V

Cumulative Antiselection Theory

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Abstract

A model is proposed as a potential explanation for the steady deterioration in loss ratios often observed on blocks of individual health insurance policies.

The model is compared with a classical model in its effect on a hypothetical block of policies with respect to cash and incurred loss ratios and reserves. The model is then applied to a case study, a rate increase is derived, and various projections are made.

The proposed model lends itself to calculation of premiums, calculation of durational antiselection reserves needed to stabilize loss ratios, and analysis of the effects of additional lapses resulting from premium increases.

I. Introduction

Many companies have observed a steady and seemingly irreversible decay in loss ratios in their mature blocks of individual health insurance policies. Unfortunately, in most cases realization of the problem has occurred long after effective action could be taken. The purpose of this paper is to present a model based on reasonable assumptions, which may help to explain this ubiquitous decay.

Two characteristics of individual health insurance business are here proposed as causing this decay. These characteristics are much more pronounced in health insurance than in life insurance. They probably were dismissed as relatively unimportant at the time of the development of classical health insurance theory, just as they had been for life insurance. These characteristics are

1. Insureds are more able to quantify the probability of a health claim than that of a death claim. This is a result of both the (usually) much higher frequency of claims and

the obvious ease of determining when one is sick as opposed to when one is going to die. There is also the important element of voluntary claim control by the insured in health insurance, which does not exist in life insurance.

2. Lapse rates are much higher for a given block of health policies than for life policies. Those insureds who are aware of the "impaired" status (meaning that they have higher claim expectations) logically have a lower lapse rate than healthy policyholders, at least during the early durations, when lapse rates are higher.

We will now create a simple set of assumptions and definitions to begin a demonstration of the consequences of these characteristics. Let us begin with some definitions:

1. Partition active lives, l_x, into two classes; active healthy lives, $_al_x$, and active impaired lives, $_il_x$. Then, for any x, $l_x = _al_x + _il_x$. This allows us to assume that policyholders can to some extent predict their own claim probabilities, and can be considered as two distinct bodies of policyholders: healthy (or "select") and unhealthy. This partition allows us to treat the two populations separately with respect to morbidity and lapsation, which in turn leads to the "cumulative antiselection theory" (CAST) effect of progressively deteriorating experience.

2. Let the probability of a member of $_al_{[x]+t}$ becoming a member of $_il_{[x]+t+1}$ be $q^{ai}_{[x]+t}$, the probability of a healthy life becoming unhealthy. Recoveries from $_il$ to $_al$ have already been deducted from q^{ai}.

3. Claim costs for $_al_{[x]+t}$ and $_il_{[x]+t}$ are $_aS^{(d)}_{[x]+t}$ and $_iS^{(d)}_{[x]+t}$. The value of k_2 is chosen so that $_iS^{(d)}_{[x]+t} = k_2{}_aS^{(d)}_{[x]+t}$ for any $[x] + t$, with k_2 greater than 1. The choice of k_2 will define how well the resulting model will allow CAST effects to work at the later durations. By defining the relationship

between $_al_x$ and $_il_x$, k_2 implicitly defines the partition of l_x itself.

4. Deaths are included in lapses.
5. Interest will be zero, for the clearest demonstration of the principles involved.
6. Incurring a claim does not remove an insured from l_x, nor does it necessarily move an insured from $_al_x$ to $_il_x$. Coverages such as disability may warrant complete removal of the claimant from l_x, and could easily be included in the calculations if desired.
7. Only hospital indemnity policies are used, in order to give a clear demonstration of the concept of cumulative antiselection.
8. "Cross-product terms," reflecting occurrences such as lapsation in the year of claim or impairment, have been ignored. Such terms are invariably small, and would unduly complicate the already inexact calculations.

Cumulative antiselection theory now departs from classical select and ultimate theory in two assumptions:

First, it is proposed to eliminate "ultimate" claim costs and extend the use of claim costs dependent on duration throughout the policy life. Periods when the claim costs exceed the classical ultimate claim costs might even be called the "antiselect period." The crucial point is that l_x claim costs are an increasing function of duration. The model described in this paper produces these increasing claim costs by combining $_al_x$ and $_il_x$, each of which has claim costs independent of duration but dependent on attained age.

Second, defining the probability of lapsing from each class as $_aq^{(l)}_{[x]+t}$ and $_iq^{(l)}_{[x]+t}$, we assume that $_iq^{(l)}_{[x]+t} = k_1(_aq^{(l)}_{[x]+t} - u) + u$, where u is the "pure" lapse rate, and k_1 is always between zero and 1. This equation assumes that the lapse rates of the impaired lives are smaller than those of the healthy lives, while both have a constant component, u. The constant u is thus assumed to represent those causes of lapsation that are independent of the individual's health, and therefore equal for $_al_{[x]+t}$ and $_il_{[x]+t}$. Both $_iq^{(l)}_{[x]+t}$ and $_aq^{(l)}_{[x]+t}$ will approach u as t increases, and as the population lapse rate levels out.

Section II of this paper presents a hypothetical block of policies using a classical model. A set of CAST assumptions that would describe the same policies are shown, and the two models are compared. Section III uses the historical experience of an actual block of policies to derive CAST characteristics of the block. A pro-

jection of future experience is made. Throughout this paper, claims are presented on an incurred-year or runout basis.

II. A Hypothetical Model

Classical theory and cumulative antiselection theory both begin at the same point, $l_{[x]}$, and both theories allow for initial underwriting. Effective underwriting would imply that $l_{[x]+0} = _al_{[x]+0}$ and that $_il_{[x]+0} = 0$. Both theories also allow for a worsening of experience by duration, but for different periods.

The population chosen was a block of 1,000 hospital indemnity policies issued to males aged 45, with a $100 per day benefit for 90 days, no elimination period, and renewability to age 65. Claim costs were taken from the *1974 Hospital and Surgical Tables*, Volume I, published by Tillinghast, Nelson and Warren, Inc. These tabular costs are shown in column 3 of Table 1.

Select factors of 55 percent in the first year, 68 percent in the second year, and 104 percent thereafter were used, to arrive at a tabular aggregate factor of 100 percent.[1] The results of applying these factors to column 3 of Table 1 are shown in column 4 of the table. The lapse assumptions chosen are shown in column 5 of Table 1; when combined with the other assumptions, they produce a net annual premium of $105.45. A 50 percent anticipated loss ratio results in a gross premium of $210.90, and in the remaining results shown in Table 1.

The classical case is now defined sufficiently so that we can develop and analyze a corresponding CAST representation.

In order to develop the CAST case fully, we must define q^{ai}, u, k_1, and k_2. Let us choose $k_2 = 5$, which defines the relationship of $_al$ and $_il$. Let us then assume the following, dropping $[x]$ from the notation:

1. The number of policyholders in force at each duration is the same under each model.
2. Lives in $_al$ are always "select," and therefore the 55 percent select factor would apply at every duration. In other words, $_aS^{(d)}_t = 0.55S^{(d)}_t$. This is in keeping with the basic assumptions underlying the $_al_i l$ partition, but would not fully reflect different underwriting or preexisting condition clauses that could cause distortion.

