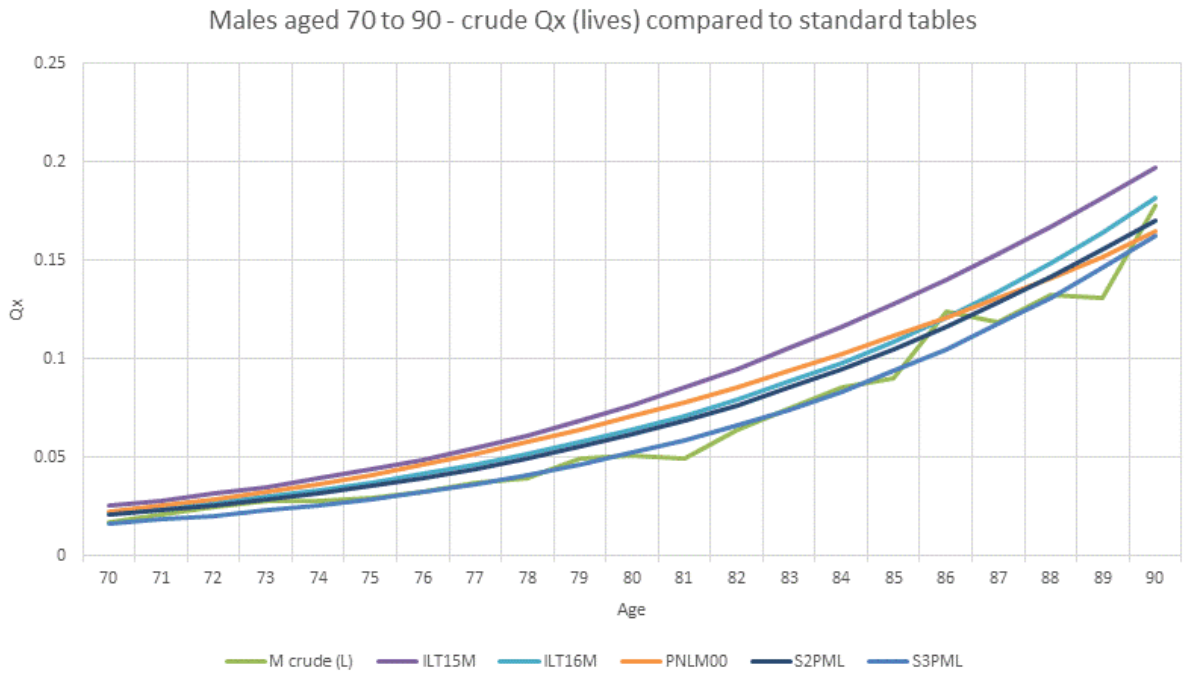
Actual death amounts (€'000s) exposure by age-band

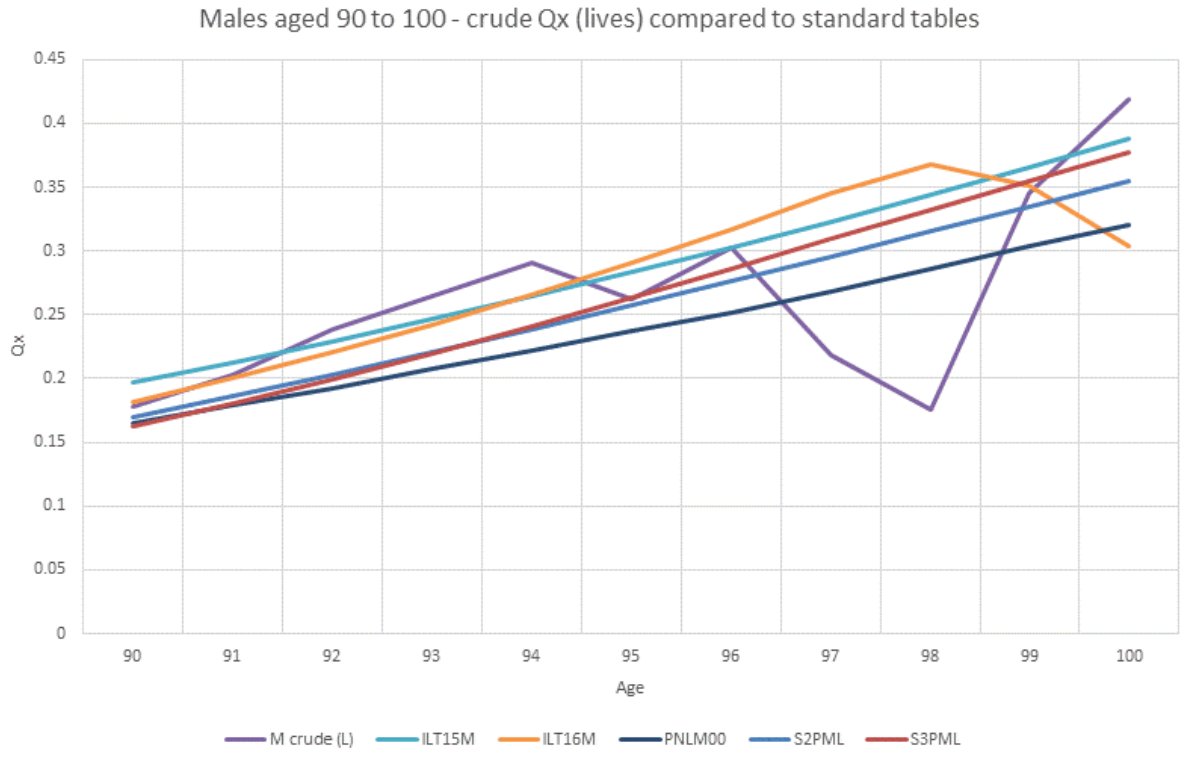
Age Band	Male	Female	Total
Under 60	1,145	646	1,791
60 to 70	9,838	2,259	12,097
70 to 80	22,183	3,361	25,544
80 to 90	27,132	8,079	35,211
Over 90	8,852	6,169	15,021
Total – all ages	69,150	20,514	89,664
Ages 60+	68,006	19,868	87,874

