

CMI WORKING PAPER 89

PROPOSED "08" SERIES ACCELERATED
CRITICAL ILLNESS TABLES

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The Continuous Mortality Investigation (CMI) has recently published a new Working paper, which is in response to a key finding from Working Paper 75 which was that: “The shape of the latest [accelerated critical illness] experience by age and duration shows significant variation from the AC04 tables, suggesting that new tables may be warranted”.

They are proposing a new series of “08” tables for Accelerated Critical Illness and hope to formalise them later in 2016. These tables will represent a major step forward as they are based on a far more extensive dataset than predecessor AC04 tables and were derived using a more conventional graduation methodology. As we have recently completed a similar exercise within SCOR I have endeavoured to show how our work compares where possible.

This working paper is of great value to the industry for many reasons and this paper that follows is merely a summary of the work done by the CMI. I would like to thank them for their hard work and would encourage you to read the whole paper.



WORKING PAPER 89 – A SUMMARY

This working paper provides:

1. Proposed “08” Series rates for the range of ages deemed appropriate for graduation.
2. Comparisons of the experience with the graduated rates using supplementary rating factors to assist actuaries to assess the appropriateness of the proposed tables and inform their use of the final tables.
3. Comparisons of the graduated rates with selected exiting tables, including AC04 Series.

4. An indicative approach to extending the age range to those ages where data was insufficient to graduate appropriately.
5. Comparison of the accelerated critical illness experience under endowment and whole of life contracts in 2007- 2010 with the graduated rates – noting that the rates were derived using business from term contracts only. Stand-alone critical illness experience is also compared against these rates.

Additionally they are releasing the following backing spreadsheets with this working paper:

- Proposed “08” Series tables with values of both μ_x and q_x for ages 30-65, including indicative rates at younger and older ages.
- All Offices results for 2007-2010 comparing the experiences of the graduations dataset with the proposed tables and indicative rates.
- The dataset that underlies the tables.

INPUT DATA

As this work was an update to Working Paper 75 the dataset underlying that was the starting point. Data included calendar years 2007 – 2010. All rated data was excluded. It was noted that the different offices would have covered different critical illnesses, using different definitions, at different times and that this was not adjusted for.

The dataset was adjusted to reflect incurred but not processed claims, referred to as “Incurred But Not Settled” or “IBNS” which was not done in Working Paper 75, although they did allow for claims paid to the end of 2011.

This was done by using the datasets with both settlement and claim dates included and calculating delays with a Chain Ladder method. This approach is a revision to historic CMI critical illness analysis as outlined in Working Paper 67.

The CMI also decided to use only term data as the endowment and whole of life data tends to be older by underwriting year and therefore have different underwriting and distribution practices underlying it. Overall they decided adding in this data could distort the graduation.

COMPARISON TO 100% T1	Graduation Dataset	
	Claims	Exposure
Term	20,889	9,866,073
Endowment	993	377,199
Whole of Life	776	198,369

TABLE 1

APPROACH TO GRADUATIONS

The CMI have reflected age, gender, duration, and smoker status in their proposed rates. Their approach was guided by analysis of the dataset using a generalised linear model (GLM).

This showed several results including:

- Age, gender, smoker status and duration are all important factors that should be reflected in the graduations.
- It was reasonable to graduate the "All Office" data as no office had substantially different age or duration shape so as to distort the results.

- Amounts-weighted results were unlikely to differ materially from lives-weighted graduations.
- Other factors were not significant enough once age and duration were allowed for to suggest a different shape of rates.

The approach taken was to favour a simpler graduation approach with fewer parameters where the graduation was materially the same. Graduation was only done over the ages where the data was considered reliable to ensure the older and younger ages with less data didn't distort the results.

The graduation formulae were chosen with regard to a number of statistical tests. The Akaike Information Criterion (AIC) was used as the principal test to select the graduation formulae. After considering a variety of methods it was proposed to use Simple Gompertz method to produce these tables.

It is worth noting that the CMI released Working Paper 77 in March 2015. This was a review of work undertaken by the CMI and made recommendations on modelling work.

