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Critical Illness Committee

WORKING PAPER 50

CMI critical illness diagnosis rates for accelerated business, 2003-2006

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EXECUTIVE SUMMARY

This paper presents claim diagnosis rates for accelerated critical illness insurance, on a 'lives' basis, based on data for nearly 20,000 claims settled in 2003 to 2006. Four sets of rates are included in the paper: for males and females, and for non-smokers and smokers; these have been named:

ACMNL04
ACMSL04
ACFNL04 and
ACFSL04.

Each table has separate rates at durations 0, 1, 2, 3, 4 and 5+ for ages 18 to 65 and ultimate (durations 5+) rates for ages 66 to 110.

Only the rates at ages 30 to 60 have genuine credibility as insured rates. At these ages the derivation of these diagnosis rates is based on the methodology set out in Working Paper 43 in which diagnosis rates were derived using data for claims settled in 1999 to 2004 (the "WP43 rates"). The 2003-2006 dataset is more recent, covers a shorter period and is more stable in terms of contributing offices than the dataset used in Working Paper 43, however both are very immature in terms of age and duration. Although this may distort the shape of the rates, the Committee considers the production of a formal table to be worthwhile, particularly because of the substantial differences in the shape of these rates by age from currently available tables of critical illness rates.

We again derive diagnosis rates at these ages by adjusting an initial set of rates (CIBT02) first by age only, and then by duration only, to broadly fit the expected settled claims to the actual settled claims. This was done in a pragmatic manner – for each gender/smoker dataset independently – to reach a reasonable fit, having regard to the data volumes.

Overall, the male 2003-2006 rates are around 90% of the WP43 rates whereas the female rates are closer to 100%, although in all cases there is considerable variation by age. The selection patterns inferred from the data exhibit minor differences from those in the WP43 rates, but all four datasets now show positive selection (unlike the WP43 rates for male smokers). Indeed the degree of selection in these rates at duration 0 is higher in each of the four datasets than was apparent for the 1999-2004 dataset.

A large number of assumptions underlie these diagnosis rates and a considerable degree of uncertainty surrounds the rates; consequently the Committee is again making available to member offices spreadsheets containing summarised data that will allow practitioners to experiment with alternative approaches.

The Committee has also extended the rates to younger and older ages to produce a full age-range table that can be used in the pricing and valuation of whole-of-life policies and (the small proportion of) term and endowment assurance policies that cover individuals outside the age range for which we have credible data volumes. We have adopted a pragmatic means of extending the age range of the rates and it is important for actuaries to recognise that these rates are not based on credible volumes of insured data.

The Committee is well-progressed in a number of areas of further work which we believe will be valuable in aiding understanding of the rates contained in this paper, and how they might be used. It is intended that these additional analyses will be published in a Working Paper in Spring 2011.

The Committee intends to recommend the final 2003-2006 diagnosis rates contained in this paper as formal tables for adoption by the Actuarial Profession after publication of the subsequent paper.

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1. INTRODUCTION

1.1. This paper presents claim diagnosis rates for accelerated critical illness insurance, on a 'lives' basis, using data for claims settled in 2003 to 2006. The derivation of these diagnosis rates broadly replicates that set out in Working Paper 43 in which diagnosis rates were derived using data for claims settled in 1999 to 2004 (the "WP43 rates"). Four sets of all-causes rates are included in the paper: for males and females, and for non-smokers and smokers.

1.2. The underlying data is consistent with that used for the 'All Office' results released to member offices for these four years and includes nearly 20,000 settled claims. Whilst this is a substantial dataset, and represents a large proportion of the entire market there are few claims outside of the age range 25 to 65. Although the rates in this paper cover a wider range of ages, only those in the age range 30 to 60 have genuine credibility as insured rates.

1.3. In this paper we again derive diagnosis rates for those ages where we have data by adjusting an initial set of rates (CIBT02) first by age only, and then by duration only, to broadly fit the expected settled claims to the actual settled claims. This is done in a pragmatic manner – for each gender/smoker dataset independently – to reach a reasonable fit, having regard to the data volumes. Because there is no formal statistical model underlying this work, no measures of statistical credibility can be provided alongside the rates. Draft rates for ages 25 to 65 were included in a paper released only to firms that financially support the CMI in August 2010 (for brevity, we refer to this as the "Draft Paper", and the rates it contained as the "Draft rates", hereafter).

1.4. The 2003-2006 dataset contains credible volumes for only a limited age range however the Committee appreciates the need for a full age-range table for the pricing and valuation of whole-of-life policies and (the small proportion of) term and endowment assurance policies that cover individuals outside this age range. We therefore sought a pragmatic means of extending the age range of the rates and the sets of rates in this paper cover ages 18 to 110. It is important for actuaries to recognise that these rates have been produced for convenience and are not based on credible volumes of insured data; the Committee acknowledges that other approaches may be equally valid.The Committee is well-progressed in a number of areas of further work which we believe will be valuable in aiding understanding of the rates and how they might be used. It is intended that these additional analyses will be published in a Working Paper in Spring 2011. This subsequent paper is provisionally entitled "Supplementary Analyses to CMI

critical illness diagnosis rates for accelerated business, 2003-2006" and is referred to in the remainder of this paper as the "Supplementary Analyses Paper".

1.5. This paper contains final 2003-2006 diagnosis rates. The Committee intends to recommend these rates for adoption by the Actuarial Profession after publication of the Supplementary Analyses Paper.

1.6. This paper complies with the material requirements of the principles in the Board for Actuarial Standard's generic TASs. In particular, TAS D and TAS M have been met insofar as their principles are applicable.

Summary of feedback on recent work

1.7. In Working Paper 43 we set out a number of areas where feedback would be particularly useful, to influence the approach taken to producing formal tables of 2003-2006 rates. Some of these areas were also covered by a number of specific questions contained in the Draft Paper. In addition to the written feedback received to these two papers, the Committee received considerable verbal feedback, in particular as a result of presentations at the Healthcare Conference (in May 2010) and at the Life Convention (November 2010).

1.8. Much of the feedback was positive and supportive and did not require the Committee to alter its thinking with regard to the scope of the rates contained in this paper. Such feedback is not considered further here, with the exception of two areas that caused specific debate:

- Whether the formal tables should be all-causes only, or also include a breakdown by cause; and
- Whether rates should be produced for only a limited age range.

These are briefly discussed in paragraphs 1.10, 1.11 and 1.12 below.

1.9. A number of responses related to the additional analyses that the Committee is now undertaking. These comments are not summarised here but the Committee will give further consideration to whether they can be reflected in the scope of the Supplementary Analyses Paper, or whether they are better addressed subsequently, to avoid delaying the publication of the next phase of work.

1.10. Whilst the feedback clearly indicated a high degree of interest in any insights the Committee can provide into cause-specific diagnosis rates, there was also a realistic understanding that it is not practical to extend this beyond "major" causes. Others expressed concerns about the impact of overlapping conditions and whether claim recording practices are sufficiently accurate and consistent. The Committee concluded that there was no strong demand for formal cause-specific tables. Illustrative rates will be included in the Supplementary Analyses Paper and the Committee welcomes views on the scope of further subsequent work in this area.

1.11. There were also some requests for alternative "all causes" rates covering a narrower range of conditions, perhaps "big 3" or "big 6" sets of rates. This is not straightforward, given the information currently available to the Committee and has not been addressed within these rates. The Committee will give further consideration as to whether illustrative rates can be included within the scope of the Supplementary Analyses Paper, or whether this can be addressed subsequently.

1.12. There were a number of responses that suggested that there was no need for formal tables to extend beyond age 70 (say) however, as noted in paragraph 1.4, the Committee was conscious that a full age-range table was needed by some. It was also cognisant that a key function of a formal table is to provide a "common currency" and that this would be diluted if a variety of practices emerged for extending the rates to other ages. Indeed the Committee itself has a need for such rates as the investigation already has a small volume of exposure at ages up to 80.

The structure of this paper

1.13. Much of the content of this paper "repeats" work described in Working Paper 33 and Working Paper 43, but using the 2003-2006 dataset. In many places, the paper has not altered from the Draft Paper. In this section we outline the structure of this paper whilst also indicating, at a high-level, the changes from the previous papers.

1.14. Before we proceed to the derivation of diagnosis rates, we consider the data available to us in sections 2 to 5. In this paper we are considering claims settled in the period 2003-2006. This dataset is summarised in section 2, which corresponds to section 2 of Working Paper 43. This section has been expanded from the Draft Paper, for completeness.

1.15. Sections 3, 4 and 5 correspond to sections 3, 4 and 5 of Working Paper 33 and contain the results of analyses of the claim dates, and the intervals between them, for the 2003-2006 dataset. These sections are all unchanged from the Draft Paper.

1.16. Note that the following sections of Working Paper 33 are not included in this paper (nor were they included in the Draft Paper):

- Section 5 contained a detailed description of the modelling methodology which is not repeated here (in addition to the analysis of the 1999-2004 claims that has been updated in section 5 of this paper).
- Section 6. No sensitivities are shown in this paper for the fitting of the claim development distribution.
- Section 7. This described the methodology for calculating exposure, expected diagnosed claims and expected settled claims which is identical for this paper, except for the minor alterations noted in section 3 of Working Paper 43.
- Section 8. The description of the derivation of off rates used in the calculation of exposure is not reproduced here. Note that the same off rates were used in this work as in the work on the 1999-2004 dataset; no assumptions were required for subsequent years as there are no "new" offices after 2003.

Note that the Committee intends to include a section on sensitivities, covering both the claim development distribution and off rates in the Supplementary Analyses Paper.

1.17. Section 6 of this paper contains a description and worked example of the steps we have used to produce the claim diagnosis rates from the data used to produce "adjusted" results. This is directly comparable to the later parts of section 3 of Working Paper 43. The earlier parts of that section still apply, but are not repeated in this paper. Note that this section differs from that in the Draft Paper – for computational convenience we treated CIBT02 as if it were an age nearest table, rather than age exact, in deriving the Draft rates (as we did in Working Paper 43) and then applied an approximation to arrive at age exact rates. In this paper, we have treated CIBT02 as age exact and hence no approximation is involved in this regard. This section includes a comparison of the

fitted rates with the WP43 rates (the corresponding comparison, of the Draft rates with the WP43 rates, was included within section 8 of the Draft Paper).

1.18. Some of the issues encountered in deriving the diagnosis rates – and how these have been resolved – were discussed in section 4 of Working Paper 43. These issues include the goodness of fit of the rates to the data, smoothness, dealing with the limited age range of the data, judging the shape of selection and the extent to which the smoker and non-smoker rates should be derived independently of each other. These issues also apply to these rates but the discussion is not repeated here, although a short summary of some of the areas where the rates do not closely fit the data is included in section 6.

1.19. The focus of Working Paper 43 was to derive all-causes diagnosis rates however the Committee also derived cause-specific rates for male non-smokers only. The corresponding analysis for the 2003-2006 dataset was included in the Draft Paper. The Committee intends that the formal tables of rates will only contain all-causes rates and there is no cause-specific analysis within this paper however the Committee intends to include illustrative rates for the main causes of claim for each of the four gender/smoker datasets in the Supplementary Analyses Paper.

1.20. The all-causes rates presented in both Working Paper 43 and the Draft Paper were limited to ages 25 to 65, given the lack of data outside of this age range. As noted earlier, the Committee has now extended the rates to cover a fuller age range; these extensions are described in section 7.

1.21. The all-causes rates are then discussed in section 8, including a comparison of the final set of rates with CIBT02. The rates themselves are contained in Appendix A and a summary of the fit of the AC04 rates to the experience is contained in Appendix B.

1.22. Section 9 illustrates the experience by calendar year over the period 2003 to 2006 for the four gender/smoker datasets. This corresponds to the first part of section 7 of Working Paper 43; the second part of that paper illustrated the expected settled claims after 2004 and compared those in 2005 and 2006 with the actual settled claims. Data collection for 2007 is not yet "complete", so the corresponding illustration is not included in this paper.

1.23. Note that section 8 of Working Paper 43 contained an illustration of the sensitivity of the diagnosis rates to variants of the central claim development distribution (CDD). This demonstrated that the rates at duration 0 are particularly sensitive to the CDD – varying by up to 8% under the sensitivity tests used – which is a key assumption underlying this work. Rates at other durations – and indeed the shape by age – were relatively unaffected. Analysis of the sensitivities of these rates will be included in the Supplementary Analyses Paper.

1.24. Section 10 summarises the content of this paper.

1.25. Section 11 describes the additional analyses that the Committee is now undertaking. It is intended that these additional analyses will be published in the Supplementary Analyses Paper in Spring 2011

1.26. All feedback on this paper will be warmly welcomed by the CMI Critical Illness Committee. In order to be reflected in the Supplementary Analyses Paper, it would be helpful if feedback could be received by 18 March 2011.

Errata to the Draft Paper

1.27. The Draft Paper issued in August 2010 included indicative rates for the main causes of claim for male non-smokers only. There was a mismatch between the actual claims and the exposure for deaths only in that analysis and the death rates were generally higher than they should have been. Consequently, the residual element – which was derived as the difference between all-causes rates and the sum of cause-specific rates – should have been wider than illustrated in Figures 7.5 and 7.6.

1.28. In addition:

- Figures 8.2 and 8.3 in the Draft Paper inaccurately showed rates for ages 20 to 60, whereas the *x*-axis was labelled 25 to 65.
- Paragraphs 6.28 and 6.33 both referred to 1999-2004 instead of 2003-2006.

2. THE 2003-2006 DATASET

2.1 In order to provide context to the rates derived in this paper, the Committee felt that it would be useful to provide some background on the data underlying this analysis, and the UK critical illness market in general. The market data used in this section has been obtained from various years' editions of Swiss Re Term & Health Watch; the Committee would like to thank Swiss Re for granting permission to publish these data. Note that the rates relate to accelerated critical illness policies only; the comments in this section are also intended to relate to accelerated cover, although Figure 2.6 shows all business (including stand-alone cover).

2.2 Although there appears to be a two-year overlap with the data considered in Working Paper 43, the dataset used in this paper includes data from offices (for all of the years 2003 to 2006) that was not received in time to be included in our earlier work. The data are identical to those underlying the quadrennial "All Office" results issued to member offices ("unadjusted" results were issued in December 2009 and "adjusted" results in June 2010), but not to the results for the four individual years.

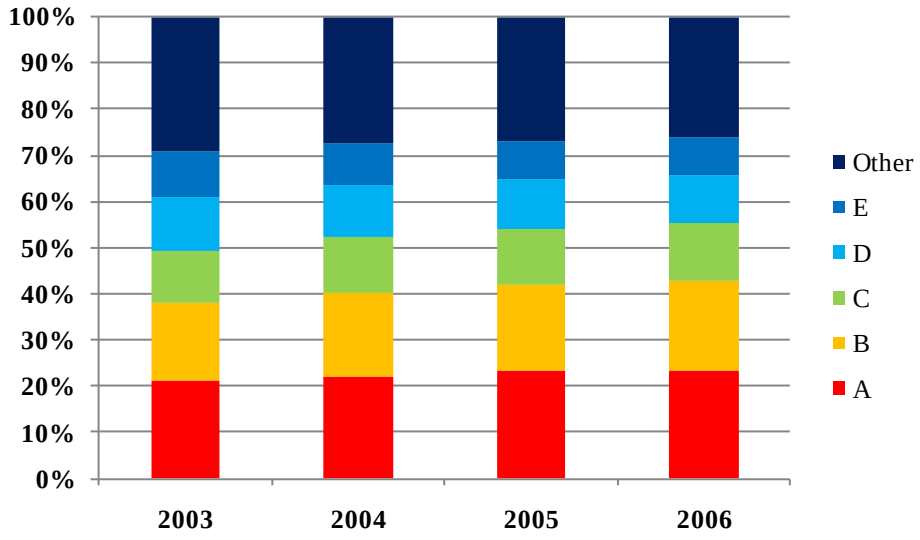
2.3 The offices contributing data underlying these rates are:

AVIVA	LV=
AXA	ROYAL LONDON MUTUAL
BUPA	SCOTTISH WIDOWS
CO-OPERATIVE INSURANCE	STANDARD LIFE
GUARDIAN FINANCIAL SERVICES	WINDSOR LIFE
HSBC LIFE	ZURICH FINANCIAL SERVICES
LEGAL & GENERAL	

2.4 This data was supplied by a relatively consistent group of offices throughout the four years under consideration. The only exceptions are some small offices leaving the investigation in later years.

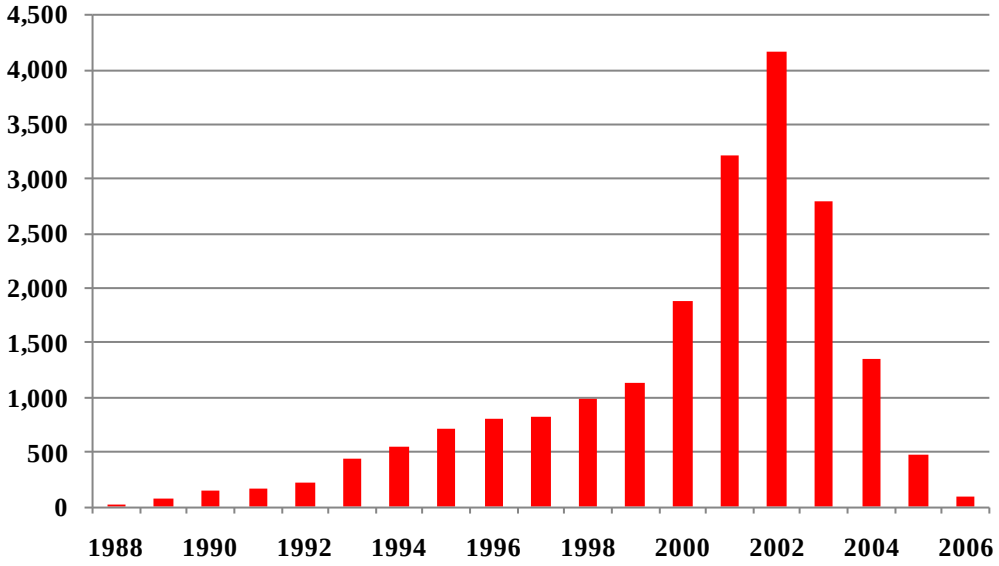
2.5 This stability is illustrated in Figure 2.1 which shows the exposure over the period for the five largest offices in the dataset (plus "others").

Figure 2.1: CMI accelerated critical illness exposure in 2003 to 2006, by office



2.6 Although the rates derived in this paper are based on claims settled between 2003 and 2006, the underlying policies again relate to a longer period, starting significantly earlier. This is illustrated in Figure 2.2 which shows the actual settled claims in the 2003-2006 dataset by policy commencement year.

Figure 2.2: CMI accelerated critical illness claims settled between 2003 and 2006, by policy commencement year



2.7 Figure 2.2 has a different profile to the corresponding diagram for the 1999-2004 dataset (Figure 2.1 of Working Paper 43), with a single peak – for policies commencing in 2002 – whereas the earlier dataset had similar numbers of claims arising from each year of commencement from 1998 to 2002 inclusive. The current shape arises from a combination of factors:

- The rapid increase up to 2002 arises from the growth in new business, for example, from 721,000 in 2001 to just over one million in 2002 (see Figure 2.3, below), compounded by an increase in the coverage of the CMI investigation.
- The steep fall after 2002 reflects a reducing volume of new policies. This effect is magnified, in terms of settled claims in 2003-2006, by the limited exposure of the more recent business and the interval between diagnosis and settlement.

2.8 The market has changed in many ways, including distribution, underwriting and product design, over the period giving rise to these settled claims. All of these changes could clearly influence the rates derived and presented in this paper; not only in terms of their overall level but also the shape by both age and duration. The Committee expects that the additional analyses – to be published in the forthcoming Supplementary Analyses Paper – will help to illustrate the impact of these changes (the scope of the forthcoming paper is detailed in section 11).

2.9 Figure 2.2 also demonstrates the immaturity of the CMI portfolio; it is interesting to compare the relative maturity of this critical illness dataset with the CMI Life Office Mortality assurances data for 1999-2002 used for the "00" Series graduations:

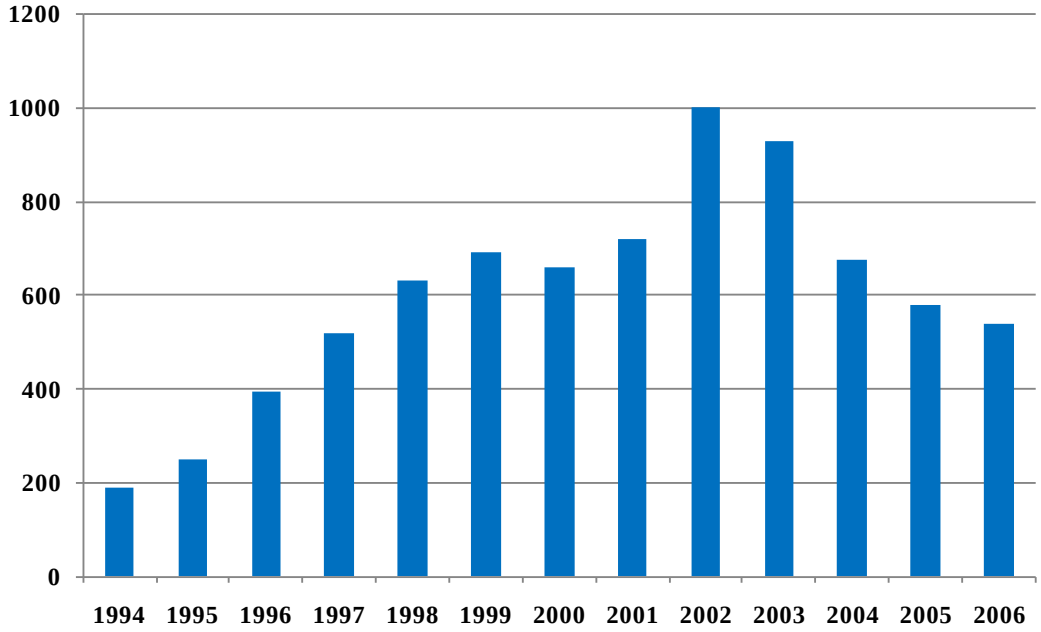
- Over 70% of the critical illness exposure is in the select period (durations 1 to 4) whereas over 70% of the mortality exposure was at durations 5+. (Indeed the spike of critical illness policies that commenced in 2002, referred to in paragraph 2.7, were "select" throughout 2003-2006.)

- Only 10% of the critical illness exposure is at ages over 50 compared to over a third of the mortality exposure.

New Business Volumes

2.10 The sales by year in the UK critical illness market for the extended period are illustrated in Figure 2.3. Rapid new business growth up to 1999 was followed by a plateau in 2000 and 2001. Sales peaked in 2002, when over one million accelerated critical illness policies were sold. The subsequent fall in sales from 2003 was in part the result of restrictions in reinsurance capacity for critical illness cover on guaranteed rates, leading to price increases for consumers.