Appendix B1 – Graphical analysis (Males)

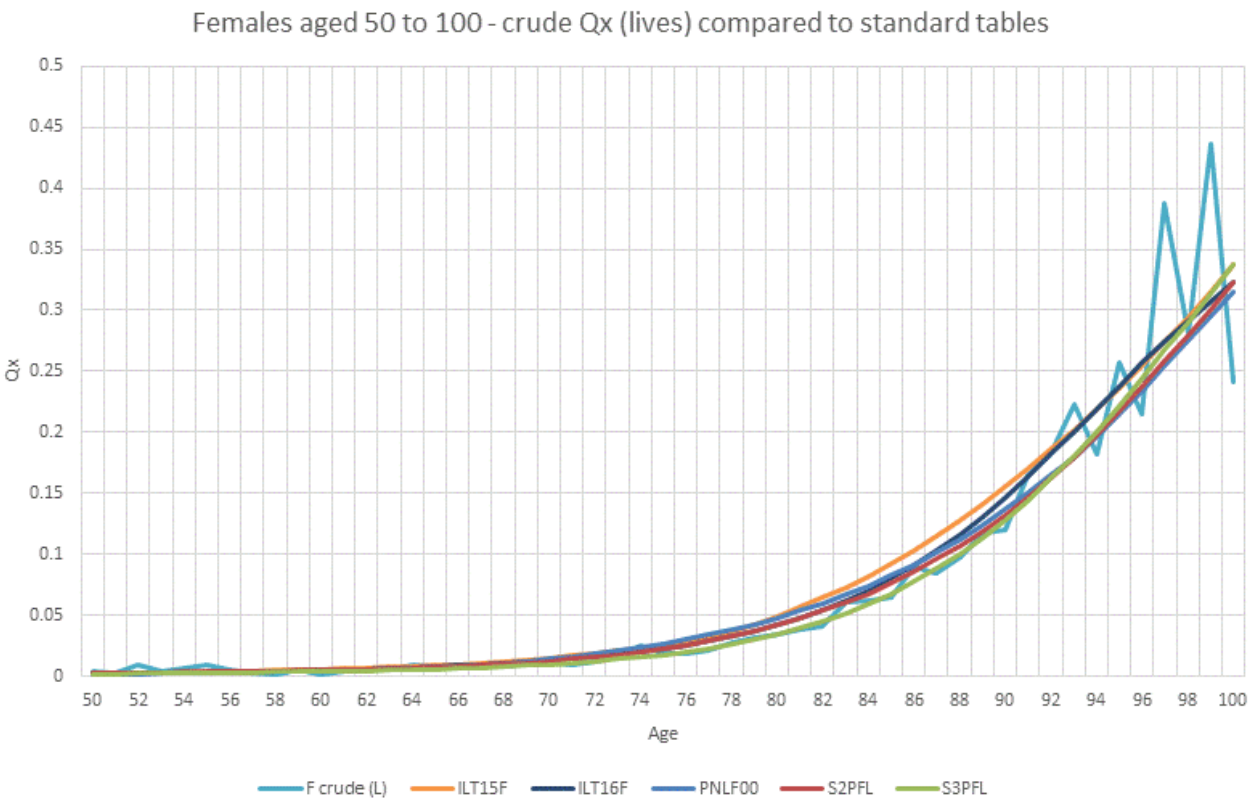


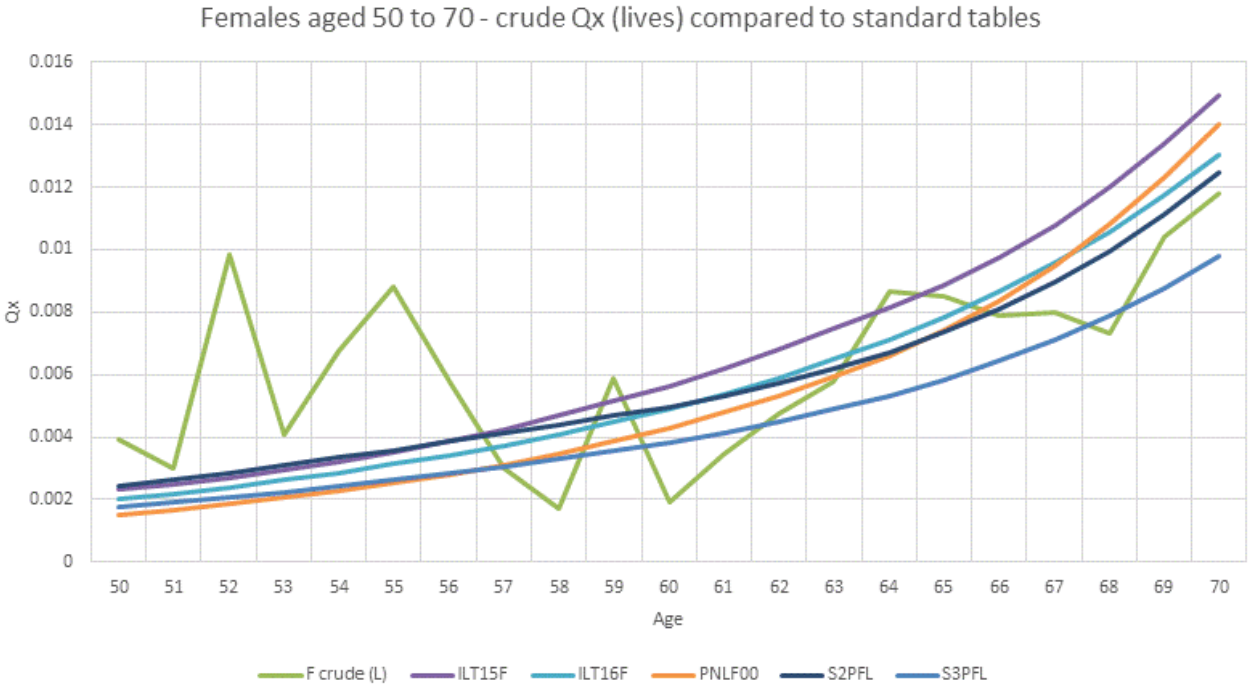


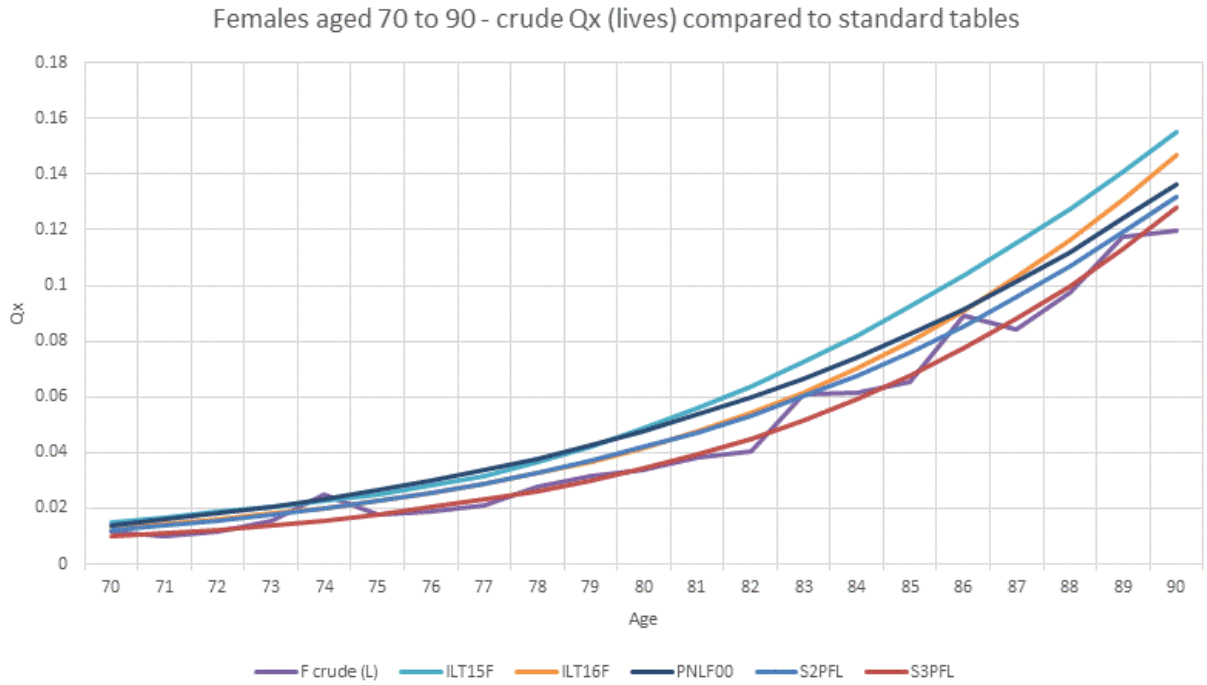

Males aged 70 to 90 - crude Qx (lives) compared to standard tables