Alongside this, software was released to make it easy for a user to investigate and undertake different graduations. This work has formed the basis of the graduations in this paper and is worth a review by actuaries undertaking such work.

PROPOSED GRADUATIONS

Given the volumes of exposure and numbers of claims in the dataset the CMI decided to graduate ultimate experience and adjust separately for shorter durations, consider the gender/smoker datasets independently and graduate males over 30-65 and females 30-60.

Selection

After considering data by smoker, gender mix and further investigating by age-groups it was decided to use a 3 year select period for male non-smokers, a 1 year select period for male smokers, a 5 year select

period for female non-smokers and a 2 year select period for female smokers. The data showed no significant reason to differentiate by age-band. **TABLE 2** summarises the rates at different durations as a percentage of ultimate rates:

LIVES	Duration 0	Duration 1	Duration 2	Duration 3	Duration 4	Duration 5+
Male non smoker	56%	82%	88%	100%	100%	100%
Male smoker	73%	100%	100%	100%	100%	100%
Female non smoker	68%	85%*	85%*	93%	96%	100%
Female smoker	74%	91%	100%	100%	100%	100%

TABLE 2 *experience at duration 2 was marginally lighter, so 1 and 2 were merged as this is unlikely to be a true feature of the data.
Source: Working Paper 89/Tables 4.I-4.4

COMPARISON OF GRADUATED RATES WITH UNDERLYING DATA

The graduated rates were compared to the underlying data using Office, Distribution Channel, Sum assured band, Product category, Commencement year and Calendar year. This analysis was conducted to identify any significant differences in shape by factors, as outlined above. However it also brought out any differences in level of experience by these factors.

The comparison was done using three methods:

- One-way A/E values using the full dataset, called "Full A/E" in the below.
- One-way A/E values using a reduced dataset, called "Modelling A/E" below. Any potential outliers or data points that appear to have undue influence on the model were removed before use in the GLM model.
- GLM A/E values. These should present a better indication of the importance of each factor as all other factors are also taken into account in the GLM model.

For Office the names couldn't be used to ensure confidentiality remained so the minimum and maximum A/Es are shown. There was significant variation as expected on this factor.

Office	Full A/E	Modelling A/E	GLM A/E
Minimum	72.4%	82.3%	83.9%
Maximum	121.3%	108.9%	111.5%
Weighted Average	101.0%	101.1%	100.2%

TABLE 3 Source: Working Paper 89/Table 5.1

Distribution Channel shows some variation on the modelled A/Es with a significant difference between Bancassurance and IFA. This, however, is shown not to be significant when office and other factors are included in the GLM model. Such anomalies highlight the importance of appropriate actuarial analysis for any dataset.

Distribution channel	Full A/E (Number of Claims)	Modelling A/E (Number of Claims)	GLM A/E
Bancassurance	104.4% (5,714)	105.5% (5,393)	101.3%
IFA	89.6% (6,159)	93.9% (5,893)	97.5%
Single Tie	101.7% (2,510)	97.9% (2,018)	100.3%
Unknown	111.3% (4,878)	102.8% (4,233)	102.0%

TABLE 4 Source: Working Paper 89/Table 5.2

The lowest sum assured band shows significantly lighter experience than the other bands.

Sum assured band	Full A/E (Number of Claims)	Modelling A/E (Number of Claims)	GLM A/E
0 (Unknown)	100.1% (6,194)	98.6% (5,721)	100.1%
1 (£0 - £25,000)	94.1% (2,828)	94.2% (2,501)	91.1%
2 (£25,001 - £75,000)	102.8% (6,145)	101.7% (5,596)	101.1%
3 (£75,001 - £125,000)	102.5% (2,587)	103.5% (2,369)	104.0%
4 (£125,001+)	100.0% (1,507)	102.1% (1,350)	103.3%

TABLE 5 Source: Working Paper 89/Table 5.3



The results in Family income benefit, Increasing term and unknown are too small to be significant. Decreasing and level term both show statistically consistent results.