TABLE 1
DEVELOPMENT OF CLASSICAL MODEL

Durations t (1)	Attained Age $[x]+t$ (2)	Tabular Claim Cost (3)	(3) Adjusted by Select Factors (4)	$q_t^{(l)}$ (5)	l_t (6)	Aggregate Claims (7)	Cash Loss Ratio (8)	Net Terminal Reserve (9)
0............	45	91.10	50.10	.40	1,000	50,100	.238	55,351
1............	46	95.10	64.67	.30	600	38,802	.307	79,820
2............	47	99.20	103.17	.25	420	43,331	.489	80,778
3............	48	103.50	107.64	.20	315	33,907	.510	80,088
4............	49	107.80	112.11	.15	252	28,252	.532	78,410
5............	50	112.30	116.79	.12	214	24,993	.554	75,984
6............	51	117.20	121.89	.10	188	22,915	.578	72,893
7............	52	122.30	127.19	.10	170	21,622	.603	69,198
8............	53	127.80	132.91	.10	153	20,335	.630	64,997
9............	54	133.70	139.05	.10	137	19,050	.659	60,394
10............	55	140.30	145.91	.10	124	18,093	.692	55,377
11............	56	147.40	153.30	.10	111	17,016	.727	50,066
12............	57	155.20	161.41	.10	100	16,141	.765	44,470
13............	58	164.00	170.56	.10	90	15,350	.809	38,611
14............	59	173.70	180.65	.10	81	14,633	.857	32,519
15............	60	184.20	191.57	.10	73	13,985	.908	26,232
16............	61	195.70	203.53	.10	66	13,433	.965	19,759
17............	62	207.80	216.11	.10	59	12,750	1.025	13,230
18............	63	220.80	229.63	.10	53	12,170	1.089	6,649
19............	64	234.60	243.98	.10	48	11,711	1.157	0

3. The classical model's values of aggregate claim costs for durations 0 and 1, being based on data tabulated separately in the *TSA Reports,* is presumed correct at those durations and should be matched by the CAST model. That is,

$$l_0 S_0^{(d)} = {_a}l_0 {_a}S_0^{(d)}$$

and

$$l_1 S_1^{(d)} = {_a}l_1 {_a}S_1^{(d)} + {_i}l_1 {_i}S_1^{(d)} .$$

4. The probability of becoming impaired, q_t^{ai}, is proportional to ${_a}S_t^{(d)}$. This seems an appealing choice in the absence of conflicting reasoning.

These assumptions combine to imply

$$q_t^{ai} = 0.0007077 {_a}S_t^{(d)} .$$

We can see then that only two independent variables, k_1 and u, are needed to define the CAST case. Since k_1 and u come from ${_i}q_t^{(l)} = k_1({_a}q_t^{(l)} - u) + u$, they can be considered parameters measuring the strength of antiselective lapsation. For illustration, the data in Table 2 were derived by assuming $k_1 = 0$, and $u = 0.1$. No claim is made that these values are "correct" values. Only future investigations into the relationship of k_1 and u to particular policies will lead to such knowledge. However, if we have chosen k_2 sufficiently large, it seems a reasonable assumption that there will be no voluntary lapsation from $_il$, which is equivalent to assuming $k_1 = 0$, or ${_i}q_t^{(l)} = u$ for all t. Future experience with the CAST model may allow this simplification in all models, once a feel for the size of k_2 is developed.

TABLE 2
DEVELOPMENT OF CAST MODEL

Duration t	$_a l_t$	$_i l_t$	q_t^{ai}	Claim Cost = (Col. 3 of Table 1) X 0.55	Aggregate Claims	Cash Loss Ratio	Net Terminal Reserve	Loss Ratio Using Classical Reserves and Premiums (for Fig. 3)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0.........	1,000	0	.0355	50.105	50,100	.181	88,405	.500
1.........	565	35	.0370	52.305	38,706	.233	132,802	.499
2.........	368	52	.0386	54.560	34,263	.294	156,711	.398
3.........	254	61	.0403	56.925	31,821	.365	168,518	.469
4.........	187	65	.0420	59.290	30,357	.435	173,065	.540
5.........	148	66	.0437	61.765	29,524	.498	173,181	.600
6.........	122	66	.0456	64.460	29,136	.559	170,084	.657
7.........	105	65	.0476	67.265	28,924	.614	164,706	.704
8.........	90	63	.0497	70.290	28,467	.672	157,430	.753
9.........	76	61	.0520	73.535	28,017	.738	148,388	.810
10.........	65	59	.0546	77.165	27,779	.809	137,783	.871
11.........	54	57	.0574	81.070	27,483	.894	125,674	.947
12.........	46	54	.0604	85.360	26,974	.974	112,551	1.014
13.........	39	51	.0638	90.200	26,519	1.064	98,498	1.089
14.........	34	47	.0676	95.535	25,699	1.145	84,018	1.148
15.........	28	45	.0717	101.310	25,631	1.268	68,497	1.257
16.........	23	43	.0762	107.635	25,617	1.401	52,021	1.375
17.........	19	40	.0809	114.290	25,030	1.531	35,164	1.487
18.........	15	38	.0859	121.440	24,895	1.696	17,609	1.638
19.........	13	35	.0913	129.030	24,258	1.824	0	1.739

The resulting ratios of expected claims to expected gross premiums, here called "cash loss ratios," are shown in Figure 1. The resulting gross premium (again assuming a 50 percent loss ratio and $i = 0$) is \$277.01, which is 131 percent of the premium developed in the classical model.
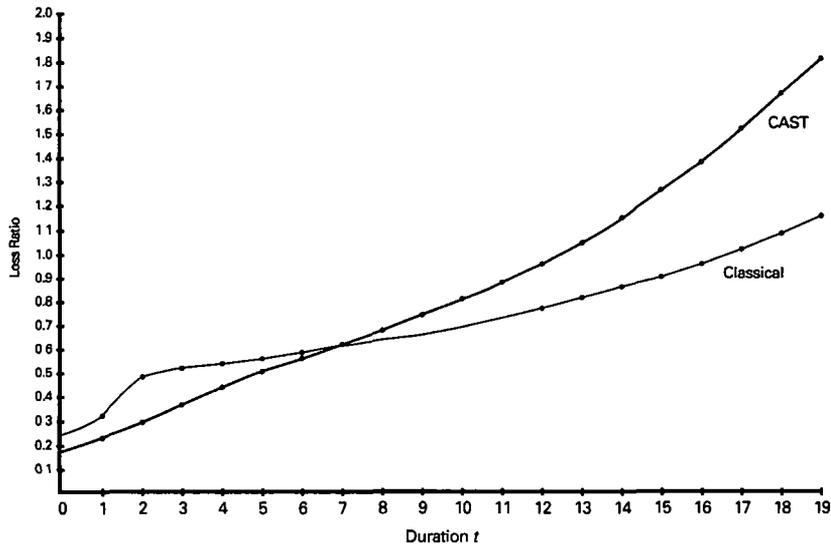

FIG. 1.—Expected cash loss ratios (CAST parameters $k_2 = 5$, $u = 0.10$, $k_1 = 0$)

A number of things can be observed from this graph. First, the slope of the CAST curve is steeper than that of the classical curve, for durations beyond $t = 2$, indicating that higher reserves probably would be necessary.

The expected loss ratios for the CAST model are significantly lower than the classical loss ratios at early durations. If the CAST model is in fact a truer representation of reality, then using the classical model as the basis for "actual to expected" analysis will allow disturbingly high claims to pass unnoticed and uncorrected.

Figure 2 compares the reserve levels under the two models. To examine the effect classical reserves would have on cash loss ratios under the two models, classical "increases in reserves" were included in the calculation of the two sets of cash loss ratios for each duration. Note that, by definition, the classical case is level at the anticipated loss ratio of 50 percent. The CAST curve in Figure 3 represents the actual experience of insurers (without interest) living in a CAST world but using classical reserves and premiums.