Figure 2.3: Accelerated critical illness sales by year, 000s, 1994-2006 (Source: Swiss Re Term & Health Watch)



2.11 Note that the growth in settled claims the years to 2002, apparent in the CMI data in Figure 2.2 is greater than the growth in new business volumes in the market data. This is partly a consequence of offices starting to contribute data to the CMI but also because Figure 2.2 is based on settled claims and hence reflects a maturing portfolio by age and duration.

Market Coverage

2.12 The market coverage of the dataset used in this paper is difficult to determine as the Committee does not have definitive data for the size of the market. Comparisons are also complicated by a number of other factors: for example, CMI data relates to lives, whereas most other statistics relate to policies, and different companies follow different conventions when reporting critical illness products within their FSA Returns.

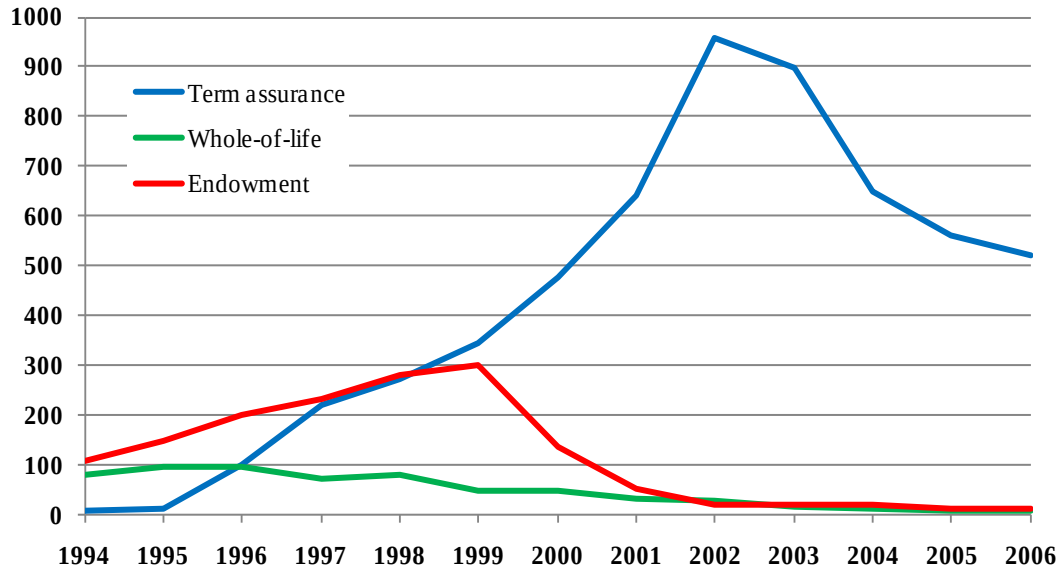
2.13 Based on the new business figures in Swiss Re Term & Health Watch, the Committee estimates that the 1999 data used in Working Paper 43 covered around a third of new critical illness policies, increasing to over a half by 2004. Using a similar approach, the Committee estimates the coverage of the dataset used in this paper has increased to nearly 60% of new policies.

2.14 Note that a proportion of the market is unattainable, as data submitted to the CMI only covers non-rated policies.

Product Changes

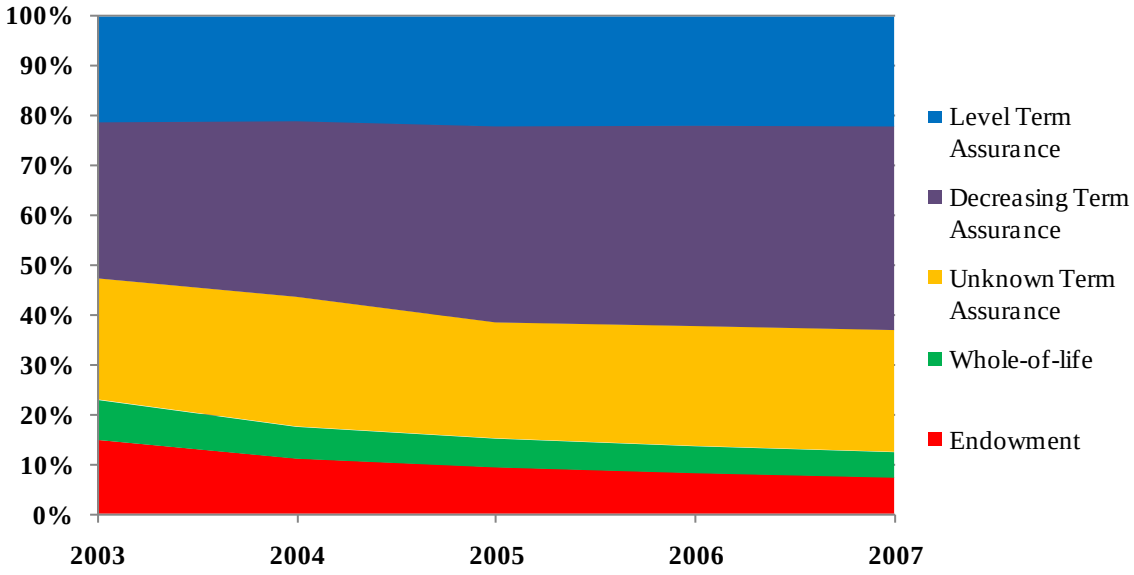
2.15 Until the late 1990s, critical illness cover was frequently sold attached to whole-of-life or mortgage endowment products, both of which have a savings element. With the demise of the endowment market by 2001, Figure 2.4 shows that the product mix of new business has become increasingly term assurance dominated.

Figure 2.4: New Accelerated critical illness sales 1994-2006 by broad product type (Source: Swiss Re Term & Health Watch)



2.16 This change was also evident in the CMI in force data shown in Figure 2.4 of Working Paper 43, which showed a reducing proportion of in force business arising from older whole-of-life and endowment products over the period. This trend has continued for the 2003-2006 dataset but is now much less significant, as shown in Figure 2.5.

Figure 2.5: CMI start-of-year in force data, 2003-2007 – percentage by product type



2.17 Unsurprisingly, the older product types represent a higher proportion of the CMI in force data, in Figure 2.5, than the new sales, illustrated in Figure 2.4.

2.18 Note that the product types illustrated in Working Paper 43 and the Draft Paper were allocated by the CMI; the data itself includes a free format field ("Product Code") which has been used to allocate data to the categories above. Since the Draft Paper was released, the CMI has liaised with data contributors to validate the allocated product types and to assign product types where this was not possible from the raw data. Given the predominance of term assurance business in the dataset, we also sought to subdivide this further; consequently Figure 2.5 separately identifies level and decreasing policies, although a significant proportion remains unclassified. Note that Figure 2.5 relates to around 95% of the total data; it has not (yet) been possible to categorise the product type for the other 5% of the data.

2.19 The rates derived in this paper are based on accelerated critical illness claims across all of the above products. Short durations (and younger ages) will be more heavily influenced by experience on term assurance, whereas durations 5+ (and older ages) will have more significant volumes of whole-of-life and endowment policies. As the sales processes and target markets for each product will differ, this may affect the results.

2.20 Another key change in product design over the period has been in the number and scope of conditions covered. The first critical illness products launched in the UK market covered a limited range of conditions, whereas the scope of products available in the market today is much wider.

2.21 The definitions of the critical illness conditions have also varied considerably over the period. Until 1999, policy wordings were driven by market forces; the publication of the ABI Statement of Best Practice in that year sought greater standardisation between different providers' policy conditions. Since then there have been three updates to the Statement (in 2002, 2004 and 2006), extending the conditions covered and updating the wording for medical advances. For example, in 2002 the Heart Attack definition was amended to take account of advances in diagnostic techniques. No attempt has been made to adjust for such changes in our analysis.

Underwriting and Claims

2.22 With no information on rated policies available to the Committee, it is difficult to measure changes in underwriting practices over the period. However, it is thought that underwriting philosophies have become stricter over time and approaches to non-disclosure at claim stage have tightened. As the investigation contains sales from the 1980's through to 2006 it is clear that a wide range of underwriting practices will have contributed to the observed experience.

2.23 Claims practices will also have evolved, as experience of critical illness claims handling has developed; however these changes may be of less significance to the rates derived in this paper as we use claims settled in 2003-2006, whereas the underwriting practices relate to a longer period, starting significantly earlier, as illustrated in Figure 2.2.

Distribution

2.24 As with the changes already discussed, changes in distribution channel may affect the rates derived in this paper. The socio-economic mix of lives in each channel may be different, as well as sales processes and persistency experience.

2.25 The market share of Independent Financial Advisors (IFAs) has increased steadily over time, particularly as Direct Sales Forces began to fall out of favour in the 1990s. By 2002, IFAs accounted for almost half of new critical illness sales, as shown in Figure 2.6. (Note this shows all sales, as the Committee did not have access to market data on accelerated cover only by distribution channel; however accelerated cover provides the vast majority of sales).

2.26 This change is also evident in the CMI in force data displayed in Figure 2.7 (for accelerated cover only).

Figure 2.6: Mix of CI sales by distribution channel 1995-2004 (Source: Swiss Re Term & Health Watch)

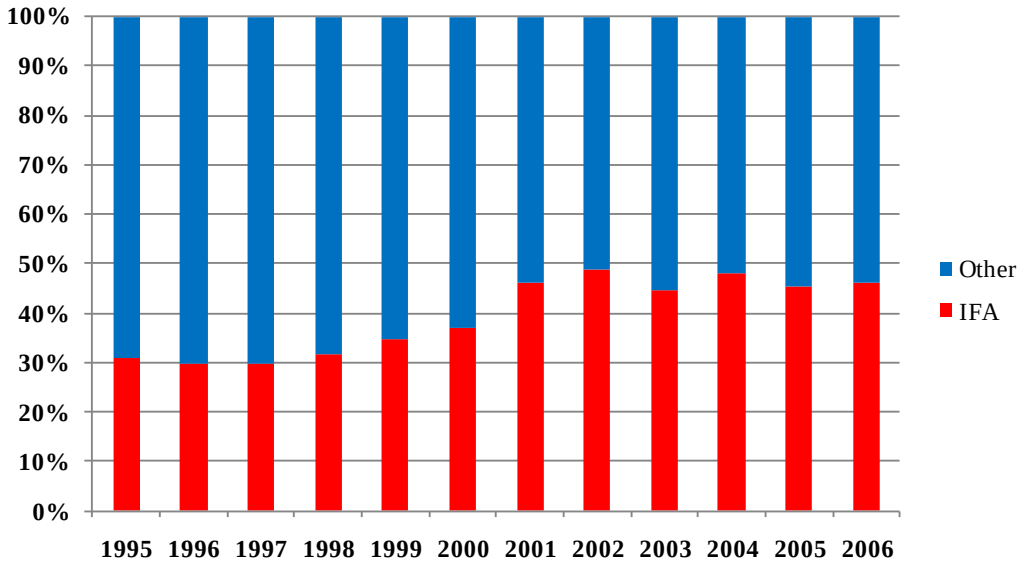
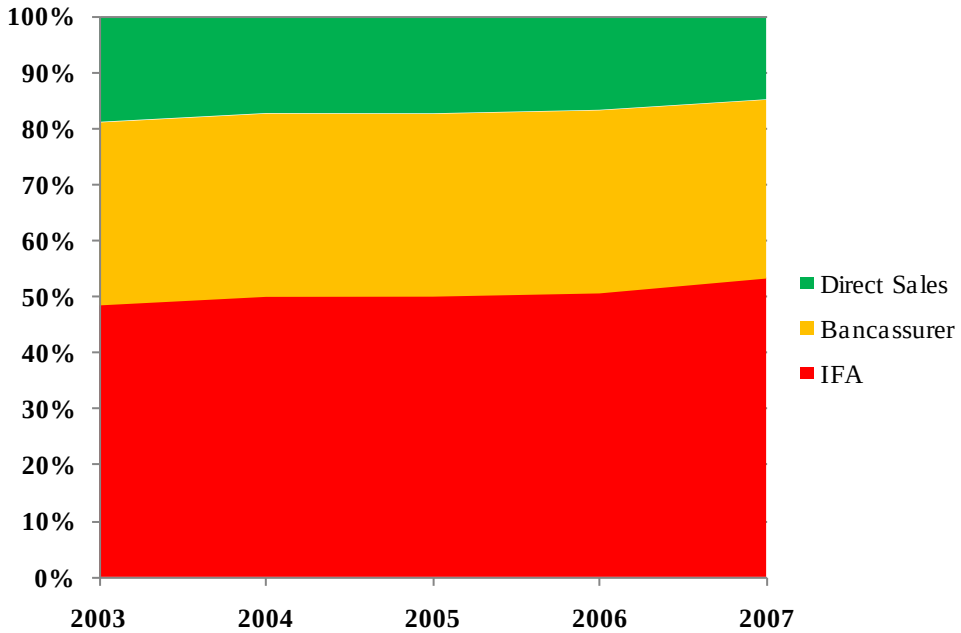


Figure 2.7: CMI start of year in force data, 2003-2007 – percentage by distribution channel



2.27 Note that Figure 2.7 excludes around 10% of data where the distribution channel is categorised as "other" or where it is unknown.

3. CLAIM DATES AND THE PROGRESSION TO SETTLED CLAIMS

3.1 We first provide an overview of the data collected by the CMI on settled claims. This corresponds to section 3 of Working Paper 33. A total of 22,774 claims settled in 2003-2006 have been submitted to the CMI and are included in the All Office results for that quadrennium.

Claim dates

3.2 The CMI requests four dates of claim for each settled claim submitted – date of diagnosis, date of notification, date of admission and date of settlement. These dates are not always received and in certain instances appear inconsistent.

3.3 Table 3.1 shows the number and percentage of claim records containing each of the four dates for the 1999-2004 period underlying Working Paper 43 and separately for the 2003-2006 quadrennium.

Table 3.1. Number and percentage of total claim records containing each date of claim.

Dates submitted by office	**1999-2004**		**2003-2006**	
	Number of claims	**% of claims**	**Number of claims**	**% of claims**
Diagnosis	13,583	64%	16,941	74%
Notification	18,713	88%	17,844	78%
Admission	10,156	48%	13,408	59%
Settlement	19,601	92%	20,859	92%
Total	**21,365**	**100%**	**22,774**	**100%**

Note the values for 2003-2006 differ from those shown in a similar table in the note accompanying the 2006 'All Office' results, due to data changes since the release of results for each individual year (see paragraph 2.2). This comment also applies to Table 3.3, below.

3.4 No adjustments have been applied to dates of claim in compiling the values above, other than corrections arising from the data checks undertaken at the time individual office data were processed.

3.5 It is clear that the CMI received dates of diagnosis and admission on an increased proportion of the 2003-2006 claims data compared with 1999-2004. The proportion of claims with dates of settlement remained constant whereas the proportion with date of notification fell (although the latter is not of great significance to our analysis). What is not clear from Table 3.1 is the year-by-year trend. Up to and including 2004, we saw a trend of increasing proportions of claims being provided with each date of claim. This then plateaued before starting to fall in most cases. For example, the percentage of claims submitted with date of diagnosis increased steadily from 37% in 1999 to 81% in 2005 before falling to 77% in 2006; the percentage of claims submitted with date of settlement increased from 81% in 1999 to 97% in 2004, but decreased to 92% in 2005 and fell further to 82% in 2006. Such falls are disappointing as it is this pair of dates that are of primary importance for our analyses. However, it should be noted that the falls in diagnosis date provision have not been steep, and in both cases the coverage for 2003-2006 is still favourable compared with that of our earlier analyses for 1999-2004.

3.6 For most offices, the percentage of claims supplied with a date of diagnosis or death did not change significantly; some offices did not submit any dates of diagnosis but many submitted them on all (or nearly all) of their claims. Table 3.2 illustrates the position for the five largest offices. It will be observed that there is little variation over time. Given the consistency of data contributors in the 2003-2006 data, noted earlier, the percentage varies little by year in the overall dataset, unlike the 1999-2004 data, where the changing weight of various offices produced greater variation.

Table 3.2. Percentage of total claim records containing date of diagnosis for the five largest offices (in terms of settled claims in 2003-2006).

Office	2003	2004	2005	2006
A	15%	17%	16%	15%
B	67%	75%	81%	75%
C	100%	100%	100%	100%
E	100%	100%	100%	100%
G	100%	100%	100%	100%
Total	74%	80%	83%	80%

Note that the office labels in Table 3.2 are the same as used in Table 3.2 of Working Paper 33 (but bear no relation to those used in Figure 2.1). Offices D and F from the earlier table are not included here as they are not amongst the largest offices for these years.

3.7 In time, the Committee hopes that the proportion of claims with a reliable date of diagnosis will be sufficiently high to allow the use of more conventional methods, such as deducting claims diagnosed before the investigation period from those settled during the period and applying IBNS adjustments to estimate the total diagnosed claims in the period. (Note that this is also the approach proposed in Working Paper 45 for 'Per Policy' Life Office Mortality data.) However in the interim, our methodology has been developed to make allowance for incomplete data on dates of claim.

Progression to settled claims

3.8 As in Working Paper 43, we are seeking to derive claim rates based on dates of diagnosis, when claims are incurred. However, we collect data on the basis of settled claims so the time-interval between these two dates is of great significance to our analysis.

3.9 Whilst our modelling work, described in section 5, focuses on the interval between the date of diagnosis and the date of settlement, we first consider the intervals between dates more generally. Note that within this section we illustrate the intervals using crude average time-intervals, although a more accurate approach is used in our modelling.

3.10 In the analysis summarised below, in addition to the overall interval between diagnosis and settlement, we consider the separate intervals between diagnosis and notification, between notification and admission, and between admission and settlement. As noted in Working Paper 33, whilst the latter stages of this progression can be assumed to be well-ordered – i.e. we presume a claim will not be admitted until it has been both diagnosed and notified, nor settled before it has been admitted – the date of diagnosis will not necessarily occur before the date of notification. This is due to ambiguities in the definitions of both the date of diagnosis and the date of notification, discussed more fully in earlier papers. Companies were asked to adopt revised guidance on diagnosis dates, issued by the Health Claims Forum, only from 1 January 2007, so no common standard was in place during the investigation period we are currently considering.

Policyholder or insurer?

3.11 Paragraphs 3.14 to 3.16 of Working Paper 33 discussed the nature of the interval between diagnosis and settlement and, in particular, how part of the interval is attributable to the policyholder and part to the insurer. These comments are not repeated here, though the relative lengths of the two parts of the interval are considered in paragraph 3.14, below.

Intervals between dates of claim

3.12 Table 3.3 shows the average observed intervals between various dates of claim, where we have them, and the volumes of data for the 1999-2004 dataset underlying Working Paper 43, and for the 2003-2006 dataset underlying this paper.

Table 3.3. Crude average interval between various dates of claim (in days).

Pairs of Events	**1999-2004**			**2003-2006**		
	Average number of days between events	**Number of records**	**% of records containing both dates**	**Average number of days between events**	**Number of records**	**% of records containing both dates**
Diagnosis to notification	94	12,013	56%	83	14,656	64%
Notification to admission	85	9,518	45%	89	12,421	55%
Admission to settlement	12	9,926	46%	15	13,008	57%
Diagnosis to settlement	178	11,989	56%	187	15,424	68%

3.13 Claims with diagnosis date on, or notification date on or after, the date of settlement have been excluded from further analysis in this section, but all other claims with relevant dates have been included.

3.14 The average length of the overall interval between diagnosis and settlement, of primary importance to us, for claims settled in 2003-2006 is longer than for claims settled in 1999-2004. However, the part of this attributable to the policyholder – diagnosis to notification – is shorter, whilst that attributable to the insurer – notification to settlement – has slightly increased. In part, these effects may result from the different proportions of claim dates provided rather than being a reflection of an underlying trend. Indeed, the average lengths of the 1999-2004 intervals were not internally consistent – the average length of the overall interval between diagnosis and settlement was considerably shorter than the sum of its parts. This is because the intervals are being measured for different subsets of claims, where we have the relevant dates. The relationships between the dates appear more consistent for the 2003-2006 data than for the 1999-2004 data, perhaps due to the increased proportion of claims contributing to more than one of each of the intervals.

3.15 For each interval, the proportion of claims provided with both relevant dates is higher in 2003-2006 than in 1999-2004. However, this masks a fall in the proportion of claims provided with both date of diagnosis and date of settlement from a peak of 73% in 2005 to 66% in 2006. This is disappointing as it is this pair of dates that are of primary importance for our analyses.

3.16 Table 3.4 shows these intervals for each calendar year of the 2003-2006 quadrennium. This appears to provide further evidence for trends of a shortening interval between

diagnosis and notification, but an increase between notification and admission (and therefore settlement). These intervals are considered further below.

Table 3.4. Crude average interval between various dates of claim (in days) by calendar year.

	1999-2004	2003	2004	2005	2006	2003-2006
Diagnosis to notification	94	96	87	79	75	83
Notification to admission	85	76	81	99	97	89
Admission to settlement	12	12	17	19	12	15
Diagnosis to settlement	179	178	184	197	187	187

Diagnosis to notification

3.17 The interval between diagnosis and notification reduces each year in 2003-2006. The main driver for this appears to be an increasing number of claims where this interval is negative, from just 37 in 2003 to 713 in 2006, with the largest increase occurring between 2004 and 2005. Prior to 2005 only one office submitted claims with this feature, but from 2005 it was widespread. A negative interval is feasible if date of notification is based on the original notification by the policyholder and date of diagnosis is interpreted as confirmation of a valid claim perhaps requiring permanence to be established.

3.18 The trend may therefore be a result of a widespread change in the practice of recording dates by offices as well, perhaps, as an increase in policyholders submitting claims before diagnosis is confirmed. There is, however, some evidence of the interval between diagnosis and notification shortening even for offices with no negative intervals.

Notification to admission

3.19 The interval between notification and admission is based on the fewest number of claims of each of the intervals. However, there does appear to be a trend of the average interval increasing over the period, albeit starting from a lower level than the average in 1999-2004.

3.20 There is no strong evidence for the reasons behind such a trend though there are some indications that many of the claims with date of notification before date of diagnosis have a longer interval between notification and admission, as might be intuitively expected. An increasing number of such claims may therefore have pushed the average interval upwards.

Admission to settlement

3.21 This remains the shortest of the intervals being considered, at an average of just 15 days over 2003-2006. This average fluctuates quite significantly over the period though the magnitude remains small.

3.22 As we saw in the 1999-2004 data, in general there remains great variation between the lengths of the admission to settlement interval. Whilst most are less than a week, around 10% are more than a month and around 2% more than three months, which clearly inflate the average. Thus, although the magnitude of the average interval is small, quite large variations from year to year are not necessarily indicative of any trend. Death claims in particular show large variation in the length of this interval, perhaps whilst probate is established. Indeed, the variations appear greater for single life policies than joint life – the average interval for death claims on single life policies is 51 days

compared to 13 days for joint life policies, both of which have increased from the corresponding figures for 1999-2004 (35 days and 7 days respectively).