0.25
0.2
0.15
0.1
0.05
0
Qx
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
Age
M crude (L)
ILT15M
ILT16M
PNLM00
S2PML
S3PML

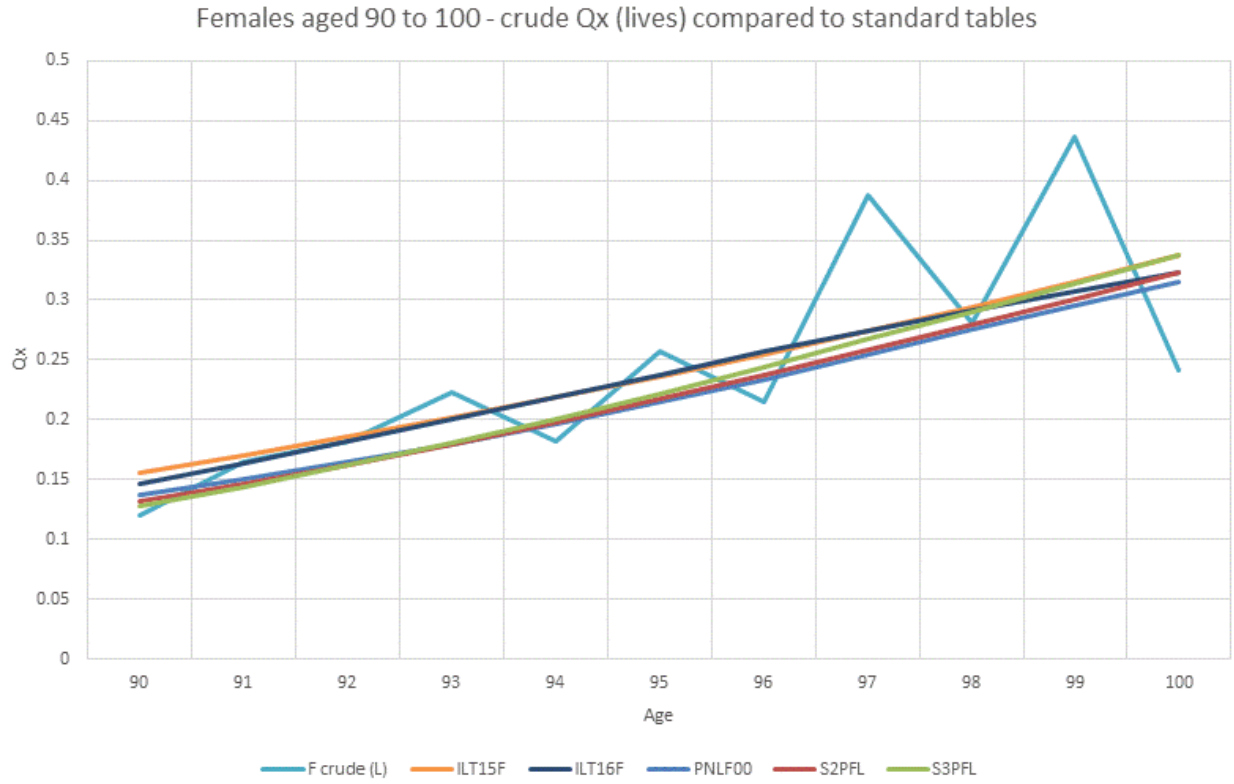

Males aged 90 to 100 - crude Qx (lives) compared to standard tables
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Qx
90 91 92 93 94 95 96 97 98 99 100
Age
M crude (L)
ILT15M
ILT16M
PNLM00
S2PML
S3PML

Appendix B2 – Graphical analysis (Females)