The ratio of classical to CAST loss ratios, which we will call R, is developed as follows:

$$\frac{_c\mathcal{L}_n^{CL}}{_c\mathcal{L}_n^{CAST}} = R_n = \left\{ \frac{(l_n)S_n^{(d)}}{210.90\,l_n} \right\} \div \left\{ \frac{_d l_n {}_a S_n^{(d)} + _i l_n \,_i S_n^{(d)}}{277.01\,l_n} \right\}$$

$$= \frac{277.01}{210.90} \left\{ \frac{l_n S_n^{(d)}}{_d l_n {}_a S_n^{(d)} + _i l_n \,_i S_n^{(d)}} \right\}.$$

This ratio, and the corresponding ratio of cumulative loss ratios, in columns 6 and 7 of Table 3, are quite interesting. Column 7 shows that the ratio of the "cumulative loss ratios" for the two models, as predicted by their respective theories, converge to 1.00. A comparison of columns 6 and 7 shows that, while the cumulative loss ratios converge, "current" loss ratios diverge, at least while CAST deterioration is occurring. This implies that, even if normal select-ultimate adjustments are made to experience by means of realistic classical reserves, expected CAST loss ratios will increase with time, as shown in Figure 3. (This result follows from the increasing proportion of $_i l_x$ in l_x by duration.) This conclusion will likely be disquieting to actuaries responsible for monitoring individual health experience for their companies.
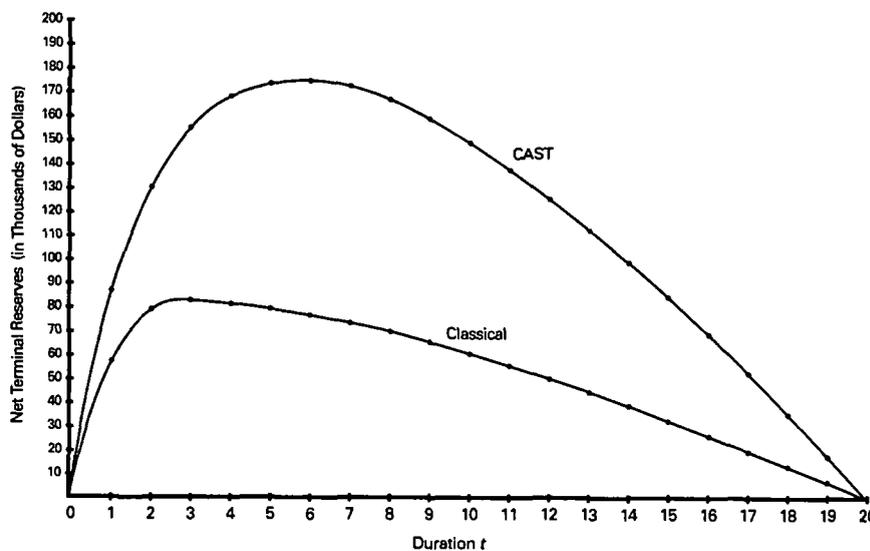

FIG. 2.—Net terminal reserves
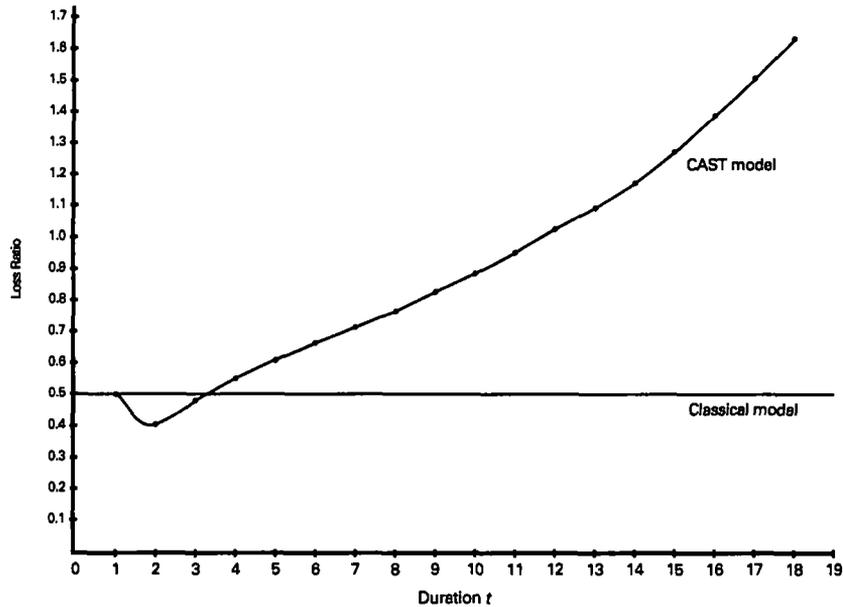
FIG. 3.—Incurred loss ratios using classical reserves and premiums

TABLE 3
LOSS-RATIO COMPARISONS

t (1)	$_c\mathcal{L}_t^{CL}$ (2)	Cumu-lative (2) (3)	$_c\mathcal{L}_t^{CAST}$ (4)	Cumu-lative (4) (5)	(2) ÷ (4) (6)	(3) ÷ (5) (7)	CAST Claims ÷ Classical Premium (8)	Cumu-lative (8) (9)	(8) ÷ (2) (10)	(9) ÷ (3) (11)
0......	.238	.238	.181	.181	1.31	1.31	.238	.238	1.00	1.00
1......	.307	.263	.233	.200	1.32	1.32	.306	.263	1.00	1.00
2......	.489	.310	.294	.220	2.10	1.41	.386	.289	.79	.93
3......	.510	.337	.365	.239	1.40	1.41	.479	.314	.94	.93
4......	.532	.357	.435	.258	1.22	1.38	.571	.339	1.07	.95
5......	.554	.371	.498	.277	1.11	1.34	.654	.364	1.18	.98
6......	.578	.384	.559	.295	1.03	1.30	.734	.387	1.27	1.01
7......	.603	.396	.614	.312	.98	1.27	.806	.410	1.34	1.04
8......	.630	.407	.672	.328	.94	1.24	.883	.431	1.40	1.06
9......	.659	.417	.738	.345	.89	1.21	.969	.453	1.47	1.09
10......	.692	.427	.809	.361	.86	1.18	1.063	.474	1.54	1.11
11......	.727	.436	.894	.377	.81	1.16	1.174	.495	1.61	1.14
12......	.765	.444	.974	.393	.79	1.13	1.279	.516	1.67	1.16
13......	.809	.453	1.064	.408	.76	1.11	1.398	.536	1.73	1.18
14......	.857	.461	1.145	.423	.75	1.09	1.504	.556	1.75	1.21
15......	.908	.469	1.268	.439	.72	1.07	1.665	.577	1.83	1.23
16......	.965	.477	1.401	.454	.69	1.05	1.840	.596	1.91	1.25
17......	1.025	.485	1.531	.469	.67	1.03	2.011	.616	1.96	1.27
18......	1.089	.493	1.696	.485	.64	1.02	2.228	.637	2.05	1.33
19......	1.157	.500	1.824	.500	.63	1.00	2.396	.657	2.07	1.31

Let us imagine such an actuary, who is experiencing loss ratios like those in columns 8 and 9 of Table 3. If the CAST model is correct, these would be the cash loss ratios resulting from the use of classical premiums. Rather than comparing with columns 4 and 5, however, the classical actuary would be watching columns 2 and 3, and probably would not recognize a real problem until at least the $t = 4$ results were calculated. Since the original lifetime anticipated loss ratio was 50 percent, he still believes himself to be well off, especially since the cumulative loss ratio is only 95 percent of expected at $t = 4$. By the time the rate increase is developed, approved by state insurance departments, and fully implemented, it would be at least $t = 8$. By that time, 74 percent of the premiums under the form have already been collected, which means that a much larger premium increase will be needed than would have been needed to correct the problem at policy inception. In fact, even in the absence of assumed additional lapsation, which would worsen the situation, a 50 percent future lifetime loss ratio starting at $t = 8$ would require a 114 percent premium increase under the CAST model.

At that point in the policy life, repeated large increases would be unavoidable, because increased lapsation and accelerated CAST effects would occur in the wake of each increase. In other words, the policy block would enter an assessment spiral.

If this coverage were one whose claims were subject to inflation, the situation could be even more serious, because of (1) the added weighting of larger claim costs in the later years' experience, (2) the higher lapse rate due to the necessarily higher premium increases, and (3) the fact that most companies do not calculate reserves under realistic inflation assumptions.

