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Term Mortality and Lapses

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I would be surprised if there is a term insurance market in the world today more complex and competitive than the U.S. market. It was not always this way.

Prior to the mid-late 1970s, a new issue was rated either standard or substandard. There were no smoker/nonsmoker distinctions. Super-preferred/preferred/residual classes did not exist. Term premiums varied only by gender and attained age—ART, five- and 10-year renewable and convertible.

Term Wars I (TWI) was launched in the late 1970s with the introduction of select and ultimate premium structures. Initially, these were select and ultimate ART plans, but they quickly evolved into what was then a more tax efficient design—increasing (or graded) premium whole life (IPWL or GPWL). IPWL had S&U ART-type rates for 20 years or so with a very high level premium for life, thereafter.

TWII started in the late 1980s with products similar to today's—level premiums for n-years, followed by much higher ART rates. A typical early TWII product might have had one preferred and residual class for nonsmokers and one or two smoker classes.

By the mid-1990s some companies had split the nonsmoker or non-tobacco classes into as many as five super-preferred/preferred classes and one residual class. The number of smoker/tobacco class splits has been more modest—generally no split or just one preferred and one residual class.

Accurately anticipating policyholder lapse and mortality experience has always been key to pricing or projecting profits for term plans. But past experience provided little or no help in predicting the future at the outset of either TWI or TWII. Even today, it is hard to impossible for most actuaries to find good, credible experience data, particularly for mortality.

Credible lapse experience is much easier to obtain than credible mortality experience, but it still takes years for a complete picture to emerge. As expected, companies see a sharp spike in lapse rates when premiums spike up after the level premium period. At Session 63 (Term Mortality and Persistency) of the SOA's Spring Meeting in New Orleans, George Hrischenko of Transamerica Re said they are seeing total termination rates of about 80 percent at the end of 10- or 20-year select periods, with smaller total decrement rates for a five-year term where premium increases after the level premium period are less dramatic. Other companies have reportedly seen somewhat different lapse patterns, e.g. 60 percent in year 10 and 50 percent in year 11 of a 10-year level premium plan. Persistency during the level term period is comparatively much better, with the lowest lapse rates occurring for the best risk classes, older issue ages and the longer level term periods.

Developing assumptions for mortality is much tougher and currently involves a great deal of speculation and professional judgment. For example:

- There is no ultimate experience and not much more than about 10 years of select experience consistent with today's underwriting criteria.

- Nobody really knows how preferred/residual ratios change over time. In fact, we still are not certain how smoker/nonsmoker ratios behave over the entire select and ultimate period.
- Related to the prior two points, there is debate among actuaries about how aggregate mortality rates will increase over the select and ultimate period. The most recent SOA mortality study, distributed at the 2004 annual meeting, provided A/Es for both 2001 VBT and 1975-80 expected bases. Each expected basis has its fans and critics as being representative of the slope of aggregate (or, in the case of the 2001 VBT, also smoker/nonsmoker) mortality, and some are not comfortable with either.
- Differences among companies in the number of and/or underwriting criteria for preferred and residual classes create opportunities for policyholder anti-selections that are very difficult to quantify.
- For companies that assume future mortality improvement, is it likely that historical rates of improvement will apply to the future? Even if you think the answer is "yes," judgment is needed to determine the period over which to measure the historical improvement rates that are supposed to be representative of future rates of improvement.

  Measuring historical improvement rates is not so easy either. Given the frequent changes in the companies contributing to industry mortality studies and changes in people's habits (e.g., the decreasing prevalence of smoking), it is a real challenge to find consistent data from either industry studies of insured experience or population tables which can be used to ascertain historical improvement rates. Then there is the issue of how longevity gains from past improvements in medicine and public health measures will compare with the gains that current and future biomedical research might produce.
- Most, and maybe all, actuaries expect substantial mortality anti-selection after the level premium period when gross premiums increase dramatically and most remaining policies lapse. I will elaborate on this issue below, since it was one of the topics discussed during Session 63 in New Orleans.