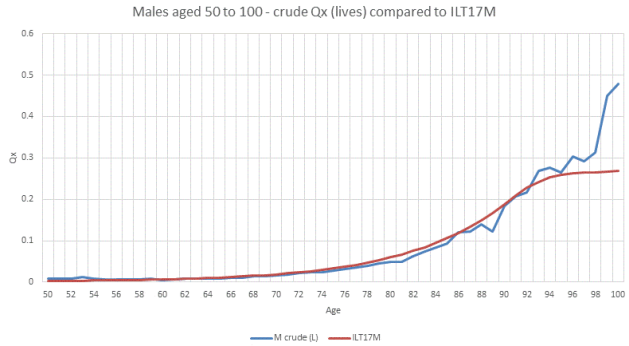


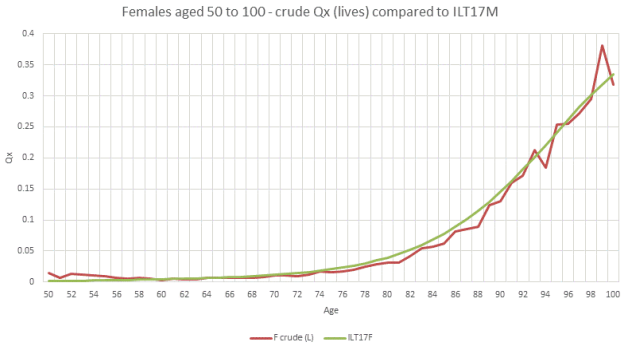


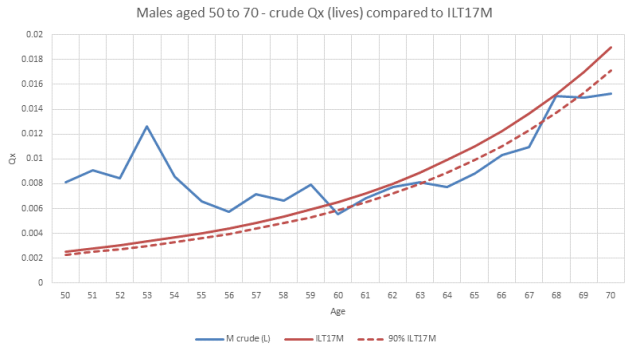

Females aged 70 to 90 - crude Qx (lives) compared to standard tables
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Qx
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
Age
F crude (L)
ILT15F
ILT16F
PNLF00
S2PFL
S3PFL

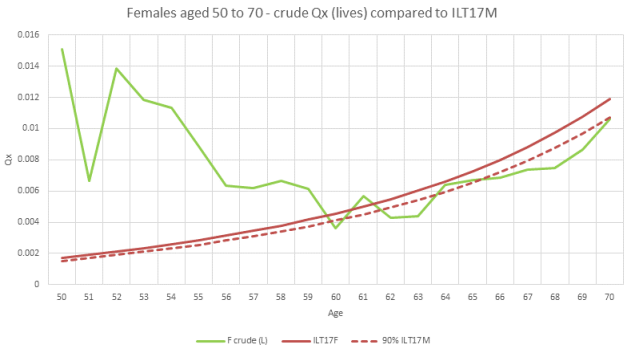

Females aged 90 to 100 - crude Qx (lives) compared to standard tables
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Qx
90 91 92 93 94 95 96 97 98 99 100
Age
F crude (L)
ILT15F
ILT16F
PNLF00
S2PFL
S3PFL

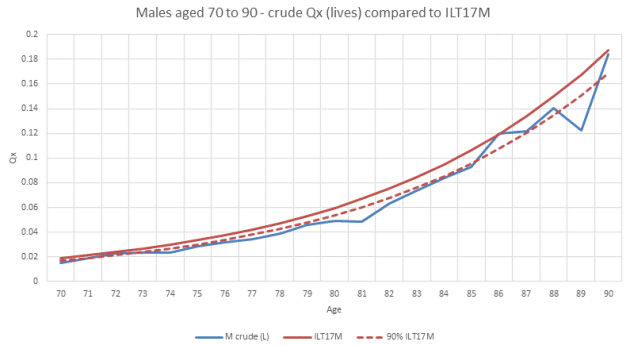
Appendix B3 – Graphical comparison with ILT 17