Section III will include an illustration of how the antiselective lapsation following rate increases can be quantified.

III. A Case Study

Appropriate experience data by duration have been made available to me, for which I would like to thank the actuary involved. The data were by calendar duration, necessitating some interpolation, which was done graphically. The policy involved was a level premium hospital indemnity policy. Experience was also adjusted to reflect an anticipated lifetime loss ratio of 50 percent, for ease of comparison.

Development of Classical Model

The development of a model for "expected" values using the classical description involved a number of assumptions and approximations. It was then used to compare with actual results.

Lapse rates derived from the actual data (graduated, rounded, and extrapolated) are shown in column 4 of Table 4. The classical model was normalized to begin at $t = 0$ with 1,000 policies, each having an unlimited hospital confinement period, no elimination period, $10 per day benefits, and renewability to age 65.

By analysis of actual data, we found the average issue age to be 52. Our model then assumed that all 1,000 policies were issued at age 52, half to men, half to women. (Such a central-age assumption might be too simplistic were we performing the analysis for the company's use.)

Claim costs by attained age were taken from the *1974 Hospital Table* and are shown in column 6 of Table 4. Adjustments were made to claim costs for: the unlimited benefit period (col. 7); the fact that the policy is guaranteed issue (col. 8); and the preexisting condition exclusion of the policy (col. 10). The cash loss ratios resulting from these assumptions are shown in column 14.

The resulting net annual premium is $18.925 per $10 unit. In order to test whether this premium is adequate, we shall make a comparison of loss ratios. Before doing so, we must first determine what loss ratios we will be comparing. Let us look at a few loss-ratio bases, beginning with the simplest.

The most available loss ratios are simply the calendar-year aggregate results on an incurred basis. If the number of units issued were the same each year, those results would be as shown in Table 5. Incurred claims here are simply paid claims (on a run-off basis) plus the increase in policy reserves, where the reserve basis is that from Table 4, with $i = 0$. The figures in Table 5 indicate the need for a premium increase on the order of 17 percent. A relatively small trend upward over time is seen in the A/E ratios.

If the company had more resources, it might make a more detailed analysis, perhaps using a seriatim or grouped in-force listing to calculate expected cash claims for each calendar year. The results would be those shown in Table 6. We can see from the table that the reserves used in developing Table 5 obscured a bit of the premium inadequacy. The aggregate results in Table 6 imply the need for a 25 percent increase.

TABLE 4
CLASSICAL MODEL OF CASE STUDY

t (1)	[x]+t (2)	l_t (3)	$q_t^{(l)}$ (4)	$\sum_0^t(3)$ (5)	Tabular Claim Cost (6)	Benefit Period Adjustment (7)	Guaranteed Issue Adjustment (8)	(6)X(7)X(8) (9)	Selection Adjustment (10)	(9)X(10) (11)	(11)X(3) Claims Expected (12)	$\sum_0^t(12)$ (13)	Expected Cash Loss Ratio (14)
0	52	1,000	.25	1,000	13.145	1.060	1.100	15.327	.500	7.664	7,664	7,664	.202
1	53	750	.15	1,750	13.630	1.061	1.100	15.907	1.103	17.545	13,163	20,827	.464
2	54	638	.14	2,388	14.130	1.062	1.100	16.507	1.103	18.207	11,618	32,444	.481
3	55	548	.13	2,936	14.700	1.063	1.100	17.189	1.103	18.959	10,390	42,835	.501
4	56	477	.12	3,413	15.295	1.064	1.100	17.901	1.103	19.745	9,416	52,251	.522
5	57	420	.11	3,833	15.945	1.065	1.100	18.679	1.103	20.603	8,652	60,903	.544
6	58	378	.10	4,211	16.675	1.066	1.100	19.554	1.103	21.568	8,153	69,056	.570
7	59	344	.09	4,555	17.470	1.067	1.100	20.504	1.103	22.616	7,781	76,837	.598
8	60	313	.09	4,868	18.320	1.068	1.100	21.523	1.103	23.740	7,431	84,268	.627
9	61	285	.09	5,153	19.250	1.069	1.100	22.636	1.103	24.968	7,116	91,384	.660
10	62	259	.09	5,412	20.220	1.070	1.100	23.799	1.103	26.250	6,799	98,183	.694
11	63	236	.09	5,648	21.265	1.071	1.100	25.053	1.103	27.633	6,521	104,704	.730
12	64	215	.09	5,863	22.355	1.072	1.100	26.362	1.103	29.077	6,252	110,956	.768

Taking the level of sophistication of our analysis one step further, let us assume now that the company has the capability to analyze its experience by policy duration. Cash figures would be used, in order to avoid distortions from reserves. The results would be as shown in Table 7. The aggregate result in Table 7 is almost the same as in the prior table. The important difference is in the progression of A/E ratios. The progression 1.06, 1.28, 1.38 seems much steeper and more foreboding than the progression 1.20, 1.23, 1.26 from Table 6. The large volume of experience on which this was based makes these figures quite credible.

Development of CAST Model

The increasing A/E ratios developed in Tables 5, 6, and 7, in years 1, 2, and 3 are in keeping with what would be expected if the CAST hypotheses were accepted.

The year 0 ratio of 1.44 in Table 7 results from a somewhat overzealous choice by the author of the selection effect of a preexisting-condition clause. Such an assumption could have been made as easily in the original pricing assumptions. It does serve to point out a helpful aspect of CAST theory, so it was left as it was. That aspect is that we need not rely on the initial durations' results in developing a particular CAST model. This is advantageous, since many assumptions at the earliest durations tend to be grossly approximate, while those at later durations often can be defined more precisely as time goes on.

TABLE 5
CALENDAR-YEAR INCURRED LOSS RATIOS

Year	Actual	Expected	A/E
0	.589	.500	1.18
1	.562	.500	1.12
2	.581	.500	1.16
3	.601	.500	1.20
Years 0-3	.585	.500	1.17

TABLE 6
CALENDAR-YEAR CASH LOSS RATIOS

Year	Actual	Expected	A/E
0	.291	.202	1.44
1	.376	.314	1.20
2	.440	.359	1.23
3	.486	.385	1.26
Years 0-3	.425	.339	1.25

TABLE 7
DURATION CASH LOSS RATIOS

Year	Actual	Expected	A/E
0	.291	.202	1.44
1	.490	.464	1.06
2	.614	.481	1.28
3	.690	.501	1.38
Years 0-3	.486	.385	1.26

The actual experience at durations 0–3 was used to begin the development of Table 8. The derivation of the CAST model proceeded as follows:

1. $_aS_0^{(d)}$ was found from (col. 5)$_0$ ÷ $_al_0$. Then $_aS_t^{(d)}$ for $t = 1$–12 was derived assuming that $_aS_t^{(d)}$ is always proportional to column 9 of Table 4.

2. After choosing $k_2 = 5$, $_al_t$ and $_il_t$ (for $t = 1, 2, 3$) can be found by solving the two simultaneous equations $(_al_t + 5_il_t)_aS_t^{(d)}$ = column 5 (from Table 8), and $_al_t + _il_t = l_t$ (from Table 4).

3. $_aq_t^{(l)}$ was found by using the following:

$$_iq_t^{(l)} = k_1(_aq_t^{(l)} - u) + u \qquad \text{(with } k_1 = 0, u = 0.09)$$

and

$$_iq_t^{(l)} \,_il_t + _aq_t^{(l)} \,_al_t = l_t - l_{t+1}.$$

4. q_t^{ai} was found (for $t = 0, 1, 2$) by solving the following equation for x to find $_il_t : _aS_t^{(d)} (l_t - x) + _iS_t^{(d)} x$ = (col. 5)$_t$, and then solving

$$_al_{t-1}(1 - _aq_{t-1}^{(d)} - q_{t-1}^{ai}) = _al_t.$$

This, in turn, under the assumption that q_t^{ai} is proportional to $_aS_t^{(d)}$, yields $q_t^{ai} = 0.00241 \,_aS_t^{(d)}$. The constant was derived from the $t = 2$ case, since that was the latest duration available.