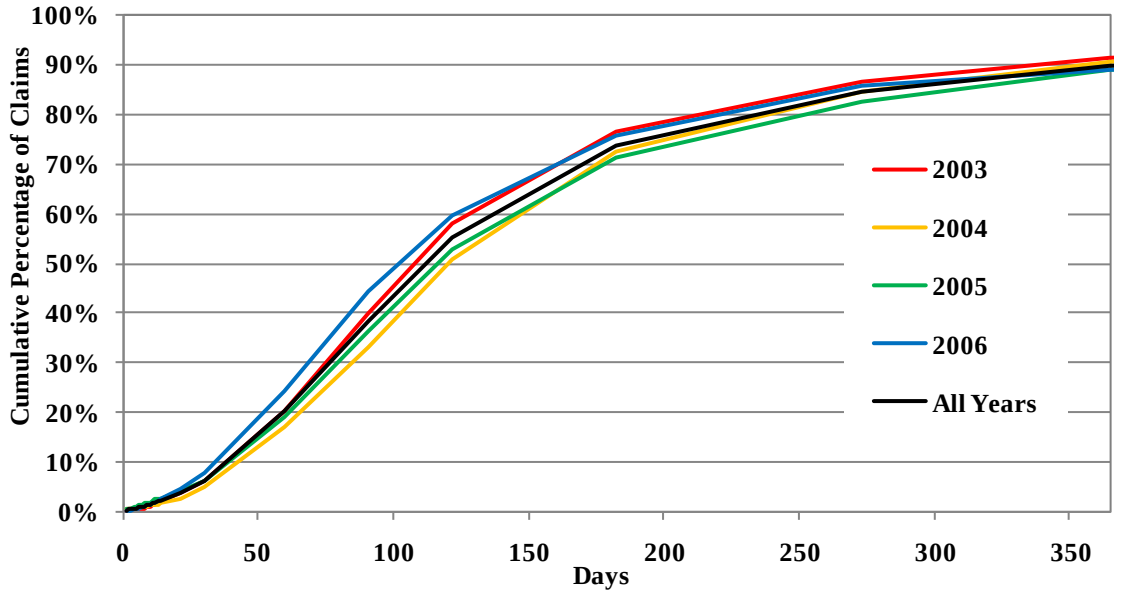
Diagnosis to settlement

3.23 The interval between date of diagnosis and date of settlement is the most important for our analyses.

3.24 Table 3.4 showed that the average interval between diagnosis and settlement increased over the 2003-2006 quadrennium, though it fluctuated from year to year. However, considering only the average interval may mask trends in the overall distribution, which is considered below.

3.25 Figure 3.1 illustrates the crude claim development distribution during the first year from date of diagnosis, by calendar year of settlement. The fluctuation by year appears to be present in the distribution as a whole, with no obvious trend. When compared with Figure 3.1 of Working Paper 33, the magnitude of the fluctuations appears smaller in the more recent dataset.

Figure 3.1. Crude claim development distribution during the first year from date of diagnosis, by calendar year of settlement.



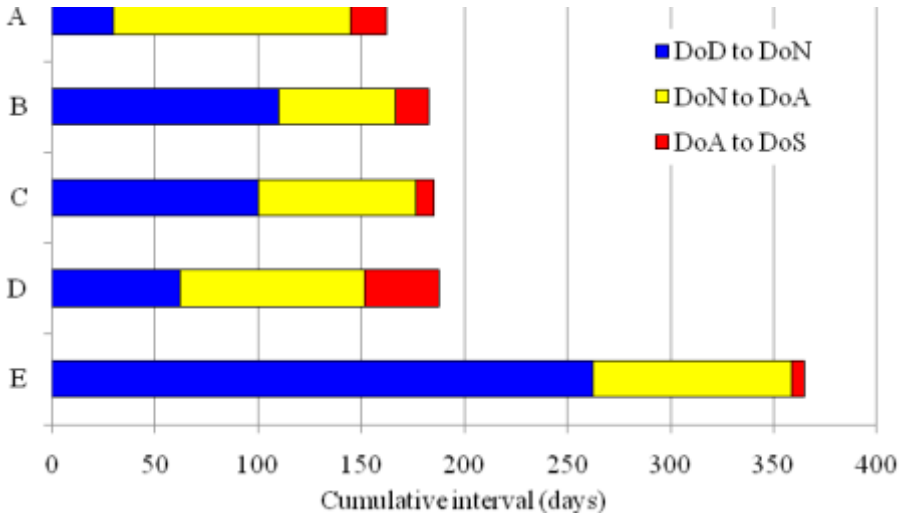
3.26 Differences in the crude claim development distribution over the period are difficult to interpret as they may result from differences in the growth of claims and changes in the mix of business and offices.

Variation between offices

3.27 With the increased internal consistency between the various claim intervals highlighted in paragraph 3.14, allied to the improved proportion of claim dates received and the relatively stable make-up of offices over the period, the effect on the claim development distribution of variation between offices is less significant for the 2003-2006 data than it was for 1999-2004. However, it will be apparent from the explanatory comments in previous paragraphs that there are still significant variations between offices. Noting our earlier comments in paragraph 3.14, these variations might arise from differences in policyholder behaviour or in processes and practices within offices, including

interpretation of date of diagnosis and date of notification. They might also reflect differences in the underlying products, or the maturity of the portfolio. Figure 3.2 illustrates the differences in intervals for five large offices that supply dates of claim for a significant percentage of the claims they submit to the CMI.

Figure 3.2. Crude average cumulative interval to settlement (in days) for five selected offices.



Note that the office labels in Figure 3.2 above are the same as used in Figure 3.2 of Working Paper 33 but not the same as used in Figure 2.1 or Table 3.2 of this paper.

4. THE INTERVAL FROM DIAGNOSIS TO SETTLEMENT: DATA

4.1 In this section we derive the set of claims data on which we undertake the modelling of the claim development distribution for claims settled in 2003-2006. This corresponds to section 4 of Working Paper 33. The modelling itself is described in section 5 of this paper.

4.2 Note, the claims data and the resulting claim development distribution are the same as were used to derive the 2003-2006 'All Office' "adjusted" results released to member offices in June 2010. The description below is a more detailed version of that which appeared in the covering note accompanying those results.

4.3 The claim development distribution used in deriving the diagnosis rates presented in this paper was based on claims settled in 2003-2006. Although the dataset only spanned four years, compared to six for the 1999-2004 dataset, the increased proportion of claims provided with both a date of diagnosis and a date of settlement in the later period results in the final modelling dataset being substantially larger than previously.

4.4 For the purpose of analysing the claim development distribution we have focussed only on those claims where we have date of diagnosis and date of settlement. Removing the 7,350 records where we do not have both dates leaves 15,424 claims.

4.5 As with the claim development distribution based on 1999-2004 claims that was described in Working Paper 33, we have chosen not to include claims where we had both the date of diagnosis and the date of admission (but no date of settlement).

4.6 The application of our methodology is limited to accelerated business in this paper. Since the claim development distribution that we derive will only be applied to expected diagnosed claims on accelerated business, and since the distribution may differ between accelerated and stand-alone business, we have restricted our attention to claims on accelerated business. This removes 1,646 claims on stand-alone critical illness policies, which we do not use further in this paper. This leaves us with 13,778 claims with both the date of diagnosis and the date of settlement on accelerated business.

Claims with very short intervals between diagnosis and settlement

4.7 One of the routine checks on critical illness data undertaken by the CMI when individual office data is processed is that the date of settlement is not before the date of diagnosis. Where a claim record fails this test, the dates are queried with the office concerned. This sometimes results in one or other date being revised but often the office advises that the date of diagnosis is unreliable for that claim and should be deleted.

4.8 This particular check does not identify claims with very short intervals between diagnosis and settlement, and there are a number of such claims, including 37 where the two dates are equal, as shown in Table 4.1.

Table 4.1. Number of claims with intervals between date of diagnosis and date of settlement up to and including 14 days. All accelerated claims settled in 2003-2006 where both dates are submitted.

Interval (days)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Number of claims	37	16	12	17	14	21	30	26	29	27	36	42	45	39	48

4.9 Where the date of diagnosis has been interpreted as the date that permanence has been established, short periods from diagnosis to settlement may exist, but a period as short as 0 or 1 day seems highly unlikely. Following the approach we adopted in Working Paper 33, we have removed those claims with an interval from diagnosis to settlement of 0 days from our subsequent analysis, but retained all claims with intervals of 1 day or greater. This removes 37 claims, leaving 13,741 claims for analysis. The 37 claims are effectively treated in an identical manner to those where we have received a date of settlement but no date of diagnosis. We acknowledge that the removal of claims with an interval of 0 days, but retention of those with an interval of 1 day, is entirely arbitrary, however it is consistent with the approach taken in Working Papers 14 and 33.

"Duplicates"

4.10 The CMI has not received sufficient information to enable us to identify all multiple claims on one individual. Indeed if these claims arise on policies with different offices then it would not necessarily be appropriate to remove such "duplicates" anyway for the purposes of modelling the claim settlement process, as the dates of diagnosis and settlement, the date of commencement and even the cause of claim may all differ.

4.11 Nevertheless where we have clear examples of duplicates – which we define as an exact match on office, gender, date of birth, date of diagnosis, date of settlement and cause of claim – we have amalgamated these claims. Note, we have only adjusted for duplicates in the development of the claim development distribution and not in other areas such as exposure and claims.

4.12 Using this approach reduces the data available for analysis to 12,843 claims.

Summary

4.13 The derivation of the set of claims on which our modelling is based is summarised in Table 4.2.

Table 4.2. Summary of the derivation of the claims data used in modelling work in section 5.

	1999-2004	**2003-2006**
Total settled claims	**21,365**	**22,774**
Minus claims without date of diagnosis or date of settlement	9,376	7,350
Minus claims on stand-alone critical illness	1,565	1,646
Minus claims with date of diagnosis equal to date of settlement	17	37
Minus "duplicates"	629	898
Minus groups of claims where very low proportion have both dates	160	0
Total settled claims on accelerated business used in subsequent modelling	**9,618**	**12,843**

4.14 Note that in the derivation of the 1999-2004 claim development distribution, we excluded 160 claims where there appeared to be a step-change in the proportion of claims, sub-divided by office and calendar year, for which we received both date of diagnosis and date of settlement. This is described in paragraphs 4.13 to 4.16 of Working Paper 33. There were no similar features in the 2003-2006 claims dataset, so no claims were removed for this reason.

4.15 For completeness, we note that the modelling dataset derived above includes 46 claims where the smoker status was not advised to the CMI. We have not attempted to derive diagnosis rates based on the small amount of undifferentiated exposure and claims.

4.16 It is important to note that the subsequent modelling is only based on around 56% of the total claims, and around 64% of the claims on full acceleration business, submitted to the CMI. One of the key assumptions underlying the diagnosis rates presented later in this paper is that the claim development distribution derived from this subset of claims can be applied to the full dataset.

4.17 In some respects, the question of whether this subset is unbiased cannot be tested – the most obvious example being by office. We have noted in section 3 some differences in the observed intervals between offices and we believe that such differences exist, perhaps because of differences in processes but, more significantly, because of the interpretation of date of diagnosis for some claims, such as those depending on permanence. However, we can only observe such differences where we have the relevant dates of claim (for a significant proportion of claims). Where an office has not submitted any dates of diagnosis, say, then we have no information on claim development for that office and can do no better than assume an average distribution.

4.18 One bias that we have observed within the subset relates to cause of claim. Table 4.3 shows the percentage of settled claims on accelerated business in 1999-2004 and 2003-2006 separately for both the full dataset and the subset used for modelling for selected causes of claim.

Table 4.3. Percentage of settled claims on accelerated business in 1999-2004 and 2003-2006 by cause of claim in the full datasets and in the claims data used to derive the claim development distributions.

Cause of claim	**Percentage of settled claims on accelerated business in 1999-2004**		**Percentage of settled claims on accelerated business in 2003-2006**	
	Full dataset	**Modelling subset**	**Full dataset**	**Modelling subset**
Cancer	46.2%	52.9%	45.3%	51.7%
Heart Attack	11.3%	13.7%	9.9%	11.3%
Stroke	5.0%	6.0%	4.6%	5.4%
CABG	2.2%	2.4%	1.8%	1.9%
MS	4.5%	4.4%	4.0%	4.3%
TPD	3.4%	2.8%	2.5%	2.6%
Death	21.0%	11.3%	19.6%	16.3%
Other (incl. unknown)	6.4%	6.5%	12.2%	6.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

4.19 Note that the "Other (incl. unknown)" category comprises some claims due to specified "other" causes, such as angioplasty or blindness, and some where the office concerned has been unable to supply the cause of claim. This latter group is likely to include some claims from cancer, heart attack, etc. The proportion of data where offices were unable to tell us the cause of claim is significantly higher in the 2003-2006 dataset.

4.20 It will be observed that death claims are under-represented in the modelling subset. However, the proportion of death claims in the 2003-2006 modelling subset is closer to the proportion in the full dataset than had been the case for the corresponding 1999-2004 dataset. The previous under-representation of MS and TPD claims has also been reversed in the more recent modelling dataset.

4.21 Table 4.4 demonstrates the increased number of dates of settlement provided for death claims in the more recent dataset which has allowed more of these claims to be retained in the modelling subset. However, the proportion of death claims submitted with a date of settlement remains lower than average. (Note that, as claims are submitted by year of settlement, we always know the year, even if we do not know the date, of settlement.) The table also highlights the increased provision of date of diagnosis for all causes apart from "Other (incl. unknown)".

Table 4.4. Percentage of all settled claims on accelerated business in 1999-2004 and 2003-2006 with date of diagnosis and with date of settlement, by cause of claim.

Cause of claim	**% of all settled claims in 1999-2004 with:**		**% of all settled claims in 2003-2006 with:**	
	Date of diagnosis	**Date of settlement**	**Date of diagnosis**	**Date of settlement**
Cancer	65%	99%	83%	94%
Heart Attack	69%	99%	83%	94%
Stroke	67%	99%	84%	96%
CABG	61%	99%	77%	97%
MS	55%	99%	77%	93%
TPD	46%	98%	73%	98%
Death	65%	63%	76%	82%
Other (incl. unknown)	62%	93%	40%	95%
Total	**64%**	**91%**	**76%**	**92%**

5. THE INTERVAL FROM DIAGNOSIS TO SETTLEMENT: MODELLING

5.1 In deriving the claim development distribution for claims settled in 2003-2006, the Committee has implemented exactly the same methodology as previously used to derive the 1999-2004 claim development distribution. This was described in detail in section 5 of Working Paper 33, but in summary, involves:

- Choosing a statistical distribution,
- Fitting the distribution to the data by adjusting the parameter values,
  - using a maximum likelihood approach,
  - adjusted to allow for truncation of the data (as described in paragraphs 5.12 and 5.13 of Working Paper 33), and
- Truncating the tail of the distribution using linear interpolation between the end of years 3 and 7, as a practical measure (as described in paragraph 5.50 of Working Paper 33).

5.2 The Committee has chosen to confine the choice of distribution in deriving the 2003-2006 claim development distribution to the Burr since previous work detailed in Working Paper 33 indicated that it provided a good fit and good flexibility. This is described in more detail in Working Paper 33 but for completeness, the Burr model, as we have used it, is a 3-parameter model with the following probability density function:

$$f(t) = \frac{\alpha\gamma\lambda^{\alpha}t^{\gamma-1}}{(\lambda + t^{\gamma})^{\alpha+1}}$$

and cumulative distribution function:

$$F(t) = 1 - \left(\frac{\lambda}{\lambda + t^{\gamma}}\right)^{\alpha}$$

5.3 As in prior work, we disregard possible variations in the claim development distribution over time, and between subsets of the data, and we derive an aggregate distribution from the modelling subset described in section 4. All other assumptions detailed in Working Paper 33 are also unchanged. In particular, the allowance for censoring in the data and the variation in 'Effective Observation Period' by office remains the same.

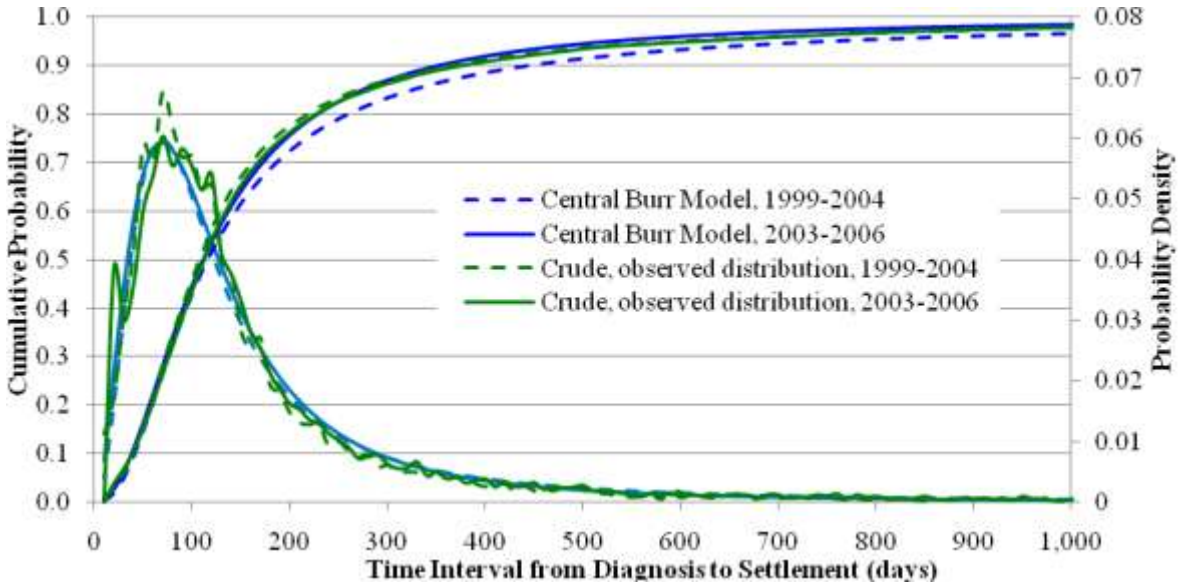
5.4 The methodology results in the parameters shown in Table 5.1 for the Burr model. Note that parameter values were rounded to four decimal places (α and γ) or the nearest integer (λ) for the 1999-2004 claim development distribution; no rounding was applied in the latest work, though the values shown in the table are rounded to the same degree.

Table 5.1. Parameter values for the Burr models of the claim development distributions for the sets of claims settled in 1999-2004 (from Working Paper 33) and 2003-2006 (derived in section 4). Parameter values are shown for the best fit only.

Burr model of claim development distribution		
	Claims settled in 1999-2004	**Claims settled in 2003-2006**
	ê ('central')	**ê ('central')**
α	0.5574	0.8408
λ	33,856	15,281
γ	2.3852	2.0967

5.5 Although the parameters take quite different values for the two models, the overall distribution is similar, as Figure 5.1 demonstrates.

Figure 5.1. Probability density functions and cumulative distribution functions for the central Burr models of the claim development distributions for the sets of claims settled in 1999-2004 (from Working Paper 33) and 2003-2006 (derived in Section 4), together with the corresponding functions for the crude distributions.



5.6 Figure 5.1 suggests there has been very little change in the crude, observed distribution though the Burr model has shortened and moved closer to the crude distribution. The closing of the gap between observed and modelled distributions is consistent with business growth levelling off and the increased "maturity" of the claims data.

6. THE DERIVATION OF ALL-CAUSES DIAGNOSIS RATES

Introduction

6.1. In this section we derive all-causes diagnosis rates, based on settled claims in 2003-2006 for the ages where we have credible volumes of data.

6.2. The methodology for deriving these rates is fully described in section 3 of Working Paper 43 (and, in part, in earlier Working Papers up to and including Working Paper 33) and is only summarised in brief here. The derivation of the male non-smoker rates is described in some detail, with the other three datasets described more briefly. This corresponds to the approach set out from paragraph 3.31 of Working Paper 43. Note that a number of practical issues that arose in deriving the WP43 rates were described in section 4 of Working Paper 43; very similar issues arose in deriving these rates but that section is not repeated in this paper.

6.3. The extension of these rates to younger and older ages is described in section 7 whilst the rates themselves are described in section 8 and contained in Appendix A.

6.4. Although the Committee experimented with several approaches to deriving diagnosis rates for the 1999-2004 dataset to satisfy ourselves that the rates were not unduly influenced by the approach used, only the approach documented in Working Paper 43 has been used here. Essentially, this approach involves adjusting the CIBT02 diagnosis rates to produce expected settled claims that are reasonably close to the actual settled claims, by both age and duration, in an intuitive manner. As will become apparent from the worked example for male non-smokers, the diagnosis rates are derived using three stages of adjustment:

i. An all-ages, all-durations adjustment is used to achieve an overall 100 A/E of 100.
ii. A re-shaping of the rates by age is applied using age-specific adjustments to achieve all-durations 100 A/Es of close to 100 for each age band.
iii. A re-shaping by duration is then applied to achieve all-ages 100 A/Es of close to 100 for each duration.

Note that after step iii, some further re-shaping by age is sometimes applied if the shape achieved by step ii is distorted by step iii.

6.5. The Committee is happy to make available to member offices the spreadsheets used in deriving the rates.

6.6. The constraints applied in deriving the rates are the same as in Working Paper 43:

- Rates cannot reduce with age. (There is an exception to this constraint if one assumes that TPD ceases at a particular age, such as 65.)
- In general, rates cannot reduce with duration unless the data implies there could be anti-selection.
- There is an additional implicit constraint in that we have not considered results by individual duration within the 5+ category.

Note that the second constraint was discussed in more detail in Working Paper 43.

6.7. The Committee used the male and female CIBT02 (Extended Cover) tables as the sets of claim rates to produce the initial values of expected settled claims. These tables were adjusted by taking appropriate percentages – by age and duration – to produce amended

values of the expected settled claims that were reasonably close to the actual settled claims. Unlike Working Paper 43 (and the Draft rates issued to member offices in August 2010), we have treated CIBT02 as an age exact table. (Consequently Table 6.1 and subsequent tables in this section are grouped by age last birthday, rather than age nearest, as in Working Paper 43 and the Draft Paper. Note that this change does not materially affect the rates that have been derived.)

The derivation of claim diagnosis rates: male non-smokers

6.8. In order to provide context to the subsequent description, the number of Actual Settled Claims for male non-smokers in 2003-2006 is shown in Table 6.1, by age band and duration. Unsurprisingly, there is little data at ages below 26 or above 65 with the former concentrated on the short durations and the latter on the long durations. The credibility of any rates derived for these age ranges is therefore limited hence, although we show the derivation of rates from age 20 to age 70 in this section, some of the rates at either end of this age range are adjusted when the rates are extended to younger and older ages, as described in section 7.

6.9. Note that the original data includes a small number of records relating to claims diagnosed before age 20 and claims settled after age 70 which have been ignored in our analysis.

Table 6.1: Actual Settled Claims in 2003-2006, male non-smokers, by age band and duration

Age last at settlement	**Curtate duration at settlement**						
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	25	39	33	12	5	7	**121**
26-30	62	120	97	53	37	63	**432**
31-35	97	163	153	169	98	182	**862**
36-40	103	243	235	198	123	325	**1,227**
41-45	90	195	248	221	147	430	**1,331**
46-50	70	160	195	173	125	478	**1,201**
51-55	59	129	153	185	136	500	**1,162**
56-60	39	98	117	123	109	430	**916**
61-65	8	24	36	45	43	193	**349**
66-70	0	1	5	9	6	41	**62**
ALL	**553**	**1,172**	**1,272**	**1,188**	**829**	**2,649**	**7,663**

NB. Table 6.1, above, corresponds to Table 3.2 of Working Paper 43; all the subsequent tables in this section of this paper correspond in a similar manner.