The SOA is working to fill in some of the gaps in our knowledge. Tom Rhodes, who chairs the Individual Life Insurance Experience Committee, said during Session 63 that the current data call for the next industry mortality study asks companies to (a) identify their multiple preferred and standard classes, and (b) provide additional plan information, including information needed to study lapse rates for level premium term business. To further encourage companies to contribute data to the study, Tom also made it clear that the MIB, which does the mortality studies for the SOA, can accept data in almost any format. Longer term, the SOA hopes to get companies to contribute more detailed underwriting-related data that can be used to define and measure mortality for different preferred and standard classes.

A substantial paper could be written about each of the points listed above, and some have—e.g., see Steve Cox's article, "Does Preferred Wear Off?" and Doug Doll's article, "Mortality Table Slope—The Discussion Goes On," both in the July 2004 issue of *Product Matters!* For the remainder of this article, I will provide some additional discussion on the topic of mortality beyond the level premium period.

I have been told that the three most popular approaches for setting mortality assumptions after the level premium period are:

1. SWAG or WAG—(Sophisticated) Wild A__ Guess
2. (B-K) Becker-Kitsos
3. (D-M) Dukes-MacDonald

Since both B-K and D-M involve their own SWAGish elements, I will skip over the pure (S)WAG approach, although some of my remarks may be of interest to its adherents.

The first point I would like to note is that there is not a single D-M or B-K approach. Doug Doll identified three variations of D-M in the July 2003 issue of *Product Matters!* and I am aware of two variations of B-K. For both B-K and D-M:

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- Lapses in excess of some set of baseline rates are assumed to be anti-selective.
- Total deaths for the excess lapse group ("reverters") and those who do not lapse ("persisters") must equal expected deaths with baseline lapses (conservation of deaths).
- You need to make an assumption for "reverter" mortality.
- Then you can use conservation of deaths to solve for expected persister mortality. One consequence of conservation of deaths is that the anti-selection will wear off m years after the last excess lapse, where m equals the select period for the base mortality table. It seems to me that this internal consistency with the base mortality table also represents one advantage of B-K and D-M over a pure (S)WAG approach.

For purposes of illustration, let's suppose that:

- D-M calculations assume that n% of excess lapses at attained age x+s (duration s for issue age x) are fully select and that the remaining (100-n)% percent have mortality equal to what persister mortality would be if there were no excess lapses at ages x+s+t, t = 1, 2, 3, . . . I believe this is what Doug Doll calls "Method 2" in his July 2003 article. The formulas become somewhat involved when excess lapses occur at more than one duration. Formulas for n% = 100% were presented in the original D-M paper in the 1980 TSA.
- B-K calculations assume that reverter mortality for excess lapses at age x+s equals:

  $$q^{r}_{[x+s]+t-1} = F(t)^* q_{[x+s]+t-1}$$

  $$F(t) = 1 + G(t)^*R^*[(q_{[x]+s}/q_{[x+s]}) - 1]$$

  G(t) grades from 1.0 for t=1 to 0 for t=16, the first ultimate duration. For purposes of the sample calculations, I have assumed that this occurs linearly.
  R is a parameter that controls the level of reverter mortality—smaller values of R translate into lower levels of reverter and higher levels of persister mortality. In the original B-K article, they recommended that R be between 0.2 and 0.4.

  I believe this is the original formulation of B-K, except that I have omitted an accidental death refinement.

- Male, issue age 40
- Base lapse rates = 10 percent per year, annual mode
- Base mortality = 1975-80 S&U, ALB
- Total lapse rates = base lapse rates, except for policy years 10-13
- Total lapse rates (QW) equal 85% or 90% in year 10 and 30%, 20% and 15% for years 11, 12 and 13, respectively.

Resulting persister mortality as a multiple of base mortality is shown in the table on page 7 for selected policy years of a 10-year level premium term product and a few choices for n%, QW_{10} and R.

The table gives some indication of the sensitivity of post-level premium period mortality to the choice of parameters and to the level of excess lapses. Not surprisingly, decreasing expected reverter mortality increases expected persister mortality.

To estimate reverter or persister mortality, it strikes me that it would be very useful to know:

- The fraction of the in-force at the end of the level premium period that would fall in each underwriting category, including various levels of substandard, if subjected to underwriting at that time. The answer would almost certainly vary by gender, issue age, underwriting class at issue and length of the level term period.
- The relationships between (a) the premiums payable by persisters after the level premium period and (b) corresponding new issue ART or level premium term premiums.