5. Results for $t = 4, 5, \ldots, 12$ follow directly, using $_al_t, _il_t, _aS_t^{(d)}, q_t^{ai}$, and $_aq_t^{(l)}$.

The CAST model derived in this way, including actual experience for the first four durations, indicates that the original net premium should have been $29.36, or 55 percent larger than the classical premium. This is in contrast with the largest premium increase derived under the classical model, 26 percent.

We now turn to predicting the effects of a rate increase. Unfortunately, the very act of increasing premiums causes a change in the underlying model, because of the one-time increase in lapsation caused by the increase. This lapsation can logically be considered antiselective, thereby producing poorer future experience.

In our case study, we will assume that a 55 percent premium increase will be implemented at $t = 5$, and that the added lapsation is just enough to offset the potential added premium revenues, a relationship that has been observed frequently by some insurers. Thus the premium revenues are equal to approximately $7,950 for $t = 5$, either with or without the increase. Note that because of our choice of $k_1 = 0$, all extra lapsation will occur from $_al_t$. Table 9 shows the results of this projection.

As expected, the projected cash-loss ratios are substantially higher than those that would result without an added lapsation assumption. The difference is derived in Table 9 and illustrated in Figure 4.

TABLE 8

CAST MODEL OF CASE STUDY

t (1)	$_al_t$ (2)	$_il_t$ (3)	$_aS_t^{(d)}$ (4)	Actual Claims (5)	Actual Loss Ratio (6)	Projected Claims (7)	Projected Loss Ratio (8)	Actual q_t^{ai} (9)	Projected q_t^{ai} (10)	$_aq_t^{(l)}$ (11)	$\sum_0^t [(5) + (7)]$ (12)
0...	1,000	0	11.014	11,014	.291	....	....	.112	....	.250	11,014
1...	638	112	11.431	13,910	.490	....	....	.080	....	.160	24,924
2...	485	153	11.862	14,827	.614	....	....	.029	....	.157	39,751
3...	395	153	12.352	14,312	.690	....	....	....	.030	.145	54,063
4...	326	151	12.864	....	....	13,906	.770	....	.031	.133	67,969
5...	272	148	13.423	....	....	13,584	.855	....	.032	.105	81,553
6...	235	143	14.052	....	....	13,349	.933	....	.034	.090	94,902
7...	206	138	14.735	....	....	13,203	1.014	....	.036	.090	108,105
8...	180	133	15.467	....	....	13,070	1.103	....	.037	.090	121,175
9...	157	128	16.267	....	....	12,965	1.202	....	.039	.090	134,140
10...	137	122	17.103	....	....	12,776	1.303	....	.041	.090	146,591
11...	119	117	18.004	....	....	12,675	1.419	....	.043	.090	159,591
12...	103	112	18.944	....	....	12,560	1.543	....	.046	.090	172,151

TABLE 9
CAST MODEL WITH 55 PERCENT PREMIUM INCREASE AT $t = 5$

t (1)	$_a l_t$ (2)	$_l l_t$ (3)	l_t (4)	$_a q_t^{(l)}$ (5)	Projected Claims (6)	Cash Loss Ratio (7)	(Col. 8 of Table 8) ÷ 1.55 (8)
0............	1,000	0	1,000	.250	....	....	....
1............	638	112	750	.160	....	....	....
2............	485	153	638	.157	....	....	....
3............	395	153	548	.145	....	....	....
4............	326	151	477	.592	13,906	.770	....
5............	123	148	271	.105	11,584	.729	.552
6............	106	138	244	.09	11,185	.781	.602
7............	93	127	220	.09	10,727	.831	.654
8............	81	117	198	.09	10,301	.887	.712
9............	71	107	178	.09	9,858	.944	.775
10............	62	98	160	.09	9,441	1.006	.841
11............	54	90	144	.09	9,074	1.074	.915
12............	47	83	130	.09	8,752	1.148	.995
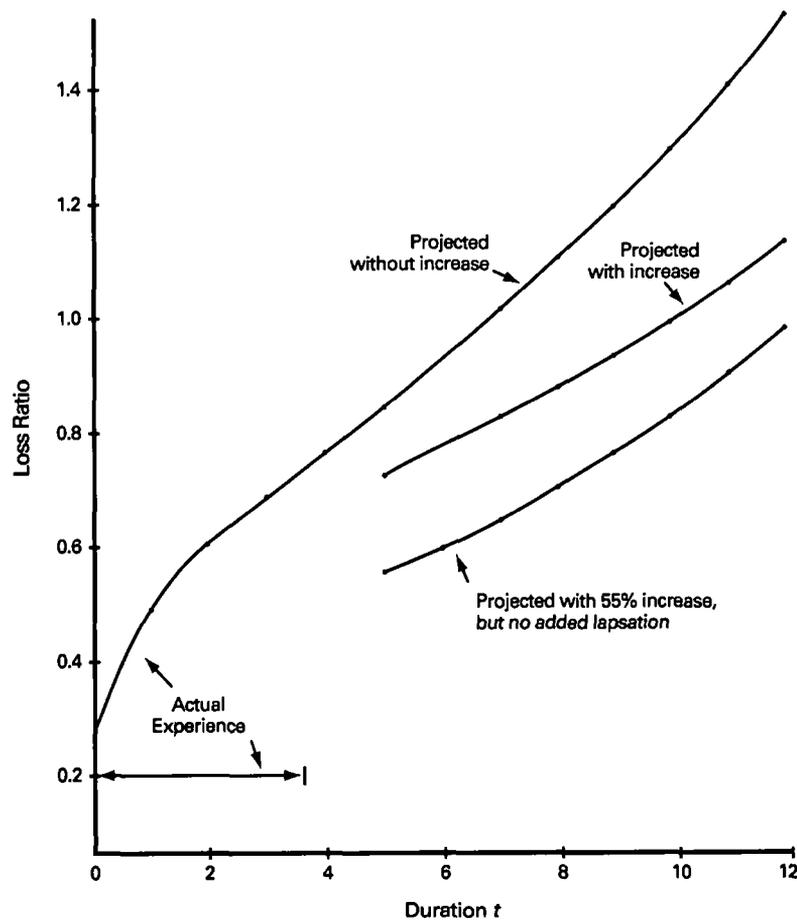
FIG. 4.—Cash loss ratios of the case study

When claims and premium revenues are projected with the added lapsation assumption, the resulting lifetime loss-ratio projection will be different from the 50 percent loss ratio at which the rate increase was targeted. There are three factors causing this difference:

1. The added lapsation will result in a higher cost per remaining policy.
2. Extra lapsation releases extra reserves.
3. Existing reserves *per policy* must be strengthened, to recognize the higher net premium and expected claims. Results will be affected by whether that strengthening is made immediately (i.e., from surplus) or leveled over the future lifetime of the policies in question.

In our case study, if reserves are strengthened from surplus at $t = 5$, the resulting net premium is equal to the ratio of the sum of claims for all years to the sum of l_t for all years, or $30.03. This is 159 percent of the classical net premium, indicating a needed increase of 59 percent.

If we philosophize that the company should pick up the cost of added lapsation, the net premium that results is the aforementioned $29.36, a 55 percent increase. This quantifies the added annual net cost due to added lapsation at $0.67, or 3.5 percent of the original net premium.

The inclusion of interest in the foregoing calculations can be accomplished with no more trouble than in the classical case. Financial analysis using the CAST model is also no different. The only potential difficulty lies in the large number of calculations resulting from extention of the select period. Today's widespread availability of computers and powerful calculators makes such concerns seem minor.