6.10. Male non-smoker experience in 2003-2006 – in terms of 100xASC/ESC – was 35% for all ages and durations combined. The first adjustment from CIBT02 (step i in paragraph 6.4) is therefore to replace 100% of the table with 35% at all ages and durations. This (obviously!) produces an overall 100A/E of 100%; the figures by age and duration are shown in Table 6.2. (Note that in this paper ASC refers to Actual Settled Claims with age and duration as at the date of settlement. In Working Paper 33 this was referred to as ASCs, to distinguish it from ASCd, based on age at diagnosis. See Appendix C of Working Paper 33 for more detail.)

6.11. It is important to note that although the adjustment has been applied to the diagnosis rates, Table 6.2 (and similar tables below) presents results in terms of Actual Settled Claims / Expected Settled Claims by age and duration at settlement.

Table 6.2: Values of 100A/E using 35% of CIBT02 at all ages and durations

Age last at settlement	**Curtate duration at settlement**						
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	90	122	173	130	126	316	**128**
26-30	88	114	114	95	116	180	**113**
31-35	87	89	89	129	112	110	**101**
36-40	76	104	103	107	95	106	**101**
41-45	65	78	96	100	93	104	**92**
46-50	61	75	84	85	84	107	**88**
51-55	79	86	87	110	104	116	**103**
56-60	91	108	103	108	113	112	**109**
61-65	104	117	116	127	130	118	**120**
66-70	0	60	142	166	101	112	**116**
ALL	**77**	**91**	**96**	**105**	**100**	**111**	**100**

6.12. Step ii seeks to remove the "U" shape, by age, in the all-durations results. In order to maintain a reasonably smooth shape to the rates, we used percentages of CIBT02 that are themselves smooth. As can be seen from Table 6.2, we need adjustments higher than 35% at younger ages and older ages, but lower at ages 41-50. The adjustments (expressed as a percentage of CIBT02) are shown below and the resulting 100A/E values are shown in Table 6.3:

Age	25	30	35	40	45	50	55	60	65
Percentage	43%	36%	35%	35%	31%	33%	38%	39%	42%

Note that in this paper, adjustments to CIBT02 are shown as whole percentages whereas the Committee used non-integral values in its work. In addition, although separate adjustments were applied at each age, only the adjustments at quinquennial ages are shown in the table above and subsequent tables of adjustments in this paper.

6.13. Note that with this revised shape of adjustments, the 100A/E values are now closer to 100 within each age band for all durations combined.

Table 6.3: Values of 100A/E using above percentages of CIBT02 by age at all durations

Age last at settlement	**Curtate duration at settlement**						
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	70	94	134	101	98	246	**100**
26-30	79	102	102	85	105	163	**101**
31-35	86	87	88	127	110	108	**100**
36-40	75	103	102	106	94	105	**100**
41-45	70	84	102	107	100	111	**99**
46-50	69	84	94	95	94	120	**99**
51-55	77	84	85	108	101	113	**100**
56-60	83	99	94	99	104	103	**100**
61-65	88	100	100	109	111	100	**102**
66-70	0	50	119	139	84	94	**97**
ALL	**76**	**91**	**97**	**105**	**100**	**110**	**100**

6.14. The Committee next reduced the rates at duration 0. Using 76% of the rates shown above at duration 0 produces the results in Table 6.4.

Table 6.4: Values of 100A/E using above percentages of CIBT02 by age at durations 1+ but 76% of these percentages at duration 0

Age last at settlement	**Curtate duration at settlement**						
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	92	105	135	101	98	246	**111**
26-30	104	112	103	86	105	164	**109**
31-35	113	96	89	127	110	108	**105**
36-40	99	113	103	106	95	105	**105**
41-45	92	92	103	107	100	111	**103**
46-50	91	91	95	95	94	120	**103**
51-55	101	92	86	108	101	113	**103**
56-60	109	108	95	99	104	103	**102**
61-65	116	109	100	109	111	101	**104**
66-70	0	54	120	139	85	94	**98**
ALL	**100**	**100**	**97**	**106**	**100**	**110**	**104**

6.15. It is important to note that the alteration to the duration 0 diagnosis rates also affects the expected settled claims at duration 1 (and to a lesser extent, later durations). This is because Table 6.4 shows results expressed in terms of settled claims. The application of the claim development distribution to a different claim diagnosis rate at duration 0 produces a different number of settled claims at duration 0 but also, with reducing significance, at subsequent durations. (Note that a similar effect occurs by age, with some of the claims diagnosed at one age being settled at higher ages. This is less visible from the tables in this paper than the corresponding durational effect because of the use of age bands.)

6.16. As a result the adjustment to the diagnosis rates at duration 0 appears to have produced a reasonable overall fit at duration 1, without any adjustment to the duration 1 rates themselves.

6.17. Indeed the shape by duration, up to duration 4, is now probably as good a fit as we are likely to achieve at an all-ages level because of the impact a change in rates at one duration has on the results at subsequent durations. One could seek to reduce the rates at durations 1 and 2 to achieve a closer fit (note that our second constraint, in paragraph 6.6, precludes reducing the rates at duration 2 below those at duration 1). Rates could also be increased at durations 3 and 4 to bring the combined A/E value closer to 100%, however the Committee chose not to apply these small adjustments, but to retain consistent adjustments across durations 1 to 4. A similar feature (including the high A/E at duration 3) was noted in Working Paper 43, the WP43 rates also combined durations 1 to 4.

6.18. Whilst the shape was considered acceptable, we increased the rates at durations 1 to 4 by 1%, so that the rates fit approximately for the combined durations. The rates for durations 5+ are clearly too low, however; Table 6.5 shows the effect of also increasing the rates at durations 5+ by 12%. Note that Table 6.5 includes an additional column demonstrating that the rates applied to durations 1 to 4 combined produce an A/E of 100%.

Table 6.5: Values of 100A/E using above percentages of CIBT02 by age but adjusted by 76% at duration 0, 101% at durations 1-4 and 112% at durations 5+

Age last at	Curtate duration at settlement							
settlement	**0**	**1**	**2**	**3**	**4**	**5+**	**ALL**	**1-4**
20-25	92	104	134	100	97	227	**110**	112
26-30	104	112	102	85	104	150	**107**	102
31-35	113	95	88	126	109	99	**103**	102
36-40	99	112	102	105	94	95	**101**	104
41-45	92	91	102	106	99	100	**99**	100
46-50	91	91	94	94	93	108	**99**	93
51-55	101	91	85	107	100	102	**99**	96
56-60	109	107	94	98	103	93	**97**	100
61-65	116	108	99	108	110	91	**97**	106
66-70	0	54	119	138	84	85	**91**	106
ALL	**100**	**99**	**96**	**105**	**99**	**100**	**100**	**100**

6.19. This completes step iii, however the fit by age that was previously achieved has now been lost, to some extent, due to the adjustments by duration. In particular, the reduction to the duration 0 rates has most impact at the younger ages whereas the increase to durations 5+ rates has most impact at older ages.

6.20. Table 6.6 shows the effect of increasing the rates at younger ages and reducing them at older ages. The adjustments to CIBT02 are shown in Table 6.7.

Table 6.6: Values of 100A/E using percentages of CIBT02 by age and duration shown in Table 6.7

Age last at	Curtate duration at settlement							
settlement	**0**	**1**	**2**	**3**	**4**	**5+**	**ALL**	**1-4**
20-25	83	94	121	91	88	206	**100**	102
26-30	98	105	96	80	98	142	**101**	96
31-35	110	92	85	122	106	96	**100**	99
36-40	98	111	100	104	92	94	**100**	103
41-45	92	91	102	106	99	101	**100**	100
46-50	92	92	95	95	94	110	**100**	94
51-55	103	93	87	109	102	104	**100**	97
56-60	113	110	97	101	106	96	**100**	103
61-65	121	112	103	113	115	94	**101**	111
66-70	0	57	126	147	90	91	**97**	114
ALL	**99**	**98**	**96**	**105**	**100**	**101**	**100**	**100**

6.21. For the 1999-2004 dataset, we highlighted an area of "poor fit" relating to ages 36 to 55 where experience at shorter durations appears generally lighter than these rates and that at longer durations heavier. A similar feature is apparent in the 2003-2006 dataset. An example of amending the rates to fit the data more closely was set out in paragraphs 4.24 to 4.26 of Working Paper 43. This example is not repeated in this paper. Although the issue is apparent again in the 2003-2006 rates, the Committee decided not to reflect this feature (or other similar features) in the final rates. In arriving at this decision, the Committee was mindful of the risk of over-fitting to the data but also considered that there are several areas in addition to this where adjustments might be applied with a similar level of justification. The current approach has the benefit of simplicity and the "areas of poor fit" are visible, allowing actuaries to make adjustment if they consider there is sufficient justification.

6.22. Hence, as for the WP43 rates, the rates in this paper have been derived by adjusting the CIBT02 rates first by age only, and then by duration only, and we have not varied the allowance for selection by age.

Table 6.7: Adjustments to CIBT02 by age and duration underlying the results in Table 6.6

Age exact at	Curtate duration at diagnosis					
diagnosis	**0**	**1**	**2**	**3**	**4**	**5+**
20	39%	52%	52%	52%	52%	58%
25	36%	48%	48%	48%	48%	53%
30	29%	38%	38%	38%	38%	42%
35	27%	36%	36%	36%	36%	40%
40	27%	35%	35%	35%	35%	39%
45	23%	31%	31%	31%	31%	34%
50	25%	33%	33%	33%	33%	36%
55	28%	37%	37%	37%	37%	41%
60	28%	38%	38%	38%	38%	42%
65	31%	41%	41%	41%	41%	45%
70	28%	37%	37%	37%	37%	41%

The derivation of claim diagnosis rates: male smokers

6.23. In order to provide context, the number of Actual Settled Claims for male smokers in 2003-2006 is shown in Table 6.8, by age band and duration. In total, the number of claims is again less than half that for male non-smokers, shown in Table 6.1; the credibility of these rates is consequently lower than that of the corresponding non-smoker rates.

Table 6.8: Actual Settled Claims in 2003-2006, male smokers by age band and duration

Age last at	Curtate duration at settlement						
settlement	**0**	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	6	29	7	7	2	0	**51**
26-30	31	45	42	18	5	14	**155**
31-35	42	94	79	67	47	64	**393**
36-40	58	102	95	97	59	112	**523**
41-45	61	97	116	89	61	157	**581**
46-50	54	90	112	125	82	181	**644**
51-55	27	68	80	81	73	180	**509**
56-60	15	31	62	54	42	156	**360**
61-65	1	2	17	12	10	64	**106**
66-70	0	0	0	2	0	6	**8**
ALL	**295**	**558**	**610**	**552**	**381**	**934**	**3,330**

6.24. Male smoker experience in 2003-2006 – in terms of 100xASC/ESC – was 63% of CIBT02 for all ages and durations combined. The use of 63% of CIBT02 at all ages and durations again did not produce the "U" shape observed for male non-smokers but an inverted "U" implying that adjustments lower than 63% are needed at younger ages and older ages, but higher adjustments are needed at ages 46-65.

6.25. Unlike the 1999-2004 experience, there is now an apparent select effect at duration 0.

6.26. Given the constraint on rates by duration (the second constraint in paragraph 6.6), the Committee combined durations 1 and 2 and durations 3, 4 and 5+. This produced the results in Table 6.9 whilst the adjustments to CIBT02 are shown in Table 6.10 for quinquennial ages.

Table 6.9: Values of 100A/E using percentages of CIBT02 by age and duration shown in Table 6.10

Age last at settlement	**Curtate duration at settlement**						
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	59	227	92	196	140	0	**141**
26-30	113	103	120	79	40	112	**101**
31-35	83	105	96	108	118	97	**101**
36-40	104	97	91	114	102	95	**99**
41-45	118	95	107	94	90	101	**100**
46-50	110	89	100	122	106	92	**101**
51-55	89	100	96	98	113	95	**98**
56-60	95	82	126	105	96	100	**102**
61-65	46	28	147	86	72	105	**97**
66-70	0	0	0	153	0	92	**77**
ALL	**101**	**98**	**103**	**106**	**100**	**97**	**100**

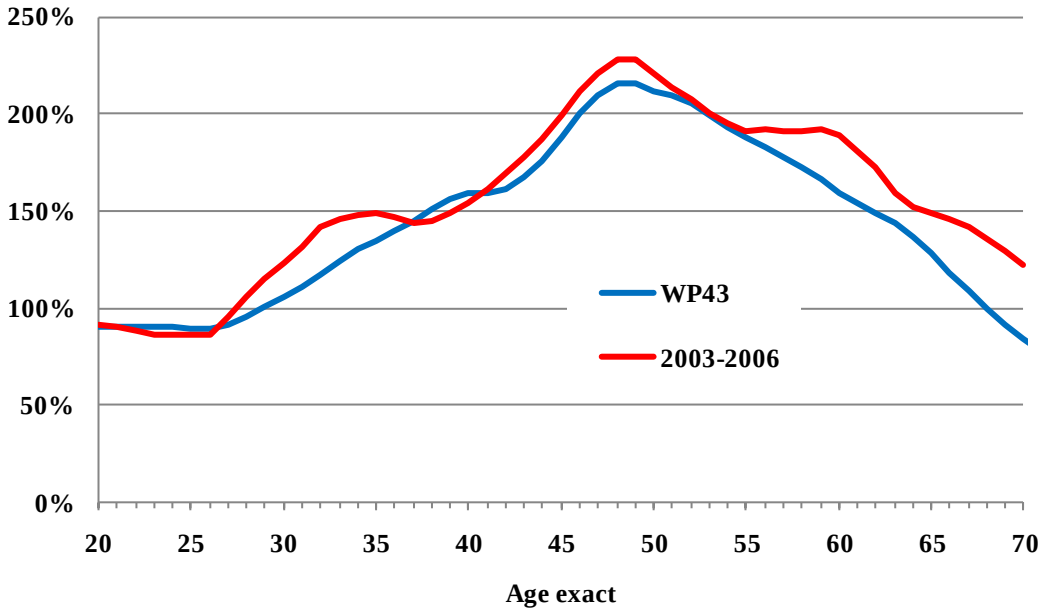
6.27. Note that we have again been unable to achieve an A/E of 100% at ages 20-25, given the constraint that diagnosis rates cannot reduce with increasing age, referred to above. We have also not achieved an A/E of 100% at ages 66+, however there were only eight claims settled at those ages so the data clearly has very limited credibility.

Table 6.10: Adjustments to CIBT02 by age and duration underlying the results in Table 6.9

Age exact at diagnosis	**Curtate duration at diagnosis**					
	0	**1**	**2**	**3**	**4**	**5+**
20	43%	49%	49%	53%	53%	53%
25	38%	43%	43%	46%	46%	46%
30	43%	49%	49%	52%	52%	52%
35	50%	55%	55%	60%	60%	60%
40	50%	55%	55%	60%	60%	60%
45	56%	62%	62%	67%	67%	67%
50	66%	74%	74%	80%	80%	80%
55	65%	72%	72%	78%	78%	78%
60	65%	73%	73%	79%	79%	79%
65	56%	62%	62%	67%	67%	67%
70	42%	47%	47%	50%	50%	50%

6.28. Figure 6.1 compares the smoker rates with the non-smoker rates; the smoker rates are those applicable to durations 3+ and the non-smoker rates are those applicable to durations 5+. The corresponding ratios from Working Paper 43 are also shown and it will be seen that the shape and level are very similar. (Note that the ultimate smoker rates in Working Paper 43 applied to durations 2+.)

Figure 6.1: Male smoker rates as a percentage of male non-smoker rates (ultimate)



6.29. For certain durations, the non-smoker rates derived above are higher than the smoker rates at ages up to 27. The Committee did not consider this plausible, and noted the relatively low number of claims at these ages (for smokers in particular). Consequently it decided to set the rates equal for non-smokers and smokers below age 28. This is described in section 7.

The derivation of claim diagnosis rates: female non-smokers

6.30. Again, in order to provide context, we start by showing the number of Actual Settled Claims for female non-smokers in 2003-2006 in Table 6.11, by age band and duration. In total, the number of claims is around 90% of that for male non-smokers, shown in Table 6.1.

Table 6.11: Actual Settled Claims in 2003-2006, female non-smokers by age band and duration

Age last at settlement	**Curtate duration at settlement**						
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	29	38	28	15	9	0	**119**
26-30	50	122	109	78	53	67	**479**
31-35	96	218	223	187	128	248	**1,100**
36-40	94	259	264	237	138	408	**1,400**
41-45	101	230	242	220	168	419	**1,380**
46-50	67	141	195	135	122	401	**1,061**
51-55	43	123	134	124	96	285	**805**
56-60	22	53	61	51	51	236	**474**
61-65	5	4	13	10	10	63	**105**
66-70	0	0	1	2	2	14	**19**
ALL	**507**	**1,188**	**1,270**	**1,059**	**777**	**2,141**	**6,942**

6.31. Female non-smoker experience in 2003-2006 – in terms of 100xASC/ESC – was 42% for all ages and durations combined. Applying this adjustment to CIBT02 at all ages and

durations produced A/E values that were reasonably flat by age and step ii was again therefore not applied for this dataset.

6.32. The most prominent feature was a select effect at duration 0; at 28% lower than the duration 1 rates this is again of similar magnitude to that observed for male non-smokers (and, in both cases, greater than observed in 1999-2004).

6.33. As with the datasets considered above, later durations needed to be combined to produce plausible rates by duration; in this case the Committee combined durations 1-4. To compensate for the reduction applied to the duration 0 rates, the rates at these durations needed to be increased by 6% to maintain an overall A/E of 100%; whilst the rates at durations 5+ were increased by 9%.

6.34. Some minor re-shaping by age was then undertaken to produce a closer fit; in the main, rates were increased at ages up to 40 and reduced above that age. This produced the results in Table 6.12 whilst the adjustments to CIBT02 are shown in Table 6.13 for quinquennial ages. Note that Table 6.12 includes an additional column demonstrating that the rates applied to durations 1 to 4 combined produce an A/E of 100%.

Table 6.12: Values of 100A/E using percentages of CIBT02 by age and duration shown in Table 6.13

Age last at settlement	**Curtate duration at settlement**							
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**	**1-4**
20-25	117	97	99	105	145	0	**102**	102
26-30	83	102	96	99	114	117	**100**	101
31-35	97	100	97	103	105	101	**100**	101
36-40	86	104	96	105	87	103	**99**	99
41-45	109	105	95	100	107	96	**100**	101
46-50	105	91	106	82	100	105	**99**	95
51-55	111	123	104	102	100	87	**99**	107
56-60	131	114	95	78	93	107	**101**	94
61-65	231	55	110	77	81	98	**94**	83
66-70	0	0	73	109	109	104	**99**	89
ALL	**100**	**103**	**98**	**97**	**100**	**100**	**100**	**100**

Table 6.13: Adjustments to CIBT02 by age and duration underlying the results in Table 6.12

Age exact at diagnosis	**Curtate duration at diagnosis**					
	0	**1**	**2**	**3**	**4**	**5+**
20	38%	56%	56%	56%	56%	57%
25	33%	49%	49%	49%	49%	51%
30	33%	48%	48%	48%	48%	50%
35	33%	48%	48%	48%	48%	50%
40	30%	45%	45%	45%	45%	46%
45	29%	42%	42%	42%	42%	43%
50	28%	41%	41%	41%	41%	42%
55	29%	42%	42%	42%	42%	44%
60	27%	40%	40%	40%	40%	41%
65	24%	35%	35%	35%	35%	36%
70	23%	34%	34%	34%	34%	35%

The derivation of claim diagnosis rates: female smokers

6.35. The number of Actual Settled Claims for female smokers in 2003-2006 is shown in Table 6.14, by age band and duration. This is the smallest of the four datasets with around 60% of the number of claims in the male smoker dataset.

Table 6.14: Actual Settled Claims in 2003-2006, female smokers by age band and duration

Age last at settlement	**Curtate duration at settlement**						
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	6	10	17	2	1	0	**36**
26-30	15	41	35	26	16	9	**142**
31-35	28	51	49	35	26	40	**229**
36-40	28	73	67	55	42	89	**354**
41-45	45	68	80	56	53	99	**401**
46-50	29	48	68	61	42	118	**366**
51-55	18	28	48	51	28	96	**269**
56-60	7	21	23	25	22	66	**164**
61-65	0	0	1	7	3	20	**31**
66-70	0	0	0	1	0	3	**4**
ALL	**176**	**340**	**388**	**319**	**233**	**540**	**1,996**

6.36. Female smoker experience in 2003-2006 – in terms of 100xASC/ESC – was 59% for all ages and durations combined. Applying this adjustment to CIBT02 at all ages and durations produced A/E values that were below 100 at younger ages and above at older ages; step ii therefore involved reducing rates at younger ages and increasing rates at older ages.

6.37. The adjustment for selection at duration 0 is lower than that for female non-smokers, with rates 12% lower than those at duration 1. As with the datasets considered above, later durations needed to be combined to produce plausible rates by duration; in this case the Committee combined durations 2+. Rates at duration 1 then appear to be 11% lower than rates at durations 2+ combined. This produced the results in Table 6.15 whilst the adjustments to CIBT02 are shown in Table 6.16 for quinquennial ages. Note that Table 6.15 includes an additional column demonstrating that the rates applied to durations 2+ combined produce an A/E of 100%.