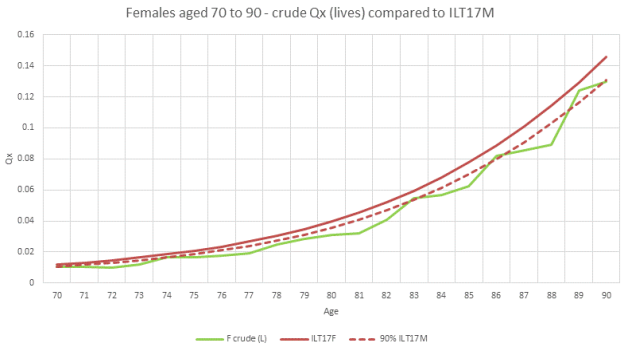


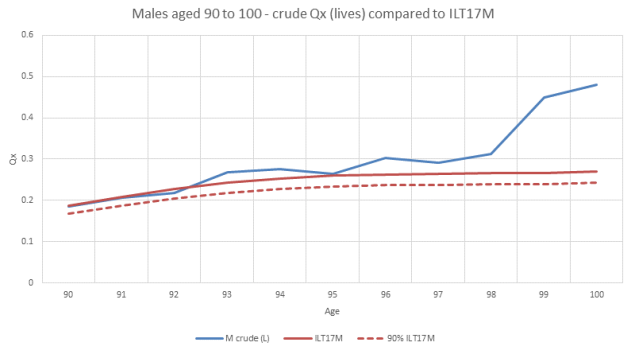


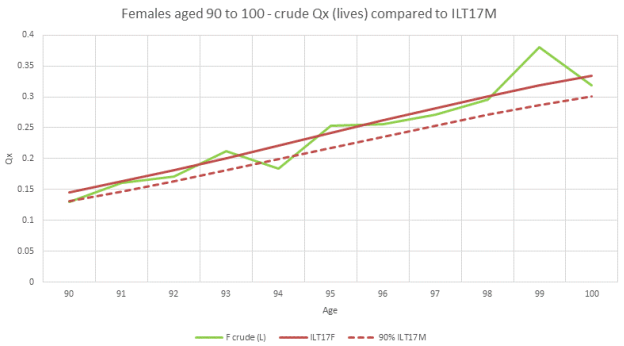












Appendix C1 – Methodology

Template

Each actuarial consultancy (or DPER) was asked to complete a standardised template in respect of each participating pension scheme. Exposed to risk example calculations and rules were provided to promote consistency in approach.

An extract from a sample template is set out in appendix C2.

This approach is the same as employed in the 2013 study and we believe it has produced reliable results. However, neither the Working Party nor Society is not responsible for the data submitted by individual contributors.

Data

The underlying data comprised of pensioners in receipt of a pension from a self-administered pension scheme at the start of the investigation period. The pensioner either survived for the duration of the investigation or died, in which case a spouse's pension may have commenced. Where applicable, the spouse was treated as a new life entering the investigation with effect from the date of death of the primary life. The population may also have been increased by the addition of new pensioner lives as a result of retirements during the investigation period.

Data fields – the following data items per individual life were used in the calculation of the exposed to risk

- Date of Birth
- Sex
- Date pension commenced
- Amount of pension
- Date of death (if applicable)

In many cases date of death was not available so an assumption was made that the death occurred half way through the investigation period.

Pension amounts reflected the level in payment at the start of the investigation period (or date pension commenced if later). No adjustments were made for pension increases or other changes in pension amounts during the investigation period e.g. cessation of bridging pension.

All pensioner exits from the investigation were assumed to be due to death rather than other possible reasons e.g. cessation of a temporary pension or cessation due to re-marriage of a spouse (an archaic feature of some pension scheme rules).

Template calculations

The initial exposed to risk was calculated using the census method and life year age interval. This method is the same is used in previous SAPS studies and appropriate for working with q_x rather than m_x or μ_x (which are consistent with central exposed to risk).

For each life, the central exposed to risk, E_x^c at each age x, was calculated as the period observed alive aged x last birthday during the investigation.

To calculate the initial exposed to risk, E_x, the central exposed to risk calculation was adjusted in respect of any deaths during the investigation period by the addition of the remaining period from date of death to age x+1 (even if this resulted in adding periods beyond the end date of the investigation).

For the amounts analysis the contribution to the amounts exposed to risk from each member was calculated similarly to the lives exposed to risk but weighted by pension amounts.

Aggregated calculations

55 templates were received and aggregated by the Working Party to calculate observed or crude q_xs.

Mathematically this can be expressed using the formula:

$$q_x = \frac{\sum_i D_{x,i}}{\sum_i E_{x,i}}$$

where $D_{x,i}$ is the number of deaths aged x last birthday for scheme i and $E_{x,i}$ is the corresponding initial exposed to risk submitted.

Comparisons with standard tables

Results are presented in terms of Actual deaths ("A") over Expected deaths ("E") where "E" is calculated by reference to standard tables.

$$Expected\ Deaths\ at\ Age\ x = Actual\ Exposure\ at\ Age\ x \times q_x^s$$

where q_x^s is the mortality rate at age *x* from the standard table.