Product Category	Full A/E (Number of Claims)	Modelling A/E (Number of Claims)	GLM A/E
Decreasing term	100.6% (11,770)	99.9% (11,389)	98.8%
Level term	100.0% (6,954)	99.7% (6,148)	101.6%
Family income benefit	115.8% (85)	-	-
Increasing term	100.3% (357)	-	-
Unknown term	75.4% (95)	-	-

TABLE 6 Source: Working Paper 89/Table 5.4

Commencement year was grouped together for analysis. Pre-1997 was removed for the more detailed models. The results were not statistically significant. There is a high correlation between Office and commencement year which suggests that the underlying underwriting practices are the driving factor for both.

Commencement year group	Full A/E (Number of Claims)	Modelling A/E (Number of Claims)	GLM A/E
Unknown	103.1% (8,899)	101.5% (8,542)	103.1%
Pre-1997	83.0% (124)	-	-
1997-2004	99.8% (6,540)	99.2% (5,908)	99.7%
2005-2010	95.7% (3,698)	96.5% (3,087)	97.5%

TABLE 7 Source: Working Paper 89/Table 5.5

The jump in 2008 experience could be a result of the Treating Customers Fairly (TCF) legislation that came into existence in 2008.

Calendar Year	Full A/E (Number of Claims)	Modelling A/E (Number of Claims)	GLM A/E
2007	99.8% (3,662)	94.7% (3,243)	95.9%
2008	104.6% (5,156)	104.8% (4,802)	104.4%
2009	99.4% (5,068)	99.4% (4,678)	99.2%
2010	97.6% (5,375)	99.2% (4,814)	98.9%

TABLE 8 Source: Working Paper 89/Table 5.6

COMPARISON AGAINST EXISTING TABLES

It was noted that comparison against existing tables is not hugely beneficial as a check on the graduation here. CIBT02 and CIBT08 are both based on population data, whereas the "08" series proposed here is based on insured data, with the added benefit of underwriting. They are both smoker aggregated as well. AC04 was proposed using earlier data, with different business mix and included Endowment and Whole of Life data. The CMI expect the proposed "08" tables to be more robust.

The comparisons gave some noticeable features including:

- The graduated rates differ significantly from AC04 and in most cases they are higher at younger ages, but lower at older ages.
- Male smokers, however, are more similar to the AC04 rates.
- AC04 was less smooth than the graduated rates are.
- Both CIBT tables, using population data, were significantly higher, as would be expected.

FIGURE 1 TO 4 Ultimate graduated rates as a percentage of selected existing rates by age