IV. Conclusions

It is hoped that the procedures outlined in this paper can be used to help explain and quantify the reasons for the loss-ratio deterioration experienced by many companies. The appropriate values of CAST parameters in various circumstances, and the resulting behavior of the model, probably will be defined only after they have been derived in a large number of cases.

It is hoped that the discussants of this paper will provide an indication of their success (or lack of it) in applying the CAST model to other "case studies." Perhaps there can also be some progress toward understanding the range of variation of the CAST parameters.

On the other hand, we now know that the currently used model is demonstrating significant flaws. It would

seem absurd, in the author's opinion, to continue to ignore CAST durational effects in our calculations of realistic operating results, or of rate recalculations, in light of that knowledge.

I would like to thank sincerely my colleagues who were kind enough to offer suggestions on earlier drafts of this paper. Their comments and critiques were invaluable.

Discussion of Preceding Paper

Claude Y. Paquin

This paper is one which the thoughtful actuary will want to read many times. It poses a most intriguing theory, which tends to grow on the reader as its substance gradually sinks in. One comes to the realization that the actuarial profession is indeed imaginative, and that health actuaries, faced with an admittedly complex task, take a back seat to no one in the profession in being innovative and talented.

In making that observation, I shall restate my personal conviction that, to the properly trained actuary, life insurance is but a simple case of health insurance in which the benefit is fixed and there can be only one claim. The modern actuary's education should thus concentrate on the mathematical principles underlying health insurance. Of course, Mr. Bluhm was correct in alluding to life insurance as the theoretical precursor to health insurance and the source of our classic approach to the development of actuarially significant figures such as premiums and reserves.

Every tribe seems to have its own gods, and the health actuaries' tribe seems to have adopted the loss ratio as the object of its devotion. The life actuaries never did, nor did the pension actuaries. Actual-to-expected ratios have traditionally been used by most actuaries, but never with the reverence that health practitioners have bestowed upon their loss-ratio god, who is enshrined in tradition and in the process of acquiring ever growing official regulatory recognition.

I have no quarrel with the theories developed by Mr. Bluhm, up to a point. In fact, I am favorably impressed by the development of his cumulative antiselection theory (CAST). I tend to part company with him when, using the same basic claim costs, he can weave a theory that transforms a classical net annual premium of $105.45 into a CAST net annual premium of $138.50. If the claim costs published in the *Transactions* are

valid for the classical premium calculation, why do they stop being valid in the CAST calculation? Probably because, in his effort to make his point, the author selected assumptions that were not completely consistent (namely and principally, here, the rather arbitrary assumption that unhealthy people cost an insurer five times as much as the healthy ones).

The ultimate conclusions one might reach from studying this paper are that (1) claim cost statistics such as are derived for published actuarial reports are not truly valid and directly useful for the calculation of premiums or reserves, and (2) the classical actuarial theory for the development of premiums and reserves (at least as seen prospectively) is inadequate. While that is disturbing, one must remember that people were also disturbed when Columbus first told them that the earth was not flat.

There are practical consequences to be perceived from the presentation of the CAST theory. One must remember that the regulators still favor the use of *loss ratios*, and their conversion to CAST theory is bound to be slow and difficult. The CAST theory is also complex enough to be subject to subtle abuse in the development of premiums, with anticonsumer consequences. The rational regulator may well conclude (with ample justification) that a health insurance form of yearly renewable term is preferable to a system that seeks to anticipate speculatively high claim levels too far in advance. For consumers who prefer a level pattern of premium payment, a health form of universal life, with a nonforfeitable interest-bearing side fund, might be developed. If this happens, life insurance will again find itself in the role of precursor.

Charles Habeck

Mr. Bluhm is to be congratulated for taking up, in his most timely paper, an aspect of the pricing and repricing of individual health insurance that has very often proved difficult for actuaries to deal with. Although the paper touches on, but does not attempt to resolve, certain other controversial questions in this area, these become less important and somewhat peripheral to its main purpose, which is to present a conceptual framework that can be used for more meaningful analysis of morbidity data.

My discussion consists of three parts: first, a brief restatement of the two most important concepts brought out in the paper; second, a series of comments and questions relating to specific points in the text; and third, some remarks on the current adjustments I am using to reflect different selection patterns as they vary by benefit and underwriting rules.

Two main points emerge from the paper: (1) writers of individual health insurance should develop the systems capacity to study loss experience by duration, and (2) these insurers also should consider the need for advance funding of benefit payments, even for plans using attained-age rating structures.

A number of insurance departments, including New York's, are requiring loss-ratio projections by policy year to be included at the time of premium rate filing. Follow-up comparisons must be made from time to time of actual to expected experience results, also recognizing duration, in order to confirm original assumptions. This same process applies when requests for premium increases are filed. Unfortunately, this treatment is not yet widely required. Thus, some years may elapse before enough data by duration can be gathered and analyzed so that it will be possible for the actuary to develop a credible pattern of extended select adjustment factors. Until then, premium calculations and projections will continue to incorporate intuitive and hypothetical patterns, as they do at the present time.

As an alternative to durational analysis, the marketing strategy involving sequential product development has achieved almost the same purpose. This approach is one that requires frequent product revision; product life may be limited to only two or three years. The closed blocks of business that result then can be monitored and managed more effectively.

A viable procedure, the advance funding of future benefit payments, either through a policy reserve or through more conservative claim reserves or contingency reserves, appears to have fallen into disfavor. This may be seen as just another reflection of the pay-as-you-go methods that have become the norm throughout the economy. Thus, the introduction of a policy reserve element into the models is less typical than it may appear from the stance of the paper. This inconsistency is especially noticeable when the concept of reserve strengthening comes into the picture, since the contracts that currently dominate the marketplace and that are most affected by inflation are not carrying any policy reserves.

Whether the process is called "reserve strengthening" or "premium stabilization" through some earmarked fund, it appears that the underlying and

possibly forlorn hope of the insurance departments that have attempted to deal with this issue is to reduce, eliminate, or at least contain the need for premium increases. This hope is not contrary to the desires of insurers, but it does run counter to the realities of the marketplace and of the current economy.

In this connection, there is some evidence that even with attained-age rating, a select-period policy reserve can be developed, as it should be, based on what we read in Mr. Bluhm's paper, both to stabilize loss results and to help demonstrate that minimum loss ratios have been met. By this means, the illusion created by deceptively low early loss ratios can be dispelled. Up to now, however, such a reserving approach has not been used very much, or at least has not been reported on.

Although a number of other salient points come out of this paper, I consider these the two most important.

In the next part of my discussion comes a series of comments and questions, following generally the order of their appearance in the paper.

1. The author may overstate the case when he refers to high loss ratios at later policy durations as indicative of "irreversible decay." High loss ratios do not become a cause for alarm unless they are unexpected and thus unprovided for. Premium calculations may show that, after eight to ten years, loss ratios can be expected to be quite high on a statutory reserve basis, but that gross premiums, over the period for which they are projected to be adequate, need not necessarily be increased. Although premiums may be set to accommodate increasing claim costs due to aging and cumulative antiselection through lapsing, there is a limit to the amount of inflation in costs that can be anticipated.

2. Reference is made to "durational antiselection reserves needed to stabilize loss ratios." One wonders what status would be assigned to such reserves for various accounting and tax purposes? Would a rate-increase filing based on a CAST projection be accepted by regulatory officials as a meaningful demonstration?

3. Loss-ratio decay is attributed to two "neglected" characteristics of the business: policyholder anticipation of a claim, and high voluntary lapse rates, especially among the healthy. Some observers would challenge these assumptions. Insureds with pending claims are not likely to lapse, of course, although some dispute arises even with this view. But reasons for lapse also include external influences such as agent or company actions, or a combination of them, such as replacements at the time of large rate increases. Still, as a thesis to explain these different lapsing patterns, policyholder awareness is certainly valid.