Confidence Intervals

Confidence intervals, where shown, are at a 95% level and are calculated in line with the methodology set out in CMI working paper 62 for lives analysis. In summary 95% confidence intervals of the lives weighted 100A/Es were estimated by assuming that the number of deaths follows a Poisson distribution. The following formula, as specified in working paper 62, was used to calculate the confidence intervals (CI) for lives-based analysis:

CI= [$100A/E - 1.96 \times s.d.$, $100A/E + 1.96 \times s.d.$]

Where $Standard\ Deviation$ ($s.d.$) = $\sqrt{A}/E \times 100$ and A is the actual number of deaths and E is the expected number of deaths according to the comparator table.

Important: The confidence intervals only capture statistical fluctuations from the central position based on the size of the dataset. There are many factors which impact mortality that can change over time which are not captured in this simple statistical based confidence interval.

Confidence intervals for amounts weighted A/Es have not been calculated.

Allowance for mortality improvements

The standard tables used in the A/E comparisons are based on data for earlier years than the period covered by SAPS (2012-2018). Therefore, to allow for the impact of mortality improvements over the intervening period the A/E comparisons were repeated using the standard tables adjusted to reflect mortality improvements.

The improvements applied to the standard tables were obtained from the CMI_2016 mortality projection model. This provides smoothed estimates of the mortality improvements for the population

of England and Wales by age, gender and calendar year up to 31 December 2015 (a date close to the midpoint of this SAPS study). Details of the CMI mortality projection model and the smoothing method applied can be found in CMI working papers 97, 98 and 103. For this analysis the model's core (default) parameter values were used. The model is primarily designed to support estimates of projected improvements and therefore requires the user to input a long-term rate in order to produce an output. However, the mortality improvements used for analysis in this paper are based on actual, historic improvements and consequently are not dependent on the user provided long-term rate of improvement required by the model. Separate improvements were calculated for males and females. This allowance for mortality improvements enables a comparison of the SAPS experience relative to the CMI standard tables on a consistent basis over time.

When allowing for mortality improvements over time, the standard mortality rates, q_x^s, were improved as follows:

$$r_{x,y} = \prod_{c}^{y} (1 - f_{x,i})$$

$$q_{x,y}^{s} = q_x^s * r_{x,y}$$

where:

- $f_{x,i}$ is the improvement factor specified by the CMI_2016 model in respect of age x and calendar year i.
- c is the central year of the standard table.
- $r_{x,y}$ is referred to as the reduction factor for age x and calendar year y.
- $q_{x,y}^s$ is the improved standard mortality rate for age x and calendar year y.

The improved standard mortality rates were then used to derive the expected mortality as follows:

$$Expected\ Deaths\ at\ age\ x\ in\ year\ y = Actual\ Exposure\ at\ age\ x\ in\ year\ y \times q^s_{x,y}$$

Appendix C2 – Extract from sample template

DATA INPUTS

Enter data in cells shaded blue

For each scheme, please select an industry sector and exposure period from the drop down boxes:

- industry sector	Oil and gas
- Investigation start date	
- Investigation end date	
- exposure period (years)	0.00
Included in 2013 SAPS study	Yes
- Investigation start date (2013 study)	
- Investigation end date (2013 study)	

METHODOLOGY

Schemes with at least 250 pensioners (but ultimately at discretion of working party member)
Data covering last intervaluation period, in most cases
More recent data than at end of previous intervaluation period, if available
No earlier than start of previous intervaluation period
Split by age last birthday and gender
Exposure and deaths, in lives and amounts
Amount bands (based on amount at start of intervaluation period): €0 to €999, €1,000 to €2,499,

Exposure to risk rules

- Lives active at both the start and end of the year of age x last birthday will be assigned exposure of 1 year
- Deaths during the year of age x last birthday will be assigned exposure of 1 year
- Lives active at the end of the investigation period during the year of age x last birthday will be assigned exposure for the fraction of the year from exact age x to the end date
- Lives active at the start of the investigation period during the year of age x last birthday (but die before end of period or attaining age x+1) will be assigned exposure for the fraction of the year from the start date to the exact age x+1

NUMERICAL EXAMPLES OF EXPOSURE CALCULATION

Simple examples of actual death and exposure calculations :

	Life A	Life B	Life C
Pension start date	01/04/2012	01/02/2014	01/04/2012
Date of birth	10/05/1948	30/09/1948	10/05/1948
Date of death			01/04/2015
Current pension amount	€1,000 p.a.	€1,000 p.a.	€1,000 p.a.
Pension Band	€1000- €2,499	€1000- €2,499	€1000- €2,499

Age	Exposure (life years)		Deaths (lives)		Exposure (amount years)		Deaths (amounts)		Expected Deaths (lives)		Expected Deaths (amounts)	
	Combine	Combined	Combine	Combined	Combined	Combined	Combined	Combined	Combine	Combined	Combined	Combined
Last birthday	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
30	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-
36	-	-	-	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-	-	-	-
44	-	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-