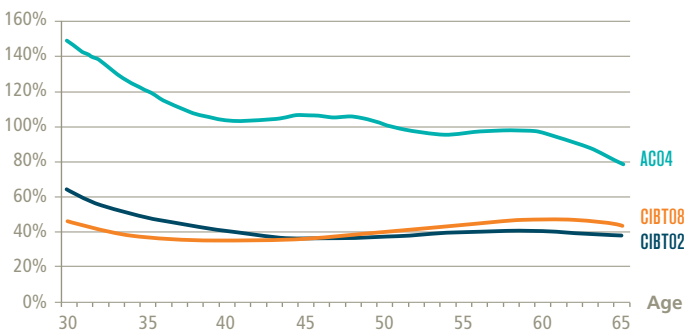


FIGURE 1 Male Non Smokers

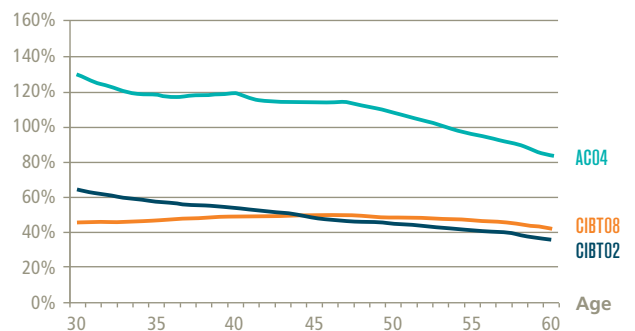


FIGURE 3 Female Non Smokers

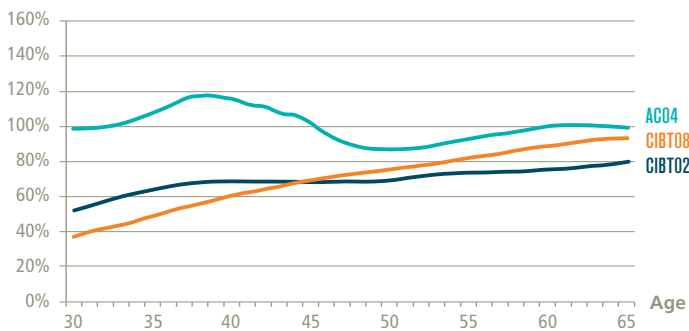


FIGURE 2 Male Smokers

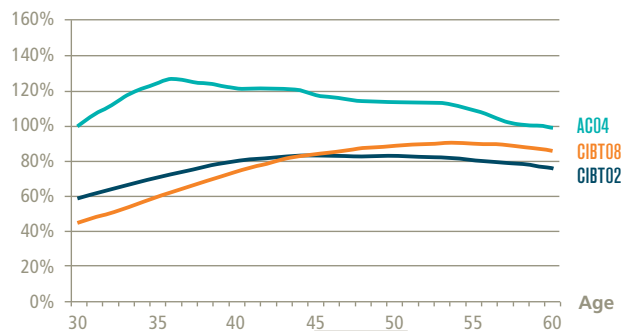


FIGURE 4 Female Smokers

Source: Working Paper 89/Charts 6A-6D.

Comparisons by select shape can only be done against the AC04 tables and are very different, except for Female smokers. The proposed tables introduce a shorter select effect for males, but which starts off steeper. For Female non-smokers the select effect is the same length, but less steep.

EXTENSION OF AGE RANGE

As mentioned before the graduated rates were created using ultimate data at ages 30 and over (except female smokers which was age 32). For younger ages the volume of data is still large but is concentrated at short durations. The younger age rates were derived using an approach to ensure the rates reduce smoothly, the smoker rates are always at least as high as the non-smoker rates and the actual claims should approximately equal expected claims using the proposed rates across the entire age range. **FIGURE 5 & 6**

Some subjectivity was employed to keep these criteria.

For males aged over 65 and females over 60 the rates were set to increase smoothly by age, non-smoker was set to never exceed smoker, each gender for non-smoker and smoker should converge with age and the table should close at an appropriately large age whilst ensuring actual claims should appear reasonable when compared to expected. The approach taken was the same as that used for AC04 and proposed in Working Paper 50.

FIGURE 5 & 6 Proposed rates at younger ages by duration for non-smokers (NS) and smokers (Sm)