If all policyholders could act rationally, then the persisters would consist solely of people who (a) still wanted insurance coverage and (b) for whom the very high persister premiums were lower than they would pay if they were underwritten and issued a new policy. For example, if persister premiums were roughly 500 percent of a new issue residual premium, then you would expect only those who would be rated Table 16 or higher, if re-underwritten, to persist. I would expect that to be a small percentage of the in-force at the end of the level premium period before the shock lapse, which would imply a very high total lapse and very high mortality for the few persisters.

Since actual total lapse rates are lower than I might expect based on the rational policyholder theory and some of the premium relationships I have seen, it would seem that many of the persisters either do not react immediately to the premium increase due to some sort of inertia, do not notice the premium increase, which seems hard to believe, do not think the increase is excessive, or are under some constraint (e.g., subject to the terms of a divorce settlement where the policy is in an irrevocable trust) that does not allow them to lapse.

Regardless of the reason(s) for why it occurs, this better-than-expected persistency makes it harder to estimate mortality for either persisters or reverters. Still, it seems hard to believe that there would not be a strong bias toward the healthiest lives terminating their coverage, which is implicitly assumed for both B-K and D-M. But the actuary, maybe in collaboration with the underwriter or medical director, has to exercise judgment in setting the parameters so that the result seems reasonable.

Given the uncertainties, it would seem natural for actuaries to:

- Limit coverage to the level premium period. But the high post-level premium period premiums and potential for additional profit might be enticing. Restricting coverage to the level premium period might also have an unfavorable impact on GAAP income. And, of course, the option of extending coverage beyond the level premium period, even at very high rates, might be a valuable option to policyholders.

Comparison of D-M and B-K Anti-Selection Multiples

	Dukes-MacDonald				Becker-Kitsos			
Policy Years	QW_{10}=85% n%=100%	QW_{10}=85% n%=90%	QW_{10}=85% n%=80%	QW_{10}=90% n%=80%	QW_{10}=85% R=0.2	QW_{10}=85% R=0.3	QW_{10}=85% R=0.4	QW_{10}=90% R=0.3
1-10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	3.85	2.71	2.14	2.40	3.28	3.00	2.71	4.19
12	4.20	2.91	2.27	2.53	3.30	2.85	2.40	3.90
13	4.35	2.98	2.31	2.58	3.27	2.74	2.21	3.71
14	4.35	2.97	2.30	2.55	3.18	2.61	2.04	3.51
15	4.12	2.81	2.19	2.43	2.94	2.37	1.82	3.16
20	*3.74*	*2.50*	*1.95*	*2.16*	*2.79*	*2.36*	*1.97*	*3.25*
25	*2.87*	*1.95*	*1.59*	*1.72*	*2.46*	*2.29*	*2.14*	*3.26*
30	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*

- Do sensitivity testing. Some candidates for sensitivity testing might be (a) the level of total and excess lapses and (b) the values of n percent (D-M) or R (B-K), including the possibility of variations by issue age, duration of excess lapse, and the magnitude of current and prior excess lapses and (c) profitability assuming no profits beyond the level premium period.

Over the next few years an increasing amount of experience will emerge, which should help reduce the magnitude of the uncertainty, at least for companies which have access to that experience. □

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REFRENCES

BECKER, DAVID N. (and KITSOS, THEODORE J.). September 1984. Pricing for Profitability in ART. *Best's Review*.

COX, STEVE. July 2004. Does Preferred Wear Off? *Product Matters!*

DOLL, DOUGLAS. July 2003. Mortality Anti-Selection – Different Versions of Dukes-MacDonald. *Product Matters!*

DOLL, DOUGLAS. July 2004. Mortality Table Slope – The Discussion Goes On. *Product Matters!*

DUKES, JEFFERY T. and MACDONALD, ANDREW M. 1980. Pricing a Select and Ultimate Annual Renewable Term Plan. *Transactions of the Society of Actuaries* XXXII: 547-565.