Table 6.15: Values of 100A/E using percentages of CIBT02 by age and duration shown in Table 6.16

Age last at settlement	**Curtate duration at settlement**							
	0	**1**	**2**	**3**	**4**	**5+**	**ALL**	**2+**
20-25	74	90	216	49	58	0	**107**	138
26-30	74	119	111	120	130	64	**106**	108
31-35	98	98	93	87	101	86	**93**	91
36-40	80	111	95	97	111	110	**102**	103
41-45	131	100	103	84	116	93	**101**	97
46-50	107	87	104	102	97	104	**100**	102
51-55	119	82	109	117	82	94	**98**	99
56-60	107	134	101	105	108	90	**101**	97
61-65	0	0	30	159	72	98	**89**	96
66-70	0	0	0	225	0	115	**98**	101
ALL	**100**	**100**	**103**	**99**	**103**	**96**	**100**	**100**

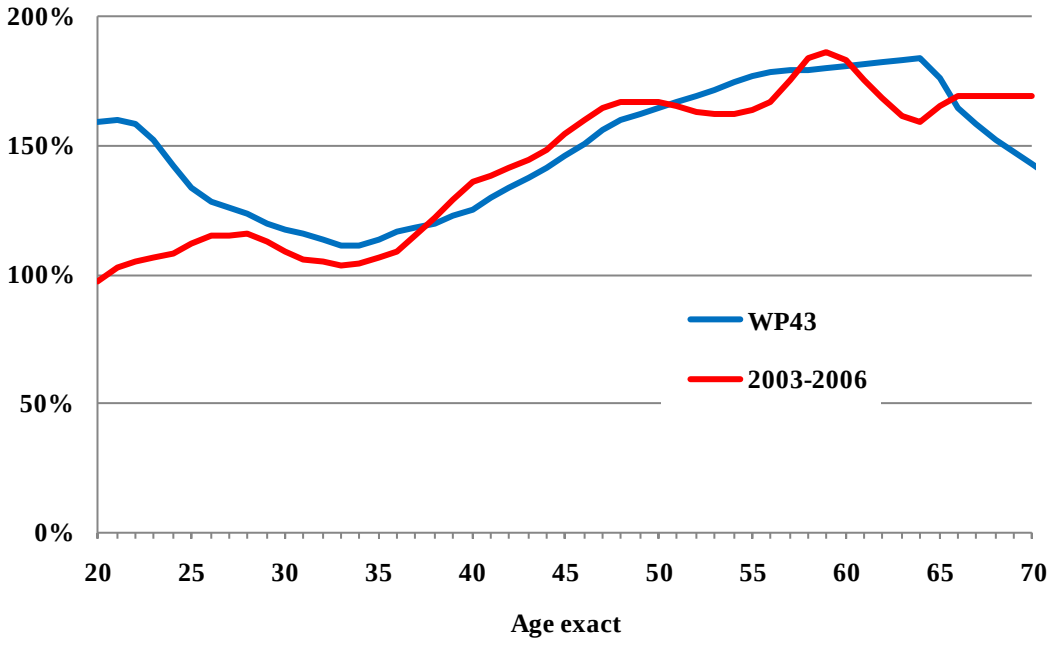
6.38. Note that we were again unable to achieve an A/E of 100% at the youngest ages or at ages 61+ whilst also producing smooth diagnosis rates by age.

Table 6.16: Adjustments to CIBT02 by age and duration underlying the results in Table 6.15

Age exact at diagnosis	Curtate duration at diagnosis					
	0	1	2	3	4	5+
20	44%	50%	56%	56%	56%	56%
25	44%	50%	56%	56%	56%	56%
30	46%	52%	58%	58%	58%	58%
35	40%	45%	51%	51%	51%	51%
40	49%	55%	63%	63%	63%	63%
45	53%	60%	68%	68%	68%	68%
50	55%	62%	70%	70%	70%	70%
55	56%	63%	71%	71%	71%	71%
60	59%	67%	75%	75%	75%	75%
65	47%	53%	60%	60%	60%	60%
70	47%	53%	60%	60%	60%	60%

6.39. Figure 6.2 compares the female smoker rates with the non-smoker rates; the smoker rates are those applicable to durations 2+ and the non-smoker rates are those applicable to durations 5+. The corresponding ratios from Working Paper 43 are also shown and (as for males) it will be seen that the shape and level are very similar, except at the youngest ages where there is limited data.

Figure 6.2: Female smoker rates as a percentage of female non-smoker rates (ultimate)



6.40. It will be noted that the ultimate non-smoker rate derived above is higher than the smoker rate at age 20. In addition, although not illustrated, some non-smoker rates at duration 1 are higher than the corresponding smoker rates. These anomalies were removed in the extension of rates to younger ages, described in section 7.

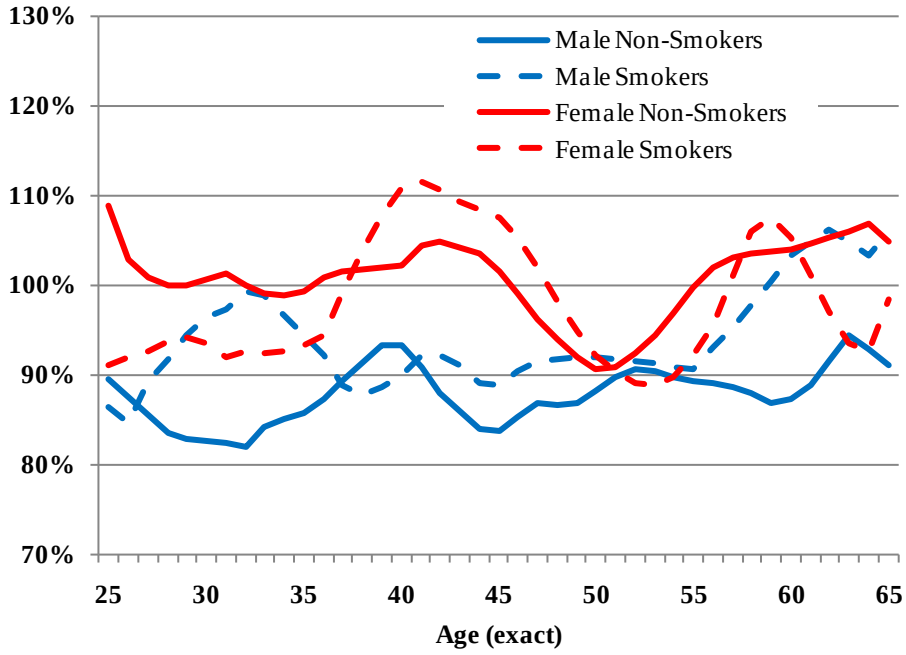
Comparison of the fitted 2003-2006 rates with the WP43 rates

6.41. One benefit of "repeating" the work described in Working Paper 43 for the newer dataset is to compare the two sets of rates.

6.42. Figure 6.3 below shows the ultimate rates derived in this section for each of the four datasets compared to the corresponding WP43 rates. There is considerable variation by age for each of the datasets, but overall:

- For male non-smokers, the 2003-2006 rates average slightly below 90% of the WP43 rates.
- For male smokers, the new rates average just over 90% of the WP43 rates. Note that the new rates increase during the late 50s, in relation to the WP43 rates; the result is that the new rates have a shape similar to the male non-smoker rates at these ages, whereas the WP43 rates were flatter.
- For female non-smokers, the 2003-2006 rates are similar to the WP43 rates at ages up to 44; the new rates then reduce to around 90% of the WP43 rates around age 50 before increasing above 100% in the 60's.
- For female smokers, the overall level of the new rates is again little different to the WP43 rates however there is even greater volatility by age than for the other three datasets, perhaps reflecting the much smaller volumes of female smoker data.

Figure 6.3: Fitted ultimate all-causes 2003-2006 diagnosis rates as a percentage of the WP43 rates



6.43. The selection patterns inferred from the data are illustrated in Figure 8.4. For three of the gender/smoker datasets, the selection patterns differ from those inferred from the 1999-2004 data, underlying the WP43 rates, as follows:

- For male non-smokers, the pattern in the 2003-2006 rates is unchanged from that in the WP43 rates, with durations 1 to 4 combined. The selection at duration 0 is slightly greater, and that at durations 1 to 4 slightly less, than that in the WP43 rates.
- For male smokers, the WP43 rates were higher at duration 0 than at duration 1. This feature did not recur in the 2003-2006 dataset, although the observed

selection is not as great as in the male non-smoker rates. The pattern has been amended from durations 0, 1, 2+ to 0, 1-2, 3+.

- For female non-smokers, there were separate WP43 rates for durations 0, 1 and 2+; in the new rates we have combined durations 1 to 4. The observed selection at duration 0 has increased and is now at a similar level to that in the male non-smoker rates.
- For female smokers, the WP43 rates combined durations 2-4 and 5+; in the new rates we have combined durations 2+. The observed selection at duration 0 and duration 1 are very similar to the WP43 rates.

Features not reflected in the diagnosis rates

6.44. In deriving the fitted rates in this section, the Committee had to make a number of decisions, including the balance between smoothness of the rates and goodness of fit to the underlying data. These are discussed in section 4 of Working Paper 43. Given the subjective nature of these decisions, it is important that any actuary using the rates understands where the rates fit closely to the experience, and where they do not. Hence in this section, we highlight features of the data that we have NOT reflected in the rates, some of which have been referred to earlier in this section; note that this list is not intended to be comprehensive. (Note that the fit of the final AC04 rates to the experience is illustrated in Appendix B.)

6.45. The first point to note is that we have used a single select pattern across all ages within each of the gender/smoker datasets, whereas a closer fit to the experience could have been obtained had we derived the rates by age for each duration separately. A specific example where the Committee opted not to fit the rates more closely to the data was at ages 36-55 for male non-smokers. Although we have an all-durations A/E close to 100, lower rates might have been chosen at shorter durations (and higher rates at longer durations). A similar feature was noted in the 1999-2004 rates and is discussed in paragraphs 4.24 to 4.26 of Working Paper 43.

6.46. The first constraint noted in paragraph 6.6, that rates cannot reduce with increasing age, has only a limited effect on the rates. An example where this arose is at younger ages for male smokers – evidenced by the all-durations A/E of 141% at ages 20-25 in Table 6.9 (although the extension of the rates to younger ages, described in section 7, below, overrides the fitted rates at these ages anyway).

6.47. The second constraint, regarding rates by duration, has a greater impact. An example where this arose, again for male non-smokers, is the uneven fit by duration within durations 1 to 4. At an all-ages level, the rates are higher than implied by the experience at durations 1 and 2, but lower at duration 3, evidenced by an all-ages A/E of 105% in Table 6.6. Note that the fit by age at duration 3 is poor even at ages 31-55, where we have most settled claims. Similar features to these arose in the 1999-2004 rates and in the other datasets.

6.48. The fit of the rates to the data is generally less close for the smoker datasets than the corresponding non-smoker rates; for example, Table 6.15 shows all-durations A/Es for female smokers of 106%, 93% and 102% at ages 26-30, 31-35 and 36-40 respectively. A closer fit to the data would have resulted in less smooth rates.

7. EXTENDING THE AGE RANGE

7.1. The 2003-2006 dataset contains credible volumes for only a limited age range and, as for the WP43 rates, the Draft rates issued to member offices in August 2010 only covered ages 25 to 65. However the Committee appreciated the need for a full age-range table for the pricing and valuation of whole-of-life policies and (the small proportion of) term and endowment assurance policies that cover individuals outside this age range. We therefore sought a pragmatic means of extending the age range of the rates to younger and older ages. The derivation of rates at younger ages is described first in this section, followed by a summary of the approach used at older ages; a more detailed description is set out in Appendix C.

7.2. It is important for actuaries using these tables to recognise that these rates have been produced for convenience and are not based on credible volumes of data, even though they have been included within the final tables. Note also that the Committee does not envisage this situation changing – few policies are ever likely to be sold below age 25 whilst the decline in volumes of whole-of-life policies, illustrated in section 2, and the tendency for most term assurance policies to cease before retirement also mean that the lack of credible insured data at older ages is likely to persist.

Younger ages

7.3. The approach adopted at younger ages differs between males and females, but is very simplistic in each case.

7.4. For males, the derivation of rates in section 6 exhibits the following features:

- The non-smoker rates are relatively flat by age between ages 25 and 30 (hence the adjustments, as percentages of CIBT02, reduce as age increases).
- The smoker rates increase significantly between ages 25 and 30, as age increases, and are lower than the non-smoker rates at ages up to 27 for certain durations (as noted earlier).
- The smoker rates below age 25 were held level, even though the experience suggested the rates should be higher, to avoid rates reducing with increasing age (see paragraph 6.27).

7.5. Given these features, the Committee chose to combine the two sets of rates where the smoker rate would otherwise have been lower than the non-smoker rate; i.e. ages 27 and below, for certain durations. This was done in a simple manner by assuming 75% of the non-smoker rate and 25% of the smoker rate (see Figure 7.2 below) and applying the rates at age 25 to all younger ages.

7.6. Note that the different selection patterns between the non-smoker and smoker rates (0, 1-4, 5+ and 0, 1-2, 3+ respectively) mean that the smoker rates at durations 3 and 4 are greater than the non-smoker rates even though the rates at durations 1, 2 and 5+ are the same.

7.7. For females, both sets of rates derived in section 6 were based on relatively constant percentage adjustments to CIBT02 between ages 25 and 30. The Committee chose to assume these percentages remain constant at ages below 25. This also had the effect of removing the anomaly between the non-smoker and smoker rates at age 20, noted in paragraph 6.40.

7.8. For interest, the Committee compared the shape of the rates at younger ages with those in the "00" Series term assurance tables. For males, the accelerated critical illness rates are flat below age 25, whereas the mortality rates increase as age increases. In contrast the female accelerated critical illness rates increase more rapidly than the corresponding mortality rates.

7.9. In undertaking this comparison, the Committee noted that for male smokers at durations 5+, the accelerated critical illness rates are slightly lower in absolute terms than the mortality rates at ages 24 to 27. The Committee decided not to make any adjustment in this regard given that both tables are based on sparse data at these ages and it is far from clear which of the sets of rates should be adjusted.

7.10. The final rates at younger ages are illustrated in Figure 7.1.

Figure 7.1: Ultimate 2003-2006 diagnosis rates at ages up to 30

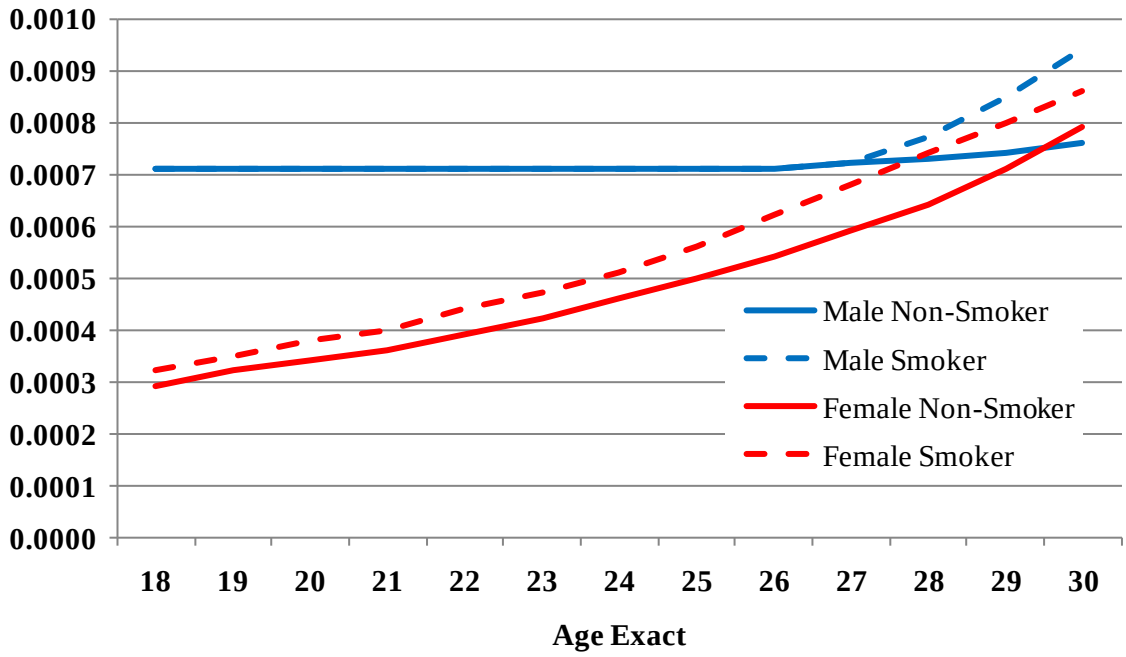
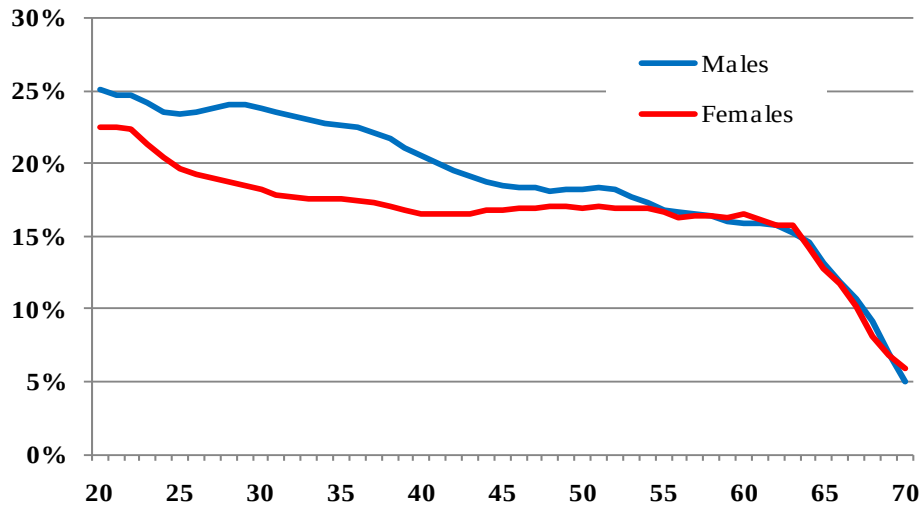


Figure 7.2: Proportion of smokers by age in the exposure underlying the 2003-2006 settled claims



Older ages

7.11. In the absence of credible insured data at the older ages, the Committee sought a simple approach that would produce rates which progressed smoothly to unity at a suitably old age. Given the paucity of data at even a population level for ages over 85, the Committee adopted a simple mathematical model. However for ages up to 85 we investigated a number of approaches to developing the rates, including:

- A cause-specific extrapolation of the rates as a % of CIBT02, based on the main causes and a residual category;
- Extrapolation of the all-causes rates as a % of CIBT02; and
- Consideration of the progression in rates by age in insured mortality tables.

7.12. The approaches investigated produced a range of rates, none of which could be considered right or wrong. Clearly, a single approach was required to produce the AC04 rates and the Committee considered it appropriate to document and expose the approach it adopted.

7.13. The approach used to derive the AC04 rates at older ages can be summarised as follows:

- We set a target for the insured table as a percentage of the CIBT02 Extended Cover tables at age 85 based on the ratio of insured to population mortality experience.
- We extrapolated the ultimate male and female rates, at an aggregate level (i.e. not smoker-differentiated), so that they increase steadily to reach these targets at age 85.
- Ultimate smoker-segregated rates were then derived from the aggregate rates using an assumed proportion of smokers and an assumed smoker to non-smoker differential at each age.
- From age 86 rates were projected so that they increase at a lower rate at each age, reaching unity at an arbitrarily selected end-age of the tables of 110.
- Select rates were derived for ages up to 65 at entry from the ultimate rates using the selection pattern for each gender/smoker dataset that has been assumed to apply at all other ages.

These steps are described in more detail in Appendix C.

7.14. These rates were used from age 60 and the fitted rates, derived in section 6, were used up to age 55. Rates between ages 56 and 59 were blended between the two sets of rates to ensure smoothness.

7.15. The Committee considers that the principle of insured experience converging towards population experience at these ages is well-founded. The approach adopted has the benefit of simplicity and could be adapted should an actuary have reason to choose different extrapolations, pace of convergence or a different end-age. However the parameterisation of the approach is clearly subjective and it is important to recognise that part of the rationale for the approach outlined below is that it produces rates that appear reasonable in relation to the range of rates produced by the other approaches. In particular, although the Committee regards the rates it produces as sensible, in the absence of credible volumes of insured data, other approaches and other rates may be equally valid.

8. THE AC04 DIAGNOSIS RATES

8.1. This section first sets out key features of the AC04 diagnosis rates, then compares them to the CIBT02 rates.

8.2. The rates themselves are contained in Appendix A to this paper. Note that some additional smoothing has been applied where the "relatively smooth adjustments to CIBT02" used in section 6 did not produce smooth rounded rates and to the extensions of these rates to older ages, described in section 7. The rates in Appendix A have also been rounded to 5 decimal places.

8.3. The Committee intends to recommend these 2003-2006 diagnosis rates as formal tables for adoption by the Actuarial Profession. It is customary for such tables to be assigned an abbreviated naming convention and the Committee proposes that the tables are called "AC{M/F}{N/S}L04", where:

AC	indicates Accelerated Critical illness (If the Committee produces formal tables of stand-alone critical illness in future, these could be denoted "SC");
M/F	indicates gender, i.e. Male or Female;
N/S	indicates smoker status, i.e. Non-smoker or Smoker (Note that the Committee has not produced aggregate tables);
L	indicates Lives (Any future Amounts tables would be denoted by "A"); and
04	indicates the approximate mid-point of the 2003-2006 dataset.

Within this paper we refer to the set of tables as the "AC04 Series".

8.4. The full set of 2003-2006 tables are therefore:

ACMNL04
ACMSL04
ACFNL04 and
ACFSL04.

Each table has separate rates at durations 0, 1, 2, 3, 4 and 5+ for ages 18 to 65 and ultimate (durations 5+) rates for ages 66 to 110.

8.5. A summary of the fit of the final rates to the experience is contained in Appendix B. It is worth noting that even within the framework adopted by the Committee, of a single selection pattern applicable at all ages, a slightly closer fit to the data could have been achieved. For example, it will be observed from Table B1 that, for male non-smokers, the ratio of actual settled claims to expected settled claims at duration 0 is 98% so these rates could have been reduced by 2% (and the rates at other durations increased slightly to compensate).

The scope of the diagnosis rates

8.6. Key features of these rates are listed below. A number of these are then discussed further in the subsequent paragraphs:

- Annual rates;
- Accelerated cover (see 8.8);
- The rates relate to a variety of product types, including term, endowment and whole-of-life assurances (see section 2 for an illustration of the mix);
- The rates are calculated on a "lives" basis (see 8.9);
- The rates are based on claims settled in 2003-2006 (see 8.10);

- The rates are based on the experience of all offices that contributed data in any of the four calendar years (see 8.11);
- Although described as "all-causes", the rates have not been adjusted for any limitations in the scope of particular products (see 8.13 to 8.16);
- The rates are on an age exact basis (see 8.17);
- The rates apply to business accepted on "standard rates" and include "normal claims" only (see 8.18 and 8.19); and
- Some approximations are made in the calculation of exposure however the Committee considers that the rates should be designated as "initial" rates (see 8.20).

8.7. Note that many of these features only explicitly apply to the rates derived from CMI data, as described in section 6. However the Committee believes that they can also reasonably be assumed to apply to the extension to older ages; it therefore intends that these key features are deemed to apply to the full set of AC04 Series rates.

8.8. The CMI collects data for both Stand-Alone cover, where the benefit is paid on diagnosis of critical illness, and Full Accelerated cover, where the entire benefit is payable on the diagnosis of critical illness or death, whichever occurs first. The AC04 Series rates are based on Full Accelerated business only; throughout the paper we abbreviate this to "accelerated".