4. The partition of the in-force into healthy and impaired lives may create some practical problems. So also does the choice of values for the key constants. The author classifies as "impaired" any insured who is aware, in effect, of

the difficulty he or she would have in obtaining other coverage, which is to say that they expect to incur a claim. Thus, they persist. Putting aside the arbitrary nature of the constants k_1 and k_2 and the choice of values for u, the model that results from these assumptions appears to be a valid one for the demonstration. It is interesting to note that the case study in Section III derives a much higher constant for use in obtaining q_x^{ai} than the model does (0.00241 as compared with 0.0007077), although both are related to the same type of benefit. Perhaps Mr. Bluhm has some additional thoughts on this relationship.

5. The term "classical" is applied to selection adjustments such as those found in the intercompany reports. The distinction seems to be that the CAST adjustment factors extend these durational adjustments throughout the policy life, instead of for just three years. Although it must be granted that claim costs are an increasing function of duration, it also must be realized that there is a practical limit, due either to antiselection or to secular trend, as noted above, on how far this can be recognized for pricing purposes.

6. I would be interested in knowing what causes of lapsation are independent of the individual's health, assuming that renewability is guaranteed. Inability to pay the premiums comes to mind. Replacement seems to depend on health status, however.

7. Section II of the paper develops the hypothetical models in a straightforward manner, one for each of the two cases. It is in this section that the importance of the policy reserve basis becomes apparent. Wide latitude is afforded insurers in the amount of this reserve for statutory reporting. But to some extent, even with this range of values, the insurer gets boxed in by regulations. This occurs because the same basis that was assumed in the original gross premium calculations must be used in reporting results to show compliance with minimum loss ratio requirements. It would appear extremely difficult for the actuary to restate results using a CAST projection and CAST policy reserve factors somewhere downstream. On the other hand, if actual-to-expected "cash" results are the test, the choice of the reserve basis becomes less important. It has been my experience that regulators tend to resist approvals on any basis that does not present absolute dollar results. They want to see how the ledger (or "cash") elements of the loss ratio have been adjusted to arrive at earned/incurred results.

8. Near the end of Section II the author describes quite accurately the consequences that occur when the actuary is taken unawares by cumulative antiselection. The influx of new business may delay his or her point of realization even further. The long time frame estimated for getting rate increases is discouraging, but realistic, and should be an encouragement to alertness and prompt action. In contrast, the expectation of a future loss ratio of 50 percent after reaching $t = 8$ is not too realistic for a closed block of business. Nor is it practical to seek an increase of the magnitude suggested. The preferred response is to minimize

losses by the proper choice of the premium increase (which means *lower* here). We may now be moving from science to art, although some insurers have been able to determine the effect on lapses and morbidity of premium increases by size of the increase.

9. In Section III the three tables showing early loss-ratio experience present a variety of reporting results, produced from a single block of data. As noted above, for statutory reporting purposes, it may be well to array the various ingredients of the loss ratio for regulatory perusal. Thus, any "distortions from reserves" can be seen more easily, and ratios of actual to expected using both statutory and CAST reserve changes can be developed. For management purposes, I would also like to see the Table 7 results further subdivided by calendar year of exposure. This breakdown would reveal trends in utilization for hospital income benefits, along with inflationary trends if the contract provided broad major medical benefits. The inclusion of policy reserve increases, if any, would clarify the developing trends and reduce the possibility of faulty interpretation, assuming that the analyst understood the implications of his choice of reserve bases.

10. Mr. Bluhm correctly states certain consequences of the 55 percent rate increase. I agree with the assertion that even with the increase, the resulting premium income will stay about the same as it would have been without the increase. There will be higher costs per policy still in force, and reserves will be released, to help confuse the picture. I do not agree that reserves must be strengthened. Although this question deserves a separate paper, and a lengthy one, it may be sufficient to consider the main alternatives here, including (a) strengthening from date of issue out of surplus; (b) incremental strengthening out of future premiums; and (c) no strengthening at all.

The chief advantage of not strengthening is a negative one: it avoids a lot of questions, especially those relating to possible manipulation and to federal income tax consequences. On the conceptual side, freezing the valuation basis can be rationalized by considering the benefits as issue-age-rated for the healthy active life component and as attained-age-rated for the impaired life segment. The additional premiums to cover excess losses for the persisting impaired lives may be projected over relatively short-term periods, say two years at a time, rather than over the remaining life of the policies in force. A subsequent increase, two years from now, will provide for the next term period, and so on. This line of reasoning applies to premium increases necessitated by inflation as well as those due to cumulative antiselection.

Reserve strengthening, as noted at the outset, has no meaning for attained-age-rated major medical policies. Earmarked surplus funds may be the way to handle excess losses on these policies. Note that nonstrengthening and the use of short projection periods for revised premiums will produce lower premium increases, making this method advantageous to the policyholders as well as to the insurer, who is trying to maximize persistency.

It is not likely that a practical method of analysis can be derived from Mr. Bluhm's paper, although he suggested that the approach illustrated in the case study could be applied to other experiences. To some extent, however, I think that the principles emphasized in his paper already are being recognized, at least on a piecemeal basis to meet specific needs. For instance, analysis may be done in the aggregate, treating all of the in-force as "impairment-aware" after a certain duration. The reality of actual practice does not detract from the impact of the basic demonstrations contained in the paper. And these comprise its chief value to the health actuary.

In the final part of this discussion, I would like to present the durational selection factors that I have been using for a number of years as the starting point for gross premium calculations. They have been confirmed or modified from time to time for various applications. These adjustment factors have not been used in projections for premium revisions, as a rule, although they are significant for valuations and experience studies.

Table 1 of this discussion shows a set of these selection factors, by benefit type. One can see that the "average" assumed claim cost level is reached in the fourth policy year. The selection effect reverses after that, and allowance is made for the cumulative antiselection we are talking about. Variations occur by type of benefit: the steepest progression relates to factors used in pricing major medical benefits; the flattest is for basic hospital plans. Flatter patterns may be produced by omitting the lowest or highest factors, or both of them, depending on the marketing and underwriting circumstances.

TABLE 1

DURATIONAL ADJUSTMENTS TO CLAIM COSTS

Benefit Type	Policy Years						
	1	2	3	4	5	6	7 and Over
Basic hospital..................	0.80	0.90	0.95	1.00	1.05	1.10	1.10
Major medical..................	0.65	0.80	0.90	1.00	1.10	1.20	1.30
Disability income..............	0.70	0.80	0.90	1.10	1.10	1.15	1.20

We have observed a few other patterns for these adjustments. In some instances a U-shaped curve results. In the first policy year the adjustment factor may have to be as high as 1.30 to reproduce actual claims, then may drop back to 1.00 or close to it, rising finally to an ultimate that may still be lower than the high first-year factor. Examples of this U-shape may be found where disability benefits involve a short elimination period (e.g., seven days), or in franchise plans with high early lapses and then stable persistency. Once again the link between persistency and cumulative adverse selection seems to be revealed.

Elsewhere the effect of duration appears to be minimal. Accident benefits might show such a pattern. But other examples could include mortgage disability plans, where persistency is relatively uniform, and certain direct-marketed basic hospital benefits, where no agent is involved. For these situations a fairly flat scale may be appropriate.

The selection pattern for a cancer insurance product may start low, climb steeply, and then stay on a "plateau" or move up slowly. Part of the adverse selection may occur at time of issue if there is awareness of a family history of cancer. A study of 1977 claims paid, by year of issue, as contained in testimony to the House Select Committee on Aging by a large writer of cancer insurance, compares loss ratios by year of issue for about twenty years exposed. The loss-ratio sequence for the most recent five years was as follows: 11.8 percent (1977 issues), 33.7 percent (1976), 44.2 percent (1975), 47.5 percent (1947), and 52.5 percent (1973). The ratios continued to climb into the 70-80 percent range, moving toward 100 percent for issues of 1958 and 1959.[2] The aggregate loss ratio for 1977 for this company was 43.3 percent, giving no apparent cause for alarm.