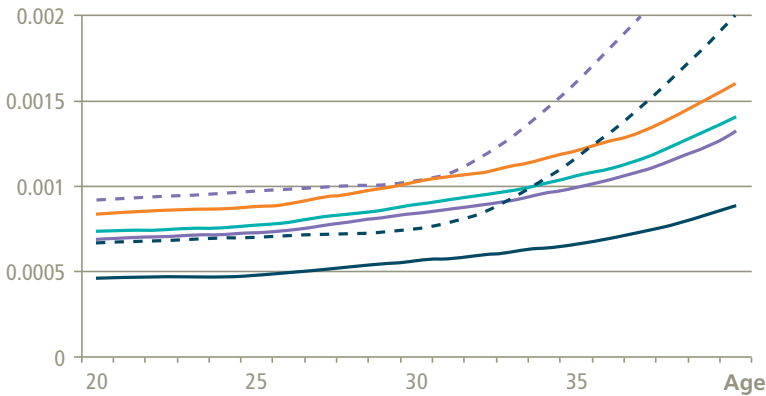


FIGURE 5 Males

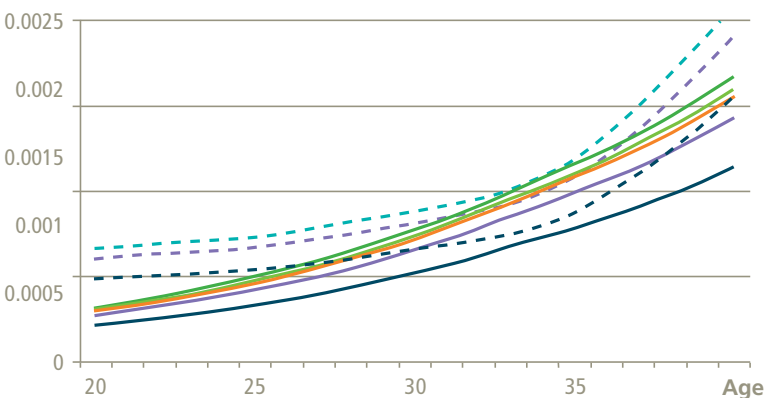


FIGURE 6 Females

Source: Working Paper 89/Charts 7 A&B.

A target at age 85 was set as a percentage of CIBT08 (instead of CIBT02 used in AC04) based on the proportion of insured to population mortality. Smoker aggregated rates were then extrapolated

to this target and a smoker differential was then applied. From age 86 rates were projected to reach unity at age 110. Select rates were derived for up to age 65 but not beyond that age.

FIGURE 7 Proposed shape of older ages

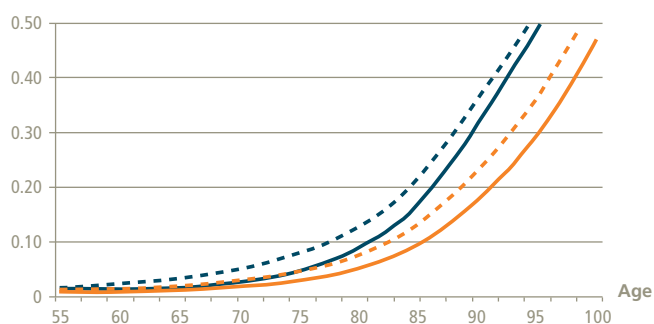
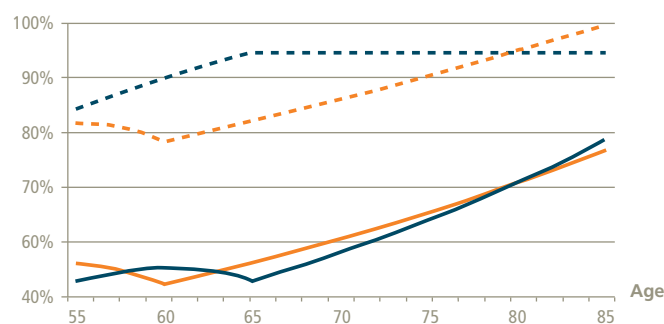


FIGURE 8 Illustrative rates at older ages as a percentage of CIBT08



Source: Working Paper 89/Charts 7 C&D

— MALE NON-SMOKER — FEMALE NON-SMOKER
 - - - MALE SMOKER - - - FEMALE SMOKER

PROPOSED TABLES

The naming convention shown in the table shows “AC” for accelerated Critical Illness, gender, smoker status, “L” for Lives and “08” for the midpoint of the dataset. The proposed tables cover ages 18-110. The

values of q_x are considered to apply as at 1st July 2008 and the values of μ_x are considered to apply as at 31st December 2008. Age definition of the tables is “age exact”.

Table name	Risk type	Product type	Gender	Risk
ACMNL08	Accelerated critical illness	Term assurances	Males	Non-smokers
ACMSL08	Accelerated critical illness	Term assurances	Males	Smokers
ACFNL08	Accelerated critical illness	Term assurances	Females	Non-smokers
ACFSL08	Accelerated critical illness	Term assurances	Females	Smokers

ANALYSIS BY SCOR

Given that SCOR regularly reviews its own basis, we felt it worthwhile to draw some high level comparisons with the CMI work.