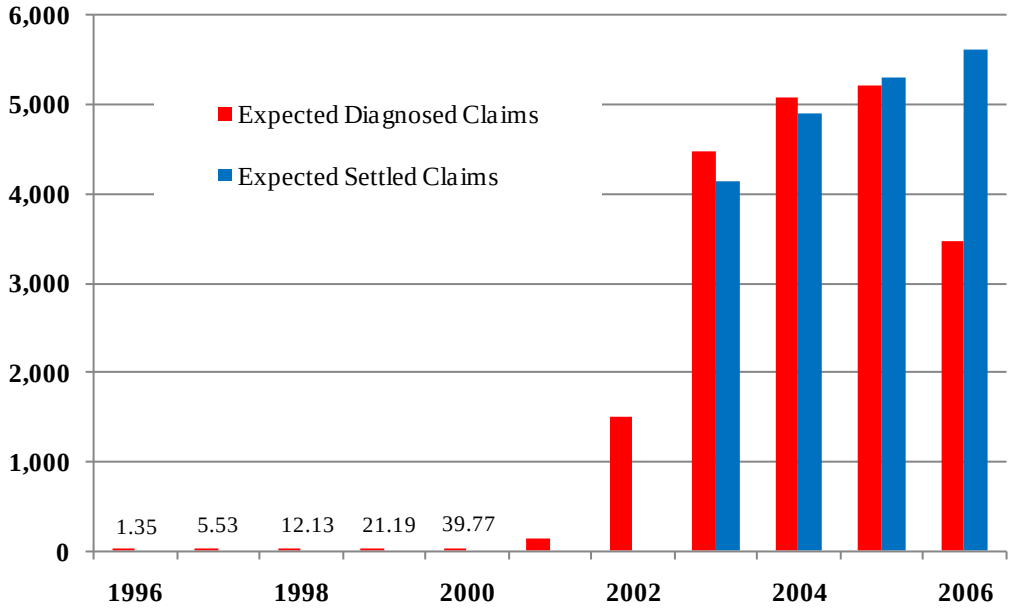
8.9. Although these rates are described as being on a "lives" basis, they are, in reality, a mixture of "lives" and "policies". Offices are asked to combine multiple policies into a single policy where they arise from one underwriting process (e.g. automatic increments) but to submit a separate record if new underwriting is involved. Even if offices are able to submit data on this basis, this will mean that a "life" may feature several times in the analysis. No attempt has been made to allow for this (or for lives having policies with different offices).

8.10. The AC04 Series rates are based on claims settled in 2003-2006. The rates do not simply apply to the mid-point of this period, because:

- The volumes of business changed over the period, and
- The rates relate to claims settled in this period, so will have been diagnosed in a slightly earlier period.

The total expected settled claims in 2003-2006 are shown by calendar year of settlement in Figure 8.1 (this corresponds to Figure 6.1 in Working Paper 43). Also shown are the expected diagnosed claims corresponding to these settled claims, by calendar year of diagnosis. Note that in this chart the expected claims are calculated using the final AC04 rates. In total, the two are equal but it will be observed that the diagnosed claims relate to an earlier period, starting as far back as 1996 (because the claim development distribution is limited to seven years). Overall the weighted mid-point of the diagnoses appears to be around August 2004 (i.e. the rates apply on average to exposure in a year from March 2004 to February 2005).

Figure 8.1: Expected settled claims (ESC) in 2003-2006, by calendar year of settlement, and the corresponding expected diagnosed claims (EDC), by calendar year of diagnosis



8.11. The rates are based on the experience of all offices that contributed data in any of the four calendar years from 2003 to 2006 inclusive. This is a much more consistent group of offices than in 1999-2004. In addition, the data volumes submitted over the period by the larger offices were more consistent than in the earlier period (see Figure 2.1).

8.12. The Committee has not undertaken any analysis for individual offices at this stage, so cannot provide any indication of the degree of variability in the rates by office. The Committee is undertaking such analyses for selected large offices for the 2003-2006 dataset and a high-level indication of the variability will be included in the Supplementary Analyses Paper.

8.13. Although described as "all-causes", the rates have not been adjusted for any limitations in the scope of particular products. All policies included in the analysis should cover cancer, heart attack, stroke and death and hence the exposure can reasonably be assumed to be accurate for these causes. However for any critical illness event that is only covered by some products, the actual settled claims only arise under that event if it is explicitly covered. The Committee did not attempt to adjust the exposure (and the expected settled claims) accordingly, as the products with fewer explicit events may incur higher numbers of claims under events such as death and TPD, so that the all-causes rates remain broadly appropriate. Furthermore such an adjustment is unlikely to be accurate and is beyond the level of detail justified by the other assumptions in our work; the Committee expects such differences to be a source of less variation than, say, varying experience between offices arising from differences in business mix, underwriting standards and claims assessment practices.

8.14. Note that in using the CIBT02 Extended Cover tables to derive the AC04 rates at older ages, as described in section 7, the Committee has produced rates covering a wider range of causes than might have been implied by using the CIBT02 Core Cover rates. Our methodology involves deriving rates based on insured data up to age 60 so the rates reflect the mix of diseases in the insured data up to that age. Consequently, the AC04 rates reflect an implicit blending from the "insured mix" of diseases up to age 60 to the

mix in CIBT02 Extended Cover tables at age 85. Actuaries may therefore need to consider whether the tables are appropriate for their use at these ages, particularly in respect of conditions such as Alzheimer's disease that only emerge at the older ages.

8.15. In addition to differences in the specified conditions under different products, there will also be differences in the definitions applied to these conditions. In particular the allowance for TPD within the AC04 rates will reflect a mix of experience under the various definitions used in the market.

8.16. Actuaries may also need to consider whether it is appropriate to adjust the AC04 tables to reflect the coverage of a contract at specific ages. For example, the AC04 rates have been constructed using the CIBT02 tables, which incorporate TPD up to age 65; if TPD ceases at a different age then it may be appropriate to adjust the tables accordingly. Indeed given that the CIBT02 tables contain a "full" year's rate for age 65 for TPD, the AC04 tables also include an allowance for a full year of TPD (at an average definition) and adjustment may therefore be appropriate if TPD ceases on the 65th birthday, for example.

8.17. The exposure in our analysis was calculated using age in months. In multiplying the exposure by CIBT02, to calculate expected diagnosed claims, the data was grouped by age last birthday (in years). As a result, the rates in Appendix A relate to age *x*, i.e. they are appropriate for the age interval from exact age *x* to exact age *x+1*. (Note that a more accurate approach has been used to derive age exact rates in this paper than in Working Paper 43 and the Draft Paper).

8.18. The AC04 Series rates should apply to business accepted on "standard rates" only. Offices are asked not to submit data for policies subject to additional premiums or restricted cover, for medical or other reasons, but the CMI has no way of checking whether this has been done accurately.

8.19. The rates should reflect only those claims accepted within the terms of the contract; offices are asked to exclude *ex gratia* claims. Claims accepted during a "Free Cover period", between the submission of a proposal and policy commencement, should also be excluded from the definition of "settled claims" as there is no exposure corresponding to these claims. Claims under Children's Cover are also excluded.

8.20. The CMI receives individual records for each critical illness benefit in force at the start and end of each calendar year, including the date of policy commencement. Within this work, the actual date of commencement is used in calculating exposure. However for the data from which these rates are derived the CMI does not receive any information on the date of exit (for exits other than claims) to allow a fully accurate calculation of exposure; for all exits (including claims), exposure is calculated on a "census" basis, assuming that exits occur in the middle of the year. Note also that:

- For claims, exposure stops mid-year in the year of settlement, not at the date of diagnosis, meaning that, on average, there is a slight over-statement of exposure compared to central exposure; and
- The exposure makes no allowance for policies entering and exiting within the same calendar year. This will result in an under-statement of exposure – and a corresponding over-statement of diagnosis rates – at duration 0.

(More complete details of the exposure calculations are contained in section 7 of Working Paper 33.)

8.21. These points mean that the definition of our exposure calculation is indeterminate between initial and central, even though we made no explicit allowance for exposure after the date of diagnosis for claims. This statement also applied to the WP43 rates (and the Draft rates); however for the purposes of the AC04 Series, the Committee considered it important that the rates are accurately designated. On balance, given the extension of exposure beyond the date of diagnosis, the Committee concluded it appropriate to designate these rates as initial rates (i.e. *q*-type rates).

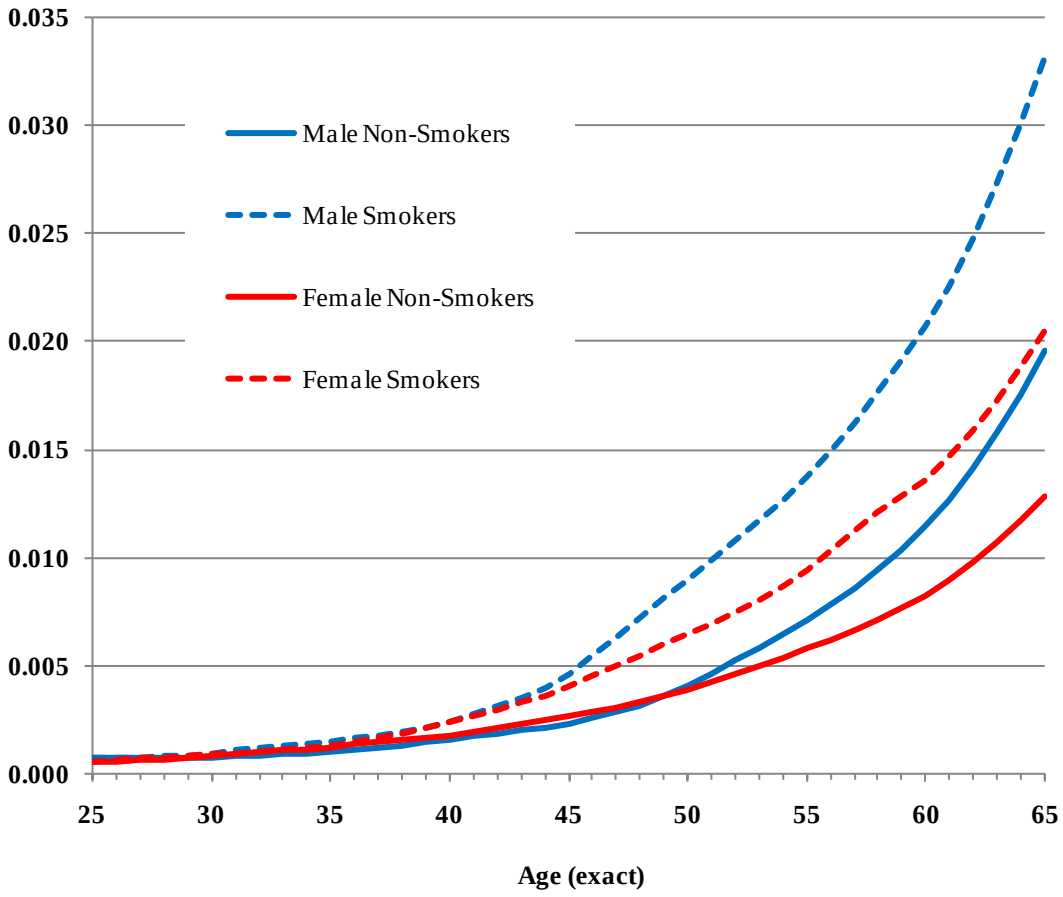
8.22. A spreadsheet containing the rates and also central rates (i.e. *m*-type rates), obtained by an approximation, is available from the Actuarial Profession's website.

The all-causes diagnosis rates

8.23. The four sets of rates are illustrated in Figure 8.2 for ages 25 to 65. This shows the ultimate rates, i.e. durations 5+ for male non-smokers, durations 3+ for male smokers, durations 5+ for female non-smokers and durations 2+ for female smokers.

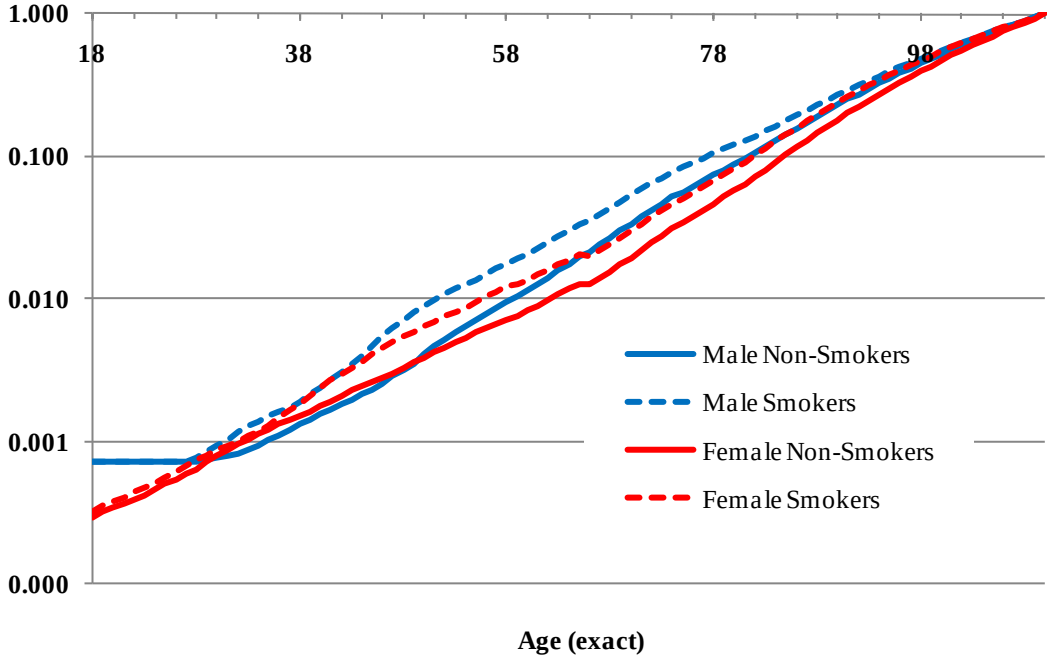
8.24. It will be observed that the two sets of male rates increase much more rapidly with increasing age beyond around age 50; this feature was also noted for the WP43 rates.

Figure 8.2: All-causes 2003-2006 diagnosis rates, ultimate



8.25. Whilst the shapes of both sets of male rates appear similar to diagrams of mortality rates, the female rates appear flatter.

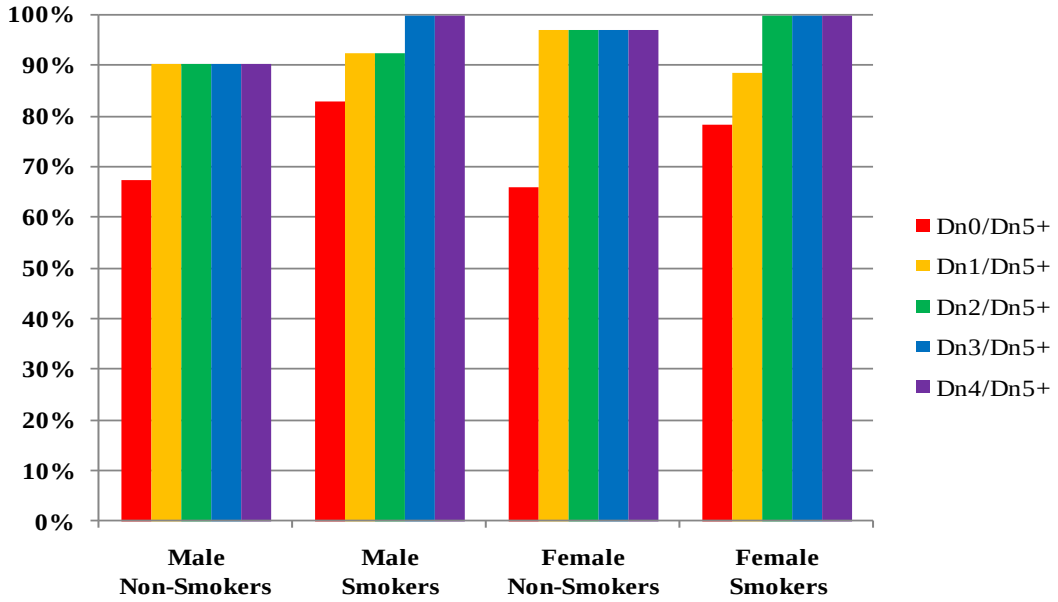
Figure 8.3: All-causes 2003-2006 diagnosis rates, ultimate (logarithmic scale)



8.26. The rates are also shown in Figure 8.3 using a logarithmic scale for the full age range. Working Paper 43 commented on the similarity of the male and female non-smoker rates from age 33 to age 41; in the 2003-2006 rates the male rates are lower at most of these ages with the cross-over occurring around age 50. The discontinuity in the female rates at age 65, referred to in paragraph C7, is apparent in Figure 8.3.

8.27. The relative select patterns in the four sets of rates are illustrated in Figure 8.4.

Figure 8.4: All-causes 2003-2006 diagnosis rates, by duration as a percentage of those at durations 5+



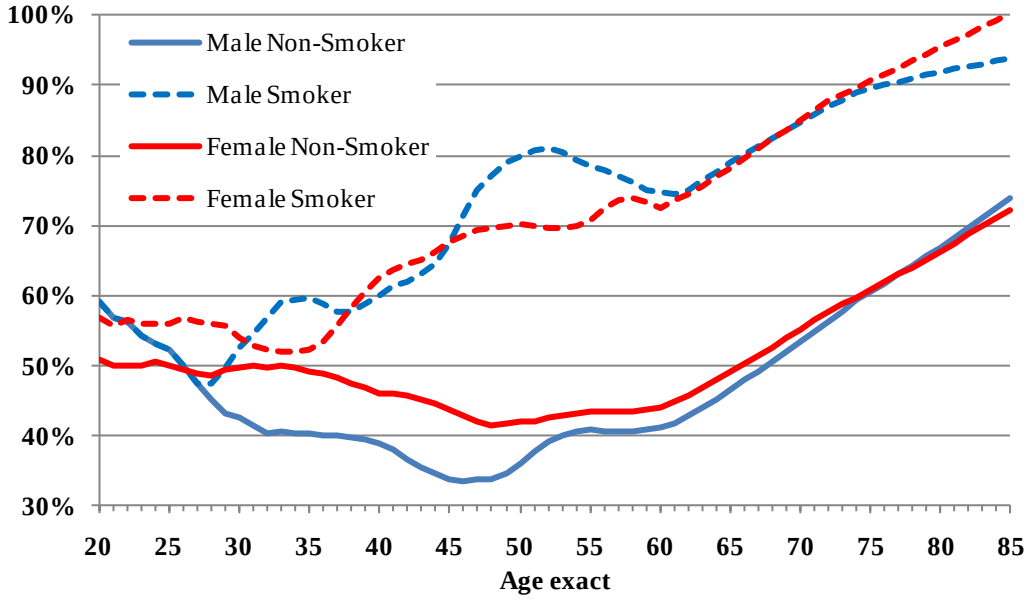
Comparison with CIBT02

8.28. Working Paper 43 compared the WP43 diagnosis rates with those from existing tables that may be in use in the UK, namely two population-based tables, CIBT93 and CIBT02, and two tables that have been adapted from population data to represent

insured experience, IC94 and CIIT00. In this paper we only show a comparison of the AC04 Series rates with CIBT02; this is effectively a graphical illustration of the adjustments derived in section 6 and the subsequent extrapolation to older ages.

8.29. Figure 8.5 shows the ultimate 2003-2006 rates as a percentage of the Extended Cover rates from CIBT02 for each of the four gender/smoker datasets. This is comparable to Figure E2 of Working Paper 43 although here we have shown the comparison up to the highest age in the CIBT02 tables, 85. Note that Working Paper 43 also contained a brief description of the derivation of CIBT02 (and the other tables); this is not repeated here, other than to note that the CIBT02 rates were derived from population data and are not smoker-differentiated.

Figure 8.5: Ultimate 2003-2006 diagnosis rates as a percentage of CIBT02 (Extended Cover)



8.30. The most conspicuous feature of Figure E2 in Working Paper 43 was a "hump" between ages 45 and 65 in the two smoker datasets. The downward slope of the hump at older ages (55 to 65) seemed counter-intuitive and is less pronounced in the AC04 Series rates (although we note that this occurs at ages where the data are less credible, so neither the strong feature in the earlier rates nor its weaker appearance in the latest rates can be considered definitive).

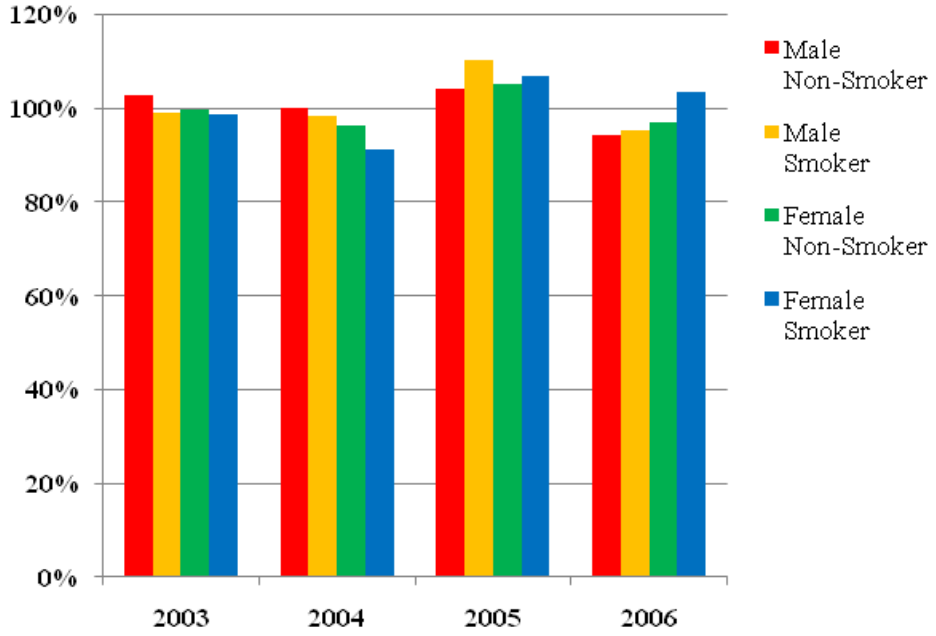
8.31. The shapes of the two sets of non-smoker rates are very similar between Figure 8.5 and Figure E2 of Working Paper 43.

9. EXPERIENCE BY CALENDAR YEAR

9.1. Earlier in this paper we showed the actual settled claims in 2003-2006 as a whole compared to the expected settled claims (for example, Table 6.6 for male non-smokers). Here, we sub-divide the 2003-2006 experience by year in order to assess the variation in experience over the period.

9.2. Figure 9.1 shows the experience for each of the four gender/smoker datasets for all-ages and all-durations combined, by calendar year.

Figure 9.1: Values of 100A/E by calendar year where expected settled claims are calculated using the rates derived in this paper



9.3. Comparing Figure 9.1 with the corresponding chart in Working Paper 43 (Figure 7.1) shows more consistent experience across the period, especially for the larger datasets, i.e. male and female non-smokers. In contrast, there appeared to be a significant reduction in experience over 1999-2004 across all four datasets. Note that the values for the experience in the overlapping years of the two datasets (2003 and 2004) are not directly comparable; the underlying datasets are different and different sets of rates have been used to calculate the expected settled claims.

9.4. Figure 9.1 shows above-average experience for all four datasets in 2005.

9.5. It should be noted that Figure 9.1 is not necessarily a reliable measure of the true underlying experience, since a single claim development distribution, derived from the 2003-2006 data (using data from both genders and both smoker statuses), has been used throughout. Working Paper 43 noted an additional caveat, regarding changes in the offices contributing data during 1999-2004 but, as noted earlier, this is less of a concern for the 2003-2006 dataset.

10. SUMMARY

10.1. This paper presents claim diagnosis rates for accelerated critical illness insurance, on a 'lives' basis, using data for claims settled in 2003 to 2006. Four sets of rates are included in the paper: for males and females, and for non-smokers and smokers.