Age	Exposure (life years)		Deaths (lives)		Exposure (amount years)		Deaths (amounts)		Expected Deaths (lives)		Expected Deaths (amounts)	
	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k	€1k-€2.5k
Last birthday	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
30	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-
36	-	-	-	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	-	-	-	-	-	-
40	-	-	-	-	-	-	-	-	-	-	-	-
41	-	-	-	-	-	-	-	-	-	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-	-	-	-
44	-	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-

Appendix D – Authorisation letter

Dear Trustee Chair

2020 SAPS mortality investigation

The Society of Actuaries in Ireland ("the Society") is about to embark on an updated study of the mortality experience of large Irish defined benefit self-administered occupational pension schemes (SAPS). In this context "large" is defined as having more than [250] pensioners and the investigation will typically cover experience in the most recent inter-valuation period falling between 2012 and 2017.

The purpose of the review is to identify any trends in longevity experience as it relates to Irish occupational pension schemes and inform Scheme Actuaries when setting appropriate mortality table assumptions for funding and accounting purposes. The results will also feed into future reviews of mortality assumptions used in the calculation of standard transfer values.

The Society has requested Scheme Actuaries to contact their trustee clients that are within scope for authorisation to include their scheme in the investigation. The analysis for your scheme will be carried out within [the scheme actuary's firm] and no individual member data will be passed to an external body. The results of the analysis will be aggregated before submitting to the Society for consolidation with the results from other schemes. The work will be carried out by members of the Society on a voluntary basis so there is no cost to individual schemes or employers.

We believe this is a worthwhile exercise and would be grateful if you could provide your authorisation to include the [ABC Defined Benefit Pension Scheme] in the study.

Yours sincerely

xxxx, FSAI
Scheme Actuary

Appendix E – Data Collection and the Irish Defined Benefit (DB) landscape

The Pensions Authority has released key statistics since 2014 about DB schemes subject to the funding standard – these statistics are compiled from annual actuarial data returns (AADR) submitted by Scheme Actuaries.

A summary of these statistics is set out below. More detail can be found in releases available on www.pensionsauthority.ie

Number of schemes subject to the funding standard

Year	2014	2015	2016	2017	2018	2019
Current	551	503	447	414	388	376
Frozen	152	163	181	197	194	194
Continuing	**703**	**666**	**628**	**611**	**582**	**570**
In Wind up	41	33	25	16	16	12
Total	**744**	**699**	**653**	**627**	**598**	**582**

Membership

Year	2014	2015	2016	2017	2018*	2019*
Pensioners	**97,868**	**100,585**	**102,015**	**102,971**	**98,458**	**101,063**
Actives	137,357	121,995	111,397	106,954	77,356	73,146
Deferreds	414,207	430,518	415,300	423,124	144,088	141,615
Total	649,432	653,098	628,712	633,049	319,902	315,824

Membership numbers were adjusted in 2019 (and 2018 re-stated) to reflect the removal on a large scheme were benefits are determined on a defined contribution basis

The 2020 study includes data from 51 separate schemes i.e. less than 10% of the number of continuing schemes. However it is estimated that the pensioner numbers included in the 2020 SAPS study, excluding Public Sector data, covers about 2/3rds of the DB industry pensioner population.

The collection of data was limited to schemes with more than 250 members in order to reduce the work involved. The study recognises that participation is voluntary and that it would be very cumbersome to try and collect exposure and death data from all Irish DB schemes. A decision was made as part of the 2008 (and maintained for the 2013 study) to ask schemes with more than 300 pensioners to participate. For the 2020 study the threshold was reduced to 250 so as to increase coverage but ultimately (as noted in the results template) left it to the discretion of individual contributing firms to determine what schemes to include. For the 2020 study, given increased concerns/authorisations regarding use of data, scheme actuaries were asked to obtain authorisation from the trustee boards for the schemes to participate, at least one trustee board declined.

All organisations acting as actuaries to SAPS were asked to contribute, either directly or via their representatives. All asked either did so or confirmed that they had no schemes that met criteria.

With coverage of about 2/3rds of the DB market, it is considered that the study is likely to be a fair representation of the market. It is unlikely that schemes where trustees declined to participate would have different underlying rates of mortality. It is possible that smaller schemes might have different typical pensions in payment and users are cautioned to consider this.

Exposure period

Scheme actuaries were asked to submit data based on the most recent triennial actuarial valuation. Most schemes would have been included in the 2013 study so this naturally avoided overlapping exposure periods. The variation in exposure periods is also a function of when the consultancy carried out the analysis, for example one consultancy returned their data in Sept and Dec 2018 so their schemes mostly cover the period 01/01/2012 – 01/04/2017 (although 3 ran beyond this end date). Another returned their data in June 2019 and coverage ran from 01/01/2013 to 31/12/2017.