Around 2012 SCOR changed the age shape of its Critical Illness tables in line with the recommendations of this paper as we were also seeing younger ages as more expensive and older ages as less expensive than our existing tables. In 2014 we did a further detailed analysis of our Critical Illness business, similar to this one done by the CMI, with a significant dataset of claims from 2009 –2013, also including only Term Assurance business.

When analysing select shape we found a very similar pattern for Male non-smokers as seen in the CMI analysis.

We used the same pattern as a starting guide for smokers as we felt the dataset, once split down into gender smoker groups, wasn't large enough to definitely suggest a different shape, however we did find a much less steep curve for the smokers than non-smokers. Female non-smokers, in our data had a less steep curve than the CMI data.

When splitting the data by distribution channel we saw IFA as significantly lighter than the other distribution channels as the CMI do. As with the GLM work in WP89 it was also clear to us that results varied significantly by provider and in particular experience varied within the bank channel. At an overall level non-IFA channels did not vary significantly which is in line with the CMI analysis.

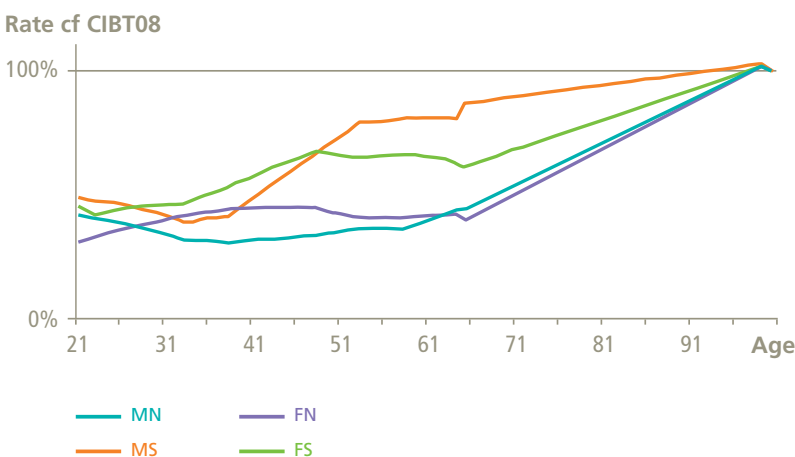
When analysing the sum assured bands we observed the lowest band displaying better experience than the higher bands, but to a smaller level than the CMI data shows. When we split the data in the highest bands further we found that the shape is more of an inverted "V" with experience peaking around the £250,000 band.

For our analysis of underwriting year we split data before 2006 and 2006 onwards. This showed the later years showing marginally heavier experience on a lives basis and significantly heavier on an amounts basis which is in contrast to the CMI's results. However, the CMI split is 2005-2010 whereas our data included up to 2013 so it isn't a direct comparison and we note that the CMI data contained a large exposure with unknown commencement date.

In our analysis, whilst we noted that there was a change in CI conditions covered over this time, as highlighted by the CMI, we believe this did not impact the results as the data covered in this time period mainly inception in years before the majority of the conditions were added. In future analyses this might need to be allowed for more carefully.

When investigating the TCF legislation and its effect on experience at SCOR we found experience before the change in legislation, in 2008, was significantly lighter than experience after. Experience peaked in 2008 after the legislation was changed and has continued to be higher than before the legislation, but has improved from this peak.

FIGURE 9 SCOR newest age shape vs CIBTo8



CONCLUSION AND OUTLOOK

Working Paper 89 and its accompanying tables has proposed some interesting adjustments and changes to the shape and level of the industry CI tables. These updates have been called for since the publication of Working Paper 75 suggested the shape of the experience was different to the AC04 tables.

The CMI has requested feedback to ensure the tables produced are relevant and SCOR would be happy to discuss this and share views on any issues raised or any additional questions that follow as the proposals are reviewed.

SCOR would be happy to discuss and share views on any issues raised within the working paper, this summary or any additional questions that follow on.

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