10.2. For ages 25 to 65, this paper "repeats" the work undertaken on the 1999-2004 dataset documented in Working Papers 33 and 43 (in which we produced the WP43 rates) However the Committee has now also produced rates outside of this age range, in order to produce a formal table that can be used at all required ages.

10.3. Working Paper 43 set out a number of perceived advantages in using the 2003-2006 dataset, including that it is more recent, covers a shorter period and is more stable in terms of contributing offices. However both the 2003-2006 and 1999-2004 datasets are very immature and vary from a very high proportion of term assurance cover at young ages and short durations to increasing proportions of endowment and whole-of-life products at older ages and high durations, as shown in section 2, which may distort the shape of the rates by both age and duration. Furthermore, changes in underwriting standards and the scope of cover over a number of years will only affect new policies and may therefore also affect the apparent shape by duration. Notwithstanding these limitations, the Committee considers that the 2003-2006 dataset provides a sound basis for a formal table.

Ages 25 to 65

10.4. Sections 2 to 5 of this paper consider the data available to us; in particular they show the fitted claim development distribution (CDD) for the 2003-2006 dataset using a Burr model. The resulting all-causes CDD is reasonably close to that fitted to the 1999-2004 dataset.

10.5. The derivation of the all-causes diagnosis rates for the ages where we have credible volumes of data is described in section 6. The method used to derive these rates is identical to that described in Working Paper 43; i.e. we adjusted an initial set of rates (CIBT02) first by age only, and then by duration only, to broadly fit the expected settled claims to the actual settled claims. This was done in a pragmatic manner – for each gender/smoker dataset independently – to reach a reasonable fit, having regard to the data volumes.

10.6. As far as the ultimate rates are concerned, the 2003-2006 rates are around 90% of the WP43 rates for both male datasets, although there is considerable variation by age. The 2003-2006 female non-smoker rates are similar to the WP43 rates at ages up to 44; the new rates then reduce to around 90% of the WP43 rates before increasing above the previous rates from age 58 to age 65. For female smokers, the overall level of the new rates is little different to the WP43 rates however there is considerable variability by age, reflecting the much smaller data volumes.

10.7. The selection patterns (based on curtate duration in years) inferred from the data vary between the four sets of rates, as follows:

Male Non-smoker:	0, 1-4, 5+	(unchanged from the WP43 rates)
Male Smoker:	0, 1-2, 3+	(0, 1, 2+ in the WP43 rates)
Female Non-smoker:	0, 1-4, 5+	(0, 1, 2+ in the WP43 rates)
Female Smoker:	0, 1, 2+	(0, 1, 2-4, 5+ in the WP43 rates)

Although three of the patterns differ from the WP43 rates, the Committee does not consider the variations to be substantial. The true underlying pattern remains uncertain.

10.8. All four datasets now show positive selection, unlike the WP43 rates in which the male smoker rates at duration 0 were almost equal to the ultimate rates and higher than those for duration 1. Indeed the degree of selection in these rates at duration 0 is higher in each of the four datasets than for the 1999-2004 dataset (although as noted in Working Paper 43, the rates at duration 0 are particularly sensitive to the CDD).

10.9. Both sets of male rates now appear to have a similar shape to mortality rates by age, whereas the female rates appear flatter. Working Paper 43 demonstrated that the shape of the WP43 rates by age differs significantly from several tables of critical illness rates; similarly, Figure 8.5 of this paper illustrates the significant difference in shape by age between the 2003-2006 rates and CIBT02.

10.10. A substantial number of assumptions underlie these rates. It is important to recognise that there is some uncertainty associated with each of these, and hence a considerable degree of uncertainty surrounds the rates. However without a formal statistical model to underpin this work, the Committee is unable to quantify this uncertainty. Most of the assumptions are unchanged from those used to produce adjusted results in Working Paper 33 and summarised in section 10 of that paper. Indeed, no additional assumptions were required to produce the diagnosis rates in this paper (or the WP43 rates) however a considerable degree of judgement has been exercised, for example in deciding on the trade-off between smoothing and goodness of fit. These areas were discussed in section 4 of Working Paper 43 and, although not repeated here, also apply to these rates.

Younger and older ages

10.11. The extension of the rates outside the age range where we have credible volumes of data is described in section 7. An arbitrary approach has been adopted at the younger ages, given that the extension only applies from age 18 to age 25 and the Committee expects the rates at these ages to have little overall financial significance.

10.12. The Committee investigated a number of approaches to developing the rates at older ages. These approaches produced a range of rates, none of which could be considered right or wrong. The specific approach used to produce the AC04 rates assumes that the insured experience steadily converges towards population experience and that smoker and non-smoker rates also converge. Whilst the Committee considers these principles to be sound, the choice of the specific parameters and the end-age of the table (110) are necessarily arbitrary. Part of the rationale for the approach is that it produces rates that appear reasonable in relation to the range of rates produced by the other approaches and the Committee acknowledges that, in the absence of meaningful volumes of insured data, other approaches are equally valid.

10.13. The fit of the final AC04 rates to the underlying data is summarised in Appendix B. Generally, the fit is very similar to that of the rates derived in section 6, however some differences arise at the younger and older ages and where additional smoothing has been applied. One particular feature is that the AC04 rates are higher than those implied by the data at ages 61-70 for both female datasets. The Committee considered amending the rates at older ages but concluded this was inappropriate given the relatively low volume of claims. More generally, although the Committee considers these rates to be a reasonable estimate of the true underlying rates, it is by no means the only set of rates that could have been derived and other approaches may be equally valid. Consequently

the Committee is again making available to member offices spreadsheets that will allow practitioners to experiment with alternative approaches to deriving the rates. Member offices wishing to receive these spreadsheets should use the e-mail address at the end of section 11.

11. FURTHER WORK

11.1. The AC04 Series tables are confined to accelerated critical illness on a lives basis. This section sets out the scope of the further work that the Committee is now undertaking which we believe will be valuable in aiding understanding of the rates and how they might be used. It is intended that these additional analyses will be published in a Working Paper (provisionally entitled "Supplementary analyses to CMI critical illness diagnosis rates for accelerated business, 2003-2006") in Spring 2011 after which the Committee intends to recommend the final 2003-2006 diagnosis rates contained in this paper as formal tables for adoption by the Actuarial Profession.

11.2. We will investigate experience on an amounts basis by segregating the data into sum assured bands to assess whether there is evidence of significant variation. This will be done in a simplistic manner, commensurate with the level of detail contained in the data.

11.3. We will investigate and report on variations in the experience for the following characteristics of the data:

- Distribution channel;
- Office (anonymously), using office-specific CDDs where possible;
- Product type, using the product categories illustrated in Figure 2.5; and
- Commencement year, separating the data between pre-2000 and subsequently. In particular we hope this will illustrate whether the shape of the AC04 Series rates by both age and duration, may be distorted by the substantial number of changes in critical illness business discussed in section 2.

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11.4. We will also illustrate the sensitivity of the AC04 Series rates to some of the key assumptions underlying the rates, in particular the choice of CDD.

11.5. Whilst the formal AC04 Series rates are at an all-causes level, we will illustrate cause-specific rates for the main causes of claim, where the data volumes permit. We expect this analysis to cover the following:

- Male non-smoker rates for cancer, heart attack, death, stroke, CABG and TPD;
- Male smoker rates for cancer, heart attack and death only;
- Female non-smoker rates for cancer, death, stroke and MS; and
- Female smoker rates for cancer and death only.

For the avoidance of doubt, it is intended that the cause-specific rates will be illustrative and will not form part of the final, formal rates.

11.6. The relatively small volume of stand-alone critical illness data makes it impractical to construct separate tables of diagnosis rates. Instead we will impute rates from the AC04 Series rates but excluding deaths and show the claims experience of stand-alone business against these rates.

11.7. Our current intention is to publish a Working Paper containing these additional analyses in Spring 2011.

11.8. The Committee intends to recommend the AC04 Series diagnosis rates contained in this paper as formal tables for adoption by the Actuarial Profession after publication of the analyses discussed above.

11.9. The Committee is always keen to receive feedback on all aspects of its work. The Committee is conscious that the "older age" rates developed in this paper have not previously been exposed for discussion within the Profession, however given the absence of data and that there can be no single right answer, it does not anticipate any changes to these rates unless there is a clear and substantive mandate for change.

11.10. The Committee is also conscious that the interpretation of the AC04 rates, for example with regard to the conditions covered, is not straightforward and additional commentary on the interpretation of the AC04 rates may be included in the Supplementary Analyses Paper, depending on the feedback received on this paper.

11.11. Please e-mail feedback to ci@cmib.org.uk. In order to be reflected in the next Working Paper, it would be helpful if feedback could be received by 18 March 2011.

REFERENCES

CMI Working Paper 14 : Methodology underlying the 1999-2002 CMI Critical Illness experience investigation (May 2005)

CMI Working Paper 28 : Progress towards an improved methodology for analysing CMI critical illness experience (July 2007)

CMI Working Paper 33 : A new methodology for analysing CMI critical illness experience (July 2009)

CMI Working Paper 43 : CMI critical illness diagnosis rates for accelerated business, 1999-2004 (February 2010)

CMI Working Paper 45 : Consultation on the Proposed Methodology for the analysis of CMI 'Per Policy' mortality data (April 2010)

(All of the above are available from http://www.actuaries.org.uk/research-and-resources/pages/continuous-mortality-investigation-working-papers)

Draft CMI critical illness diagnosis rates for accelerated business, 2003-2006 (August 2010). This paper was released only to firms that financially support the CMI and is referred to herein as the "Draft Paper".

Board for Actuarial Standards: Technical Actuarial Standard D: Data (November 2009)

Board for Actuarial Standards: Technical Actuarial Standard M: Modelling (April 2010).

(These documents can be found at: http://www.frc.org.uk/bas/standards/tas.cfm.)

Health Claims Forum: Recording of 'Date of Claim' for Critical Illness claims (November 2006), available from http://www.actuaries.org.uk/research-and-resources/pages/critical-illness-faqs

Swiss Re Term & Health Watch (various editions)

Appendix A: CMI Critical Illness Diagnosis rates, 2003-2006

A1. This appendix contains the all-causes diagnosis rates for 2003-2006 for accelerated business derived in this paper.

A2. The four sets of 2003-2006 tables contained in Tables A1 to A4 are desinated:
ACMNL04
ACMSL04
ACFNL04 and
ACFSL04.

A3. Each table has separate rates at durations 0, 1, 2, 3, 4 and 5+ for ages 18 to 65 and ultimate (durations 5+) rates for ages 66 to 110.

A4. Key features of these rates are listed below. Please see section 8 for more details on many of these features:

- Annual rates;
- Accelerated cover;
- The rates relate to a variety of product types, including term, endowment and whole-of-life assurances;
- The rates are calculated on a "lives" basis;
- The rates are based on claims settled in 2003-2006;
- The rates are based on the experience of all offices that contributed data in any of the four calendar years;
- Although described as "all-causes", the rates have not been adjusted for any limitations in the scope of particular products;
- The rates are on an age exact basis;
- The rates apply to business accepted on "standard rates" and include "normal claims" only; and
- The rates are designated as "initial" rates.

Table A1: Male Non-Smoker rates: **ACMNL04**

Age Exact	Curtate duration 0	1	2	3	4	5+	Age Exact
18	0.00050	0.00066	0.00066	0.00066	0.00066	0.00071	18
19	0.00050	0.00066	0.00066	0.00066	0.00066	0.00071	19
20	**0.00050**	**0.00066**	**0.00066**	**0.00066**	**0.00066**	**0.00071**	**20**
21	0.00050	0.00066	0.00066	0.00066	0.00066	0.00071	21
22	0.00050	0.00066	0.00066	0.00066	0.00066	0.00071	22
23	0.00050	0.00066	0.00066	0.00066	0.00066	0.00071	23
24	0.00050	0.00066	0.00066	0.00066	0.00066	0.00071	24
25	**0.00050**	**0.00066**	**0.00066**	**0.00066**	**0.00066**	**0.00071**	**25**
26	0.00050	0.00066	0.00066	0.00066	0.00066	0.00071	26
27	0.00050	0.00068	0.00068	0.00068	0.00068	0.00072	27
28	0.00050	0.00069	0.00069	0.00069	0.00069	0.00073	28
29	0.00051	0.00069	0.00069	0.00069	0.00069	0.00074	29
30	**0.00052**	**0.00069**	**0.00069**	**0.00069**	**0.00069**	**0.00076**	**30**
31	0.00054	0.00071	0.00071	0.00071	0.00071	0.00079	31
32	0.00056	0.00074	0.00074	0.00074	0.00074	0.00082	32
33	0.00060	0.00079	0.00079	0.00079	0.00079	0.00088	33
34	0.00064	0.00085	0.00085	0.00085	0.00085	0.00094	34
35	**0.00069**	**0.00091**	**0.00091**	**0.00091**	**0.00091**	**0.00101**	**35**
36	0.00075	0.00099	0.00099	0.00099	0.00099	0.00110	36
37	0.00082	0.00108	0.00108	0.00108	0.00108	0.00120	37
38	0.00090	0.00118	0.00118	0.00118	0.00118	0.00131	38
39	0.00098	0.00128	0.00128	0.00128	0.00128	0.00143	39
40	**0.00107**	**0.00139**	**0.00139**	**0.00139**	**0.00139**	**0.00156**	**40**
41	0.00116	0.00151	0.00151	0.00151	0.00151	0.00169	41
42	0.00125	0.00164	0.00164	0.00164	0.00164	0.00182	42
43	0.00134	0.00177	0.00177	0.00177	0.00177	0.00197	43
44	0.00144	0.00191	0.00191	0.00191	0.00191	0.00212	44
45	**0.00157**	**0.00209**	**0.00209**	**0.00209**	**0.00209**	**0.00231**	**45**
46	0.00175	0.00231	0.00231	0.00231	0.00231	0.00256	46
47	0.00193	0.00257	0.00257	0.00257	0.00257	0.00285	47
48	0.00214	0.00286	0.00286	0.00286	0.00286	0.00315	48
49	0.00240	0.00319	0.00319	0.00319	0.00319	0.00354	49
50	**0.00273**	**0.00366**	**0.00366**	**0.00366**	**0.00366**	**0.00405**	**50**
51	0.00310	0.00416	0.00416	0.00416	0.00416	0.00461	51
52	0.00350	0.00470	0.00470	0.00470	0.00470	0.00521	52
53	0.00393	0.00526	0.00526	0.00526	0.00526	0.00584	53
54	0.00439	0.00584	0.00584	0.00584	0.00584	0.00648	54
55	**0.00486**	**0.00644**	**0.00644**	**0.00644**	**0.00644**	**0.00714**	**55**
56	0.00531	0.00706	0.00706	0.00706	0.00706	0.00782	56
57	0.00581	0.00771	0.00771	0.00771	0.00771	0.00856	57
58	0.00639	0.00848	0.00848	0.00848	0.00848	0.00941	58
59	0.00704	0.00935	0.00935	0.00935	0.00935	0.01037	59
60	**0.00776**	**0.01031**	**0.01031**	**0.01031**	**0.01031**	**0.01144**	**60**
61	0.00859	0.01142	0.01142	0.01142	0.01142	0.01266	61
62	0.00955	0.01269	0.01269	0.01269	0.01269	0.01408	62

63	0.01068	0.01420	0.01420	0.01420	0.01420	0.01575	63
64	0.01192	0.01585	0.01585	0.01585	0.01585	0.01757	64
65	**0.01329**	**0.01767**	**0.01767**	**0.01767**	**0.01767**	**0.01959**	**65**
		0.01935	0.01935	0.01935	0.01935	0.02146	66
			0.02165	0.02165	0.02165	0.02401	67
				0.02423	0.02423	0.02687	68
					0.02709	0.03004	69
						0.03357	**70**
						0.03749	71
						0.04182	72
						0.04655	73
						0.05161	74
						0.05675	**75**
						0.06218	76
						0.06792	77
						0.07408	78
						0.08071	79
						0.08798	**80**
						0.09604	81
						0.10509	82
						0.11548	83
						0.12746	84
						0.14142	**85**
						0.15655	86
						0.17290	87
						0.19054	88
						0.20951	89
						0.22988	**90**
						0.25170	91
						0.27502	92
						0.29991	93
						0.32641	94
						0.35456	**95**
						0.38443	96
						0.41604	97
						0.44945	98
						0.48468	99
						0.52178	**100**
						0.56078	101
						0.60170	102
						0.64457	103
						0.68940	104
						0.73623	**105**
						0.78505	106
						0.83588	107
						0.88873	108
						0.94358	109
						1.00000	**110**

Table A2: Male Smoker rates: **ACMSL04**

Age Exact	Curtate duration 0	1	2	3	4	5+	Age Exact
18	0.00052	0.00066	0.00066	0.00071	0.00071	0.00071	18
19	0.00052	0.00066	0.00066	0.00071	0.00071	0.00071	19
20	**0.00052**	**0.00066**	**0.00066**	**0.00071**	**0.00071**	**0.00071**	**20**
21	0.00052	0.00066	0.00066	0.00071	0.00071	0.00071	21
22	0.00052	0.00066	0.00066	0.00071	0.00071	0.00071	22
23	0.00052	0.00066	0.00066	0.00071	0.00071	0.00071	23
24	0.00052	0.00066	0.00066	0.00071	0.00071	0.00071	24
25	**0.00052**	**0.00066**	**0.00066**	**0.00071**	**0.00071**	**0.00071**	**25**
26	0.00052	0.00066	0.00066	0.00071	0.00071	0.00071	26
27	0.00058	0.00068	0.00068	0.00072	0.00072	0.00072	27
28	0.00064	0.00072	0.00072	0.00077	0.00077	0.00077	28
29	0.00071	0.00080	0.00080	0.00085	0.00085	0.00085	29
30	**0.00078**	**0.00087**	**0.00087**	**0.00094**	**0.00094**	**0.00094**	**30**
31	0.00086	0.00096	0.00096	0.00104	0.00104	0.00104	31
32	0.00095	0.00107	0.00107	0.00116	0.00116	0.00116	32
33	0.00106	0.00118	0.00118	0.00128	0.00128	0.00128	33
34	0.00115	0.00129	0.00129	0.00139	0.00139	0.00139	34
35	**0.00124**	**0.00139**	**0.00139**	**0.00150**	**0.00150**	**0.00150**	**35**
36	0.00134	0.00150	0.00150	0.00162	0.00162	0.00162	36
37	0.00143	0.00160	0.00160	0.00173	0.00173	0.00173	37
38	0.00157	0.00176	0.00176	0.00190	0.00190	0.00190	38
39	0.00176	0.00197	0.00197	0.00213	0.00213	0.00213	39
40	**0.00198**	**0.00222**	**0.00222**	**0.00240**	**0.00240**	**0.00240**	**40**
41	0.00225	0.00252	0.00252	0.00273	0.00273	0.00273	41
42	0.00255	0.00285	0.00285	0.00308	0.00308	0.00308	42
43	0.00290	0.00324	0.00324	0.00350	0.00350	0.00350	43
44	0.00328	0.00366	0.00366	0.00396	0.00396	0.00396	44
45	**0.00380**	**0.00425**	**0.00425**	**0.00460**	**0.00460**	**0.00460**	**45**
46	0.00449	0.00502	0.00502	0.00543	0.00543	0.00543	46
47	0.00521	0.00583	0.00583	0.00630	0.00630	0.00630	47
48	0.00594	0.00664	0.00664	0.00718	0.00718	0.00718	48
49	0.00667	0.00747	0.00747	0.00807	0.00807	0.00807	49
50	**0.00742**	**0.00830**	**0.00830**	**0.00897**	**0.00897**	**0.00897**	**50**
51	0.00817	0.00914	0.00914	0.00988	0.00988	0.00988	51
52	0.00893	0.00999	0.00999	0.01080	0.01080	0.01080	52
53	0.00970	0.01085	0.01085	0.01173	0.01173	0.01173	53
54	0.01048	0.01172	0.01172	0.01267	0.01267	0.01267	54
55	**0.01136**	**0.01271**	**0.01271**	**0.01373**	**0.01373**	**0.01373**	**55**
56	0.01236	0.01383	0.01383	0.01495	0.01495	0.01495	56
57	0.01342	0.01501	0.01501	0.01622	0.01622	0.01622	57
58	0.01456	0.01629	0.01629	0.01761	0.01761	0.01761	58
59	0.01577	0.01764	0.01764	0.01907	0.01907	0.01907	59
60	**0.01714**	**0.01916**	**0.01916**	**0.02071**	**0.02071**	**0.02071**	**60**
61	0.01862	0.02083	0.02083	0.02252	0.02252	0.02252	61
62	0.02046	0.02289	0.02289	0.02474	0.02474	0.02474	62

63	0.02261	0.02529	0.02529	0.02734	0.02734	0.02734	63
64	0.02492	0.02788	0.02788	0.03013	0.03013	0.03013	64
65	**0.02744**	**0.03070**	**0.03070**	**0.03317**	**0.03317**	**0.03317**	**65**
		0.03321	0.03321	0.03589	0.03589	0.03589	66
			0.03668	0.03964	0.03964	0.03964	67
				0.04378	0.04378	0.04378	68
					0.04830	0.04830	69
						0.05326	**70**
						0.05868	71
						0.06457	72
						0.07088	73
						0.07739	74
						0.08399	**75**
						0.09069	76
						0.09763	77
						0.10489	78
						0.11257	79
						0.12083	**80**
						0.12984	81
						0.13984	82
						0.15120	83
						0.16417	84
						0.17914	**85**
						0.19515	86
						0.21226	87
						0.23050	88
						0.24992	89
						0.27057	**90**
						0.29249	91
						0.31572	92
						0.34030	93
						0.36628	94
						0.39370	**95**
						0.42259	96
						0.45300	97
						0.48496	98
						0.51850	99
						0.55367	**100**
						0.59048	101
						0.62898	102
						0.66918	103
						0.71112	104
						0.75482	**105**
						0.80029	106
						0.84756	107
						0.89665	108
						0.94756	109
						1.00000	**110**