Another distinct pattern can be expected for the medicare supplement type of coverage. Much of this business is sold with minimal underwriting (meaning that the person is not confined in a hospital or nursing home at time of issue) or no underwriting at all, with a typical wait on preexisting conditions of six months. I have used a pattern that simply shifts a portion of average first-year costs into the second year, with no further adjustment by duration; the sequence becomes 0.90, 1.10, and 1.00 thereafter. An additional flat loading may be made for guaranteed issue. The problem of antiselect lapsation may be less pronounced here than in the under-age 65 markets, especially since current regula-

tory scrutiny has tended to control the replacement activities of agents.

The effects of inflation should not be overlooked in making projections, but, when combined with the other adjustments, the resulting rate increases will speed up the deterioration through antiselect lapsation. Astute management may minimize adverse results by capping the required premium increases. For instance, it may not take a very refined projection to demonstrate the need for a 55 percent rate increase, if done on a best-case basis. But company standards may supersede theoretical considerations and dictate a limit on the increase so derived. One company may find that the effect on lapses is neutralized, or at least minimized, if increases in premiums are kept in the 20-30 percent range. Others may find a higher optimal increase for their markets, perhaps as high as 40 percent, which will maximize persistency and minimize future losses.

Once again the exigencies of the marketplace may obviate the need for the complex testing now established in the model guidelines. One continues to hope that loss-ratio tests and guidelines will remain just that, so as not to discourage or drive out marketers of individual health insurance. In retrospect, and notwithstanding my earlier conclusion, the concepts, if not the methods themselves, involved with the theory of cumulative antiselection may fit in quite well with the practical aspects of rating and rerating these products.

Howard J. Bolnick *

Mr. Bluhm is to be congratulated for adding to the literature a discussion of the problems caused by individuals who choose to remain in or withdraw from a pool of individual health insurance risks. While other actuaries may be able to build on Mr. Bluhm's work and improve his mathematical model, the valuable demonstration of the effects of morbidity antiselection cannot be overlooked.

My experience with cumulative antiselection theory (CAST) has been concentrated in small-group health insurance pools (groups with from one to, roughly, twenty-five employees). There is no question in my mind that the CAST phenomenon exists and that it has a very significant effect on the claim experience of small-group pools. As the average duration from issue for small groups within a pool increases, incurred claims tend to grow faster than expected because of increases in medical care costs. This occurs for two reasons. First, any

initial underwriting selection is dissipated relatively quickly. Second, turnover in participating groups, which ranges as high as 25-35 percent per year, tends to strip better groups from the pool. This leaves the remaining longer duration groups with a disproportionate share of the worst risks. Both of these phenomena are embodied in cumulative antiselection theory.

Given these characteristics, as the pool grows and newly issued business becomes a smaller and smaller portion of the total, an insurer that does not effectively address the CAST issue will soon be faced with the need for rate increases that exceed the increase in medical care costs. Higher than normal rate increases cause an increased flow of the better groups from the pool to newer, lower-cost programs. This, in turn, causes further large rate increases due to accelerating CAST deterioration in claim experience. This "assessment spiral" has been the cause of many well-publicized problems with small-group programs. Once an assessment spiral begins, its ultimate consequence is the financial failure of the pool and the ensuing loss of coverage for all participating groups. The fact that there is only a limited number of small-group programs that have been in existence for five or more years is testimony to insurers' traditional lack of success in addressing the CAST problem.

While the CAST problem is the same for both individual and small-group products, the solution differs. Small-group products are written using cancelable policy forms with fully flexible attained-age rating schedules. As claim experience begins to deteriorate, rating actions taken against the entire pool merely result in the assessment spiral described above. And additional reserves funded by higher premiums only hasten the day of reckoning by making the product less attractive and hindering healthy growth. Avoidance of the problems caused by using rates or reserves to solve the CAST problem requires, in my opinion, instituting a program of nonstandard renewal actions on selected groups.

Only through culling the worst groups from the pool can the CAST problem be contained. This culling process is aided by the fact that within a small-group pool a small portion of the groups causes a very large portion of the claims. For example, it is not unusual to find that 15-20 percent of the groups within a pool have had 35-45 percent of its claims. Thus, by taking nonstandard renewal actions on a small portion of all groups, the

health of the pool can be maintained for the majority of its participants.

The design of a renewal program is quite difficult. Balance must be maintained between the need to cull carefully selected groups from the pool and the need to protect participants from arbitrary and capricious action by the insurer. The method used to choose groups to be culled must recognize the limitations inherent in using past claim history as a predictor of future experience. These problems can be overcome, but only with careful planning. The reward for undertaking this exercise is a small-group program that can provide stable, competitive insurance to the majority of its participants.

There is one potentially serious problem, however, that could be caused by insurers managing their small-group pools as suggested above. As pool management becomes widespread, there is a risk that insurers will create a class of substandard small groups that are unable to obtain health insurance coverage in the private market. One example of a solution to this potential problem is the health insurance risk-sharing plan run by the state of Wisconsin. This plan is a state-run substandard pool for people unable to obtain adequate health insurance coverage in the private market. It is important not to overlook the issue of excluding some groups from the private market. To do so will ultimately cause undue pressure on insurers not to deal with the CAST problem in an effective manner.

Francis T. O'Grady and Vincent Dooley*

In the development of his cumulative antiselection theory, Mr. Bluhm discusses the additional lapses resulting from premium increases and the apparent antiselection process that occurs in connection with these lapses.

This discussion presents the results of a study of the persistency of individual medical expense policy forms that were subject to premium rate increases over the past few years. The study covered three policy editions. One had over $15 million of yearly premium in-force and was subject to a 20 percent rate increase. The second had over $7 million of yearly premium in-force and was subject to a rate increase of approximately 40 percent. The third had about $3.5 million of yearly premium in-force and was subject to a rate increase of approximately 50 percent. The persistency of the policies that had been subject to a rate increase was tracked on an ongoing basis, so that we took account not only

* Mr. Dooley, not a member of the Society, is a programmer at the Metropolitan Life.

of the additional lapses that occurred in the month of the policy anniversary in which the rate increase was made effective, but also of the lapses occurring during several months following the policy anniversary.

The results of that study, which are given here, are responsive to the following questions that relate to the subject of Mr. Bluhm's paper:

1. Does an increase in premium rates cause an increase in lapse rate?

2. If there is an increase in lapse rate, will the magnitude of the increase be a function of the size of the percentage increase in premium rates?

3. Will the in-force that persists after the premium rate increase consist of lives who are in worse health, on the average, than all the lives that were in force prior to the premium rate increase?

The percentage increase in lapse rates is given in Table 1 of this discussion. This table demonstrates that the not-unexpected answer to question 1 above is that an increase in premium rates does increase lapse rates.

The results also show that, in response to question 2 above, the larger the premium rate increase, the greater the increase in lapse rates. They also show that this relationship is somewhat linear in nature.

The relative health of the lives who lapse as opposed to that of those who persist is a difficult quantity to measure. The decision not to renew a policy, whether or not a rate increase is being made, can involve considerations (e.g., that the coverage is no longer needed because the insured has group coverage) other than the individual's health status.

We attempted to estimate the antiselection that might be involved in the decision to lapse or renew at the time of a rate increase by studying several samples of policies affected by rate-increase actions. The study covered both those who accepted the rate increase and those who lapsed. For both groups the claim history since issue was obtained for each policy.

One sample involved about 750 policies on a policy edition that is still being issued and on which there had been one prior rate increase at a modest level. Our analysis shows that 56 percent of the policies that lapsed had had claims, while almost 75 percent of those that persisted had had claims. A comparison of the amount of claims paid showed that the average total payment was almost 50 percent higher on the persisting policies than on the lapsed policies.

TABLE 1

PERCENTAGE INCREASE IN LAPSE RATES

Policy Form	Approximate Percentage Rate