Table A3: Female Non-Smoker rates: **ACFNL04**

Age Exact	Curtate duration 0	1	2	3	4	5+	Age Exact
18	0.00019	0.00028	0.00028	0.00028	0.00028	0.00029	18
19	0.00021	0.00031	0.00031	0.00031	0.00031	0.00032	19
20	**0.00022**	**0.00033**	**0.00033**	**0.00033**	**0.00033**	**0.00034**	**20**
21	0.00024	0.00035	0.00035	0.00035	0.00035	0.00036	21
22	0.00026	0.00038	0.00038	0.00038	0.00038	0.00039	22
23	0.00028	0.00041	0.00041	0.00041	0.00041	0.00042	23
24	0.00030	0.00045	0.00045	0.00045	0.00045	0.00046	24
25	**0.00033**	**0.00049**	**0.00049**	**0.00049**	**0.00049**	**0.00050**	**25**
26	0.00036	0.00053	0.00053	0.00053	0.00053	0.00054	26
27	0.00039	0.00058	0.00058	0.00058	0.00058	0.00059	27
28	0.00043	0.00063	0.00063	0.00063	0.00063	0.00064	28
29	0.00047	0.00069	0.00069	0.00069	0.00069	0.00071	29
30	**0.00052**	**0.00077**	**0.00077**	**0.00077**	**0.00077**	**0.00079**	**30**
31	0.00058	0.00085	0.00085	0.00085	0.00085	0.00087	31
32	0.00064	0.00093	0.00093	0.00093	0.00093	0.00095	32
33	0.00070	0.00102	0.00102	0.00102	0.00102	0.00104	33
34	0.00076	0.00111	0.00111	0.00111	0.00111	0.00113	34
35	**0.00082**	**0.00120**	**0.00120**	**0.00120**	**0.00120**	**0.00122**	**35**
36	0.00088	0.00129	0.00129	0.00129	0.00129	0.00132	36
37	0.00094	0.00139	0.00139	0.00139	0.00139	0.00142	37
38	0.00101	0.00149	0.00149	0.00149	0.00149	0.00152	38
39	0.00108	0.00159	0.00159	0.00159	0.00159	0.00163	39
40	**0.00116**	**0.00170**	**0.00170**	**0.00170**	**0.00170**	**0.00175**	**40**
41	0.00126	0.00183	0.00183	0.00183	0.00183	0.00192	41
42	0.00137	0.00198	0.00198	0.00198	0.00198	0.00209	42
43	0.00149	0.00215	0.00215	0.00215	0.00215	0.00226	43
44	0.00160	0.00234	0.00234	0.00234	0.00234	0.00244	44
45	**0.00171**	**0.00254**	**0.00254**	**0.00254**	**0.00254**	**0.00262**	**45**
46	0.00184	0.00274	0.00274	0.00274	0.00274	0.00281	46
47	0.00199	0.00296	0.00296	0.00296	0.00296	0.00301	47
48	0.00217	0.00319	0.00319	0.00319	0.00319	0.00326	48
49	0.00235	0.00346	0.00346	0.00346	0.00346	0.00355	49
50	**0.00254**	**0.00374**	**0.00374**	**0.00374**	**0.00374**	**0.00385**	**50**
51	0.00278	0.00406	0.00406	0.00406	0.00406	0.00419	51
52	0.00302	0.00441	0.00441	0.00441	0.00441	0.00456	52
53	0.00327	0.00479	0.00479	0.00479	0.00479	0.00494	53
54	0.00354	0.00520	0.00520	0.00520	0.00520	0.00535	54
55	**0.00382**	**0.00560**	**0.00560**	**0.00560**	**0.00560**	**0.00577**	**55**
56	0.00409	0.00602	0.00602	0.00602	0.00602	0.00619	56
57	0.00439	0.00646	0.00646	0.00646	0.00646	0.00663	57
58	0.00469	0.00691	0.00691	0.00691	0.00691	0.00710	58
59	0.00506	0.00744	0.00744	0.00744	0.00744	0.00765	59
60	**0.00544**	**0.00801**	**0.00801**	**0.00801**	**0.00801**	**0.00824**	**60**
61	0.00590	0.00869	0.00869	0.00869	0.00869	0.00894	61
62	0.00646	0.00951	0.00951	0.00951	0.00951	0.00978	62

63	0.00709	0.01043	0.01043	0.01043	0.01043	0.01072	63
64	0.00776	0.01142	0.01142	0.01142	0.01142	0.01174	64
65	**0.00849**	**0.01251**	**0.01251**	**0.01251**	**0.01251**	**0.01286**	**65**
		0.01226	0.01226	0.01226	0.01226	0.01260	66
			0.01360	0.01360	0.01360	0.01398	67
				0.01512	0.01512	0.01554	68
					0.01687	0.01734	69
						0.01941	**70**
						0.02183	71
						0.02459	72
						0.02754	73
						0.03080	74
						0.03433	**75**
						0.03813	76
						0.04224	77
						0.04676	78
						0.05182	79
						0.05759	**80**
						0.06423	81
						0.07189	82
						0.08073	83
						0.09090	84
						0.10258	**85**
						0.11545	86
						0.12959	87
						0.14509	88
						0.16203	89
						0.18049	**90**
						0.20057	91
						0.22236	92
						0.24593	93
						0.27140	94
						0.29882	**95**
						0.32831	96
						0.35993	97
						0.39378	98
						0.42994	99
						0.46847	**100**
						0.50947	101
						0.55299	102
						0.59911	103
						0.64789	104
						0.69939	**105**
						0.75367	106
						0.81077	107
						0.87074	108
						0.93362	109
						1.00000	**110**

Table A4: Female Smoker rates: **ACFSL04**

Age Exact	Curtate duration 0	1	2	3	4	5+	Age Exact
18	0.00026	0.00029	0.00032	0.00032	0.00032	0.00032	18
19	0.00028	0.00032	0.00035	0.00035	0.00035	0.00035	19
20	**0.00029**	**0.00034**	**0.00038**	**0.00038**	**0.00038**	**0.00038**	**20**
21	0.00032	0.00036	0.00040	0.00040	0.00040	0.00040	21
22	0.00034	0.00039	0.00044	0.00044	0.00044	0.00044	22
23	0.00037	0.00042	0.00047	0.00047	0.00047	0.00047	23
24	0.00040	0.00046	0.00051	0.00051	0.00051	0.00051	24
25	**0.00044**	**0.00050**	**0.00056**	**0.00056**	**0.00056**	**0.00056**	**25**
26	0.00049	0.00055	0.00062	0.00062	0.00062	0.00062	26
27	0.00053	0.00060	0.00068	0.00068	0.00068	0.00068	27
28	0.00058	0.00066	0.00074	0.00074	0.00074	0.00074	28
29	0.00063	0.00071	0.00080	0.00080	0.00080	0.00080	29
30	**0.00067**	**0.00077**	**0.00086**	**0.00086**	**0.00086**	**0.00086**	**30**
31	0.00072	0.00085	0.00092	0.00092	0.00092	0.00092	31
32	0.00078	0.00093	0.00100	0.00100	0.00100	0.00100	32
33	0.00085	0.00102	0.00108	0.00108	0.00108	0.00108	33
34	0.00092	0.00111	0.00118	0.00118	0.00118	0.00118	34
35	**0.00102**	**0.00120**	**0.00130**	**0.00130**	**0.00130**	**0.00130**	**35**
36	0.00112	0.00129	0.00144	0.00144	0.00144	0.00144	36
37	0.00129	0.00144	0.00164	0.00164	0.00164	0.00164	37
38	0.00146	0.00165	0.00186	0.00186	0.00186	0.00186	38
39	0.00165	0.00187	0.00211	0.00211	0.00211	0.00211	39
40	**0.00187**	**0.00211**	**0.00238**	**0.00238**	**0.00238**	**0.00238**	**40**
41	0.00209	0.00236	0.00266	0.00266	0.00266	0.00266	41
42	0.00231	0.00262	0.00295	0.00295	0.00295	0.00295	42
43	0.00255	0.00289	0.00326	0.00326	0.00326	0.00326	43
44	0.00283	0.00321	0.00362	0.00362	0.00362	0.00362	44
45	**0.00317**	**0.00359**	**0.00405**	**0.00405**	**0.00405**	**0.00405**	**45**
46	0.00353	0.00399	0.00450	0.00450	0.00450	0.00450	46
47	0.00390	0.00440	0.00497	0.00497	0.00497	0.00497	47
48	0.00428	0.00482	0.00545	0.00545	0.00545	0.00545	48
49	0.00466	0.00526	0.00594	0.00594	0.00594	0.00594	49
50	**0.00504**	**0.00571**	**0.00644**	**0.00644**	**0.00644**	**0.00644**	**50**
51	0.00544	0.00617	0.00694	0.00694	0.00694	0.00694	51
52	0.00587	0.00665	0.00745	0.00745	0.00745	0.00745	52
53	0.00632	0.00716	0.00801	0.00801	0.00801	0.00801	53
54	0.00679	0.00769	0.00867	0.00867	0.00867	0.00867	54
55	**0.00738**	**0.00837**	**0.00943**	**0.00943**	**0.00943**	**0.00943**	**55**
56	0.00807	0.00914	0.01031	0.01031	0.01031	0.01031	56
57	0.00881	0.00998	0.01125	0.01125	0.01125	0.01125	57
58	0.00947	0.01073	0.01210	0.01210	0.01210	0.01210	58
59	0.01004	0.01137	0.01282	0.01282	0.01282	0.01282	59
60	**0.01062**	**0.01203**	**0.01357**	**0.01357**	**0.01357**	**0.01357**	**60**
61	0.01150	0.01303	0.01469	0.01469	0.01469	0.01469	61
62	0.01245	0.01409	0.01590	0.01590	0.01590	0.01590	62

63	0.01355	0.01534	0.01730	0.01730	0.01730	0.01730	63
64	0.01475	0.01670	0.01883	0.01883	0.01883	0.01883	64
65	**0.01604**	**0.01817**	**0.02049**	**0.02049**	**0.02049**	**0.02049**	**65**
		0.01769	0.01995	0.01995	0.01995	0.01995	66
			0.02200	0.02200	0.02200	0.02200	67
				0.02429	0.02429	0.02429	68
					0.02693	0.02693	69
						0.02994	**70**
						0.03345	71
						0.03742	72
						0.04162	73
						0.04624	74
						0.05118	**75**
						0.05644	76
						0.06209	77
						0.06825	78
						0.07511	79
						0.08287	**80**
						0.09176	81
						0.10197	82
						0.11367	83
						0.12706	84
						0.14233	**85**
						0.15889	86
						0.17679	87
						0.19608	88
						0.21680	89
						0.23899	**90**
						0.26267	91
						0.28787	92
						0.31462	93
						0.34293	94
						0.37281	**95**
						0.40427	96
						0.43730	97
						0.47190	98
						0.50806	99
						0.54576	**100**
						0.58498	101
						0.62568	102
						0.66784	103
						0.71142	104
						0.75637	**105**
						0.80265	106
						0.85022	107
						0.89900	108
						0.94895	109
						1.00000	**110**

Appendix B: A summary of the fit of the AC04 rates to the experience

B1. This appendix contains a summary of the fit of the AC04 rates to the experience using tables of Actual Settled Claims / Expected Settled Claims by age and duration at settlement similar to those used in section 6 of the paper. Note that these results again cover ages 20 to 70 and ignore the small number of records relating to claims diagnosed before age 20 and claims settled after age 70.

B2. In many cells, the fit appears identical to that shown in the corresponding table in section 6 (at least to zero decimal places, as shown in these tables). In these cells, the final AC04 rates are no different from the fitted rates derived in section 6; however differences do arise at the younger and older ages (where we have diverged from the fitted rates, as described in section 7) and at other ages where additional smoothing has been applied. These differences are described below.

Male non-smokers

B3. The results for male non-smokers are shown in Table B1, which corresponds to Table 6.6. Generally the results are very similar to those obtained during the fitting process, except at the older ages.

Table B1: Values of 100A/E using final AC04 rates by age and duration for male non-smokers

Age last at	**Curtate duration at settlement**						
settlement	**0**	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	82	93	120	90	87	210	**99**
26-30	97	103	94	78	96	142	**99**
31-35	109	92	86	122	106	96	**100**
36-40	97	111	101	104	93	94	**100**
41-45	92	91	103	107	100	101	**100**
46-50	92	92	95	95	94	110	**100**
51-55	104	93	87	109	102	104	**101**
56-60	114	111	98	102	107	97	**101**
61-65	123	114	105	115	117	96	**103**
66-70	0	50	114	132	79	80	**86**
ALL	**98**	**98**	**96**	**105**	**100**	**101**	**100**

B4. Note that even within the framework adopted by the Committee, of a single selection pattern applicable at all ages, a slightly closer fit to the data could have been achieved. For example, the value of ASC/ESC at duration 0 is 98%. This feature arose partially from the fitting process, where the Committee accepted an A/E of 99% (as shown in Table 6.6), and the subsequent extensions of the rates to younger and older ages and the additional smoothing has moved the final rates slightly further from the experience. The duration 0 rates could have been reduced by 2% (and the rates at other durations increased slightly to compensate) but the Committee concluded that this was inappropriate given the other assumptions in our work.

Male smokers

B5. The results for male smokers are shown in Table B2, which corresponds to Table 6.9. There are 3 areas where non-trivial differences arise (at an all durations level):

- The fit is now better at ages 20-25 though the AC04 rates are still significantly lower than implied by the data;
- The fit is less close at ages 66-70 with the AC04 rates higher than implied by the data; and
- The additional smoothing, referred to in paragraph 8.2, has worsened the fit at ages 46-50 and 51-55 (the AC04 rates are lower than implied by the data in the first age band, but higher in the second).

Table B2: Values of 100A/E using final AC04 rates by age and duration for male smokers

Age last at	**Curtate duration at settlement**						
settlement	**0**	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	59	211	82	174	124	0	**132**
26-30	114	102	117	78	39	112	**100**
31-35	84	106	96	108	118	97	**101**
36-40	104	97	91	114	102	95	**100**
41-45	118	95	107	94	90	101	**100**
46-50	114	91	103	126	110	95	**104**
51-55	87	98	94	96	111	93	**96**
56-60	98	84	129	107	98	103	**104**
61-65	46	29	148	86	72	105	**97**
66-70	0	0	0	120	0	71	**60**
ALL	**101**	**99**	**103**	**106**	**100**	**98**	**101**

Female non-smokers

B6. The results for female non-smokers are shown in Table B3, which corresponds to Table 6.12. Generally the results are very similar to those obtained during the fitting process, except at the older ages (61-65 and 66-70) where the AC04 rates are higher than those implied by the data.

Table B3: Values of 100A/E using final AC04 rates by age and duration for female non-smokers

Age last at	**Curtate duration at settlement**						
settlement	**0**	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	123	100	103	108	149	0	**106**
26-30	83	101	95	99	113	117	**100**
31-35	96	101	97	104	106	102	**101**
36-40	86	104	96	105	88	104	**99**
41-45	110	107	97	102	109	96	**101**
46-50	105	90	105	81	99	105	**98**
51-55	111	123	104	102	101	87	**99**
56-60	130	113	94	78	92	105	**100**
61-65	197	47	95	66	69	83	**81**
66-70	0	0	51	76	75	72	**68**
ALL	**100**	**103**	**98**	**98**	**100**	**99**	**100**

Female smokers

B7. The results for female smokers are shown in Table B4, which corresponds to Table 6.15. Differences to the results obtained during the fitting process arise at ages 26-30 (where the AC04 rates are lower than implied by the data) and at the older ages – for ages 56-60 the AC04 rates are lower than those implied by the data whereas at ages 61-65 and 66-70, as for female non-smokers, the AC04 rates are higher than those implied by the data.

Table B4: Values of 100A/E using final AC04 rates by age and duration for female smokers

Age last at	**Curtate duration at settlement**						
settlement	**0**	**1**	**2**	**3**	**4**	**5+**	**ALL**
20-25	74	88	216	49	59	0	**107**
26-30	79	127	118	128	139	69	**113**
31-35	98	95	91	86	101	85	**92**
36-40	80	110	95	96	111	110	**102**
41-45	131	100	103	84	116	93	**101**
46-50	107	87	104	102	97	104	**101**
51-55	119	82	109	117	82	94	**98**
56-60	111	138	104	109	112	94	**105**
61-65	0	0	27	143	65	88	**80**
66-70	0	0	0	182	0	106	**88**
ALL	**101**	**100**	**103**	**100**	**104**	**97**	**100**

Appendix C: Description of the derivation of the AC04 rates at older ages

C1. Section 7 included a summary of the approach used to develop the rates at older ages. A more detailed description is set out below.

C2. The first step was to set a target at age 85 for the insured table as a percentage of the population table (CIBT02 Extended Cover), based on the ratio of insured to population mortality experience. This was done at an aggregate (i.e. not smoker-differentiated) level. The Committee considers that the principle of insured experience converging towards population experience at these ages is well-founded and seemed appropriate for the AC04 Series rates, on the grounds that:

- At the ages where we have credible data volumes, the ratio of insured to population rates for critical illness is generally lower than for mortality for both males and females. This may be because:
  - The underwriting requirements for critical illness will generally be more stringent than for mortality-only cover (particularly as a much larger proportion of our portfolio is Term Assurance-based); and
  - The higher cost of critical illness insurance, relative to comparable mortality-only cover, may result in a higher socio-economic profile.
- Both of these effects can be expected to wear off with increasing duration as the portfolio matures and may have been eliminated completely by age 85.

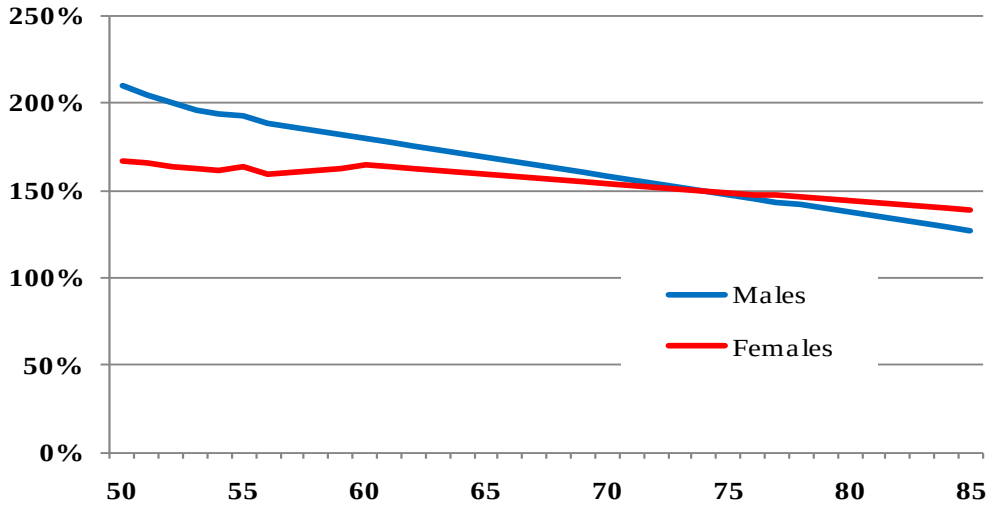
The choice of the target percentages of CIBT02 at age 85, the final age in those tables, is clearly subjective. The targets were set at the corresponding percentages of the 00 Series assurance tables to population mortality, taken as ELT16. These values produced rates that are reasonably consistent with the rates produced by the other approaches, noted in paragraph 7.11.

C3. Consequently we assumed that the critical illness rates progress as a percentage of CIBT02 from the observed values at age 60 (46% for males and 49% for females) to the insured/population percentage for mortality at age 85 (75% for males and 74% for females). Note that we ignored the minor differences in timing between the various tables (CIBT02, ELT16 and the 00 Series) and our rates for the purpose of establishing the target percentages.

C4. Smoker-segregated rates were then derived from the aggregate rates using an assumed proportion of smokers and assumed smoker to non-smoker differentials. The proportion of smokers was observed to reduce with increasing age in the data, as illustrated in Figure 7.2. Smoothed values of these observed proportions were used for ages up to 70, thereafter the proportion was assumed to remain constant.

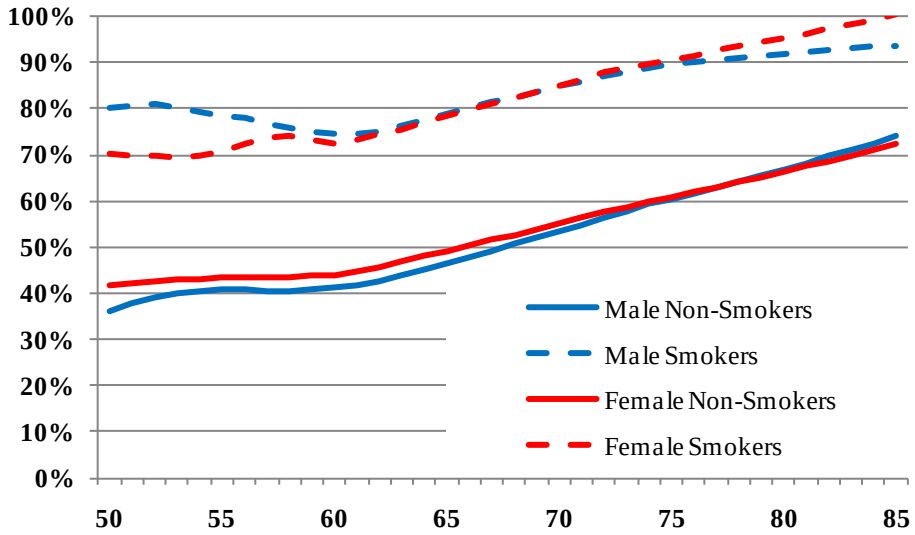
C5. The other assumption required to derive smoker-segregated rates from the aggregate rates is the ratio of smoker experience to non-smoker experience. Again, the Committee was confident that the two sets of rates could be assumed to converge with increasing age but the pace of convergence is less clear. The Committee decided to assume that the ratio of smoker experience to non-smoker experience at age 85 to that observed in the data at age 60 is consistent with the degree of convergence between the TMN00 and TMS00 tables, for males, and between the TFN00 and TFS00 tables, for females. Specifically, this gives a differential of one-third of that at age 60 for males but slower convergence, to 60% of that at age 60, for females. The resulting assumed differentials are illustrated in Figure C1.

Figure C1: Ratio of smoker experience to non-smoker experience (Observed for ages 50-60; assumed for ages 61 to 85)



C6. The steps outlined above produce smoker-differentiated rates for ages 60 to 85. Rates between ages 56 and 59 were blended between the fitted rates, derived in section 6 and used for ages up to 55, and those derived by the approach outlined above to ensure smoothness. The resulting rates, expressed as percentages of CIBT02, are illustrated in Figure C2.

Figure C2: Ultimate rates as a percentage of CIBT02



C7. Note that by opting for smooth percentages of CIBT02, the rates contain a discontinuity at age 65 that exists in these tables, where TPD is assumed to cease. This feature is more pronounced for females, as TPD makes up a greater proportion of the female CIBT02 rate at age 65 than of the corresponding male rate. The impact of this is that the female rates reduce between age 65 and 66.

C8. Select rates, for ages up to 65 at entry were derived from the ultimate rates at those ages using the percentages derived in the fitting process described in section 6.

C9. From age 86, rates were projected so that they increase at a lower rate at each age, reaching unity at the end-age of the tables of 110. Whilst the choice of 110 is arbitrary,

the observed critical illness rates are significantly higher than the corresponding mortality rates at ages where we have credible data volumes, and remain higher in the subsequent extrapolation using population rates. A lower end-age than that adopted for insured mortality tables therefore seemed appropriate.

C10. To produce rates beyond age 85, the Committee assumed that the rate of growth from each age to the next is $(1+kg)$ where:

g is the growth from age 84 to age 85 in the rates (derived above), and

k is a constant.

The values of k for each gender/smoker dataset were derived, using goal-seek in Microsoft Excel, so that the rates trend to unity at age 110.

C11. The resulting rates are illustrated in Figure C3. The Committee considered that these rates behave "sensibly" with smoker rates exceeding non-smoker throughout and male rates consistently exceeding female rates.

Figure C3: Progression of rates to unity at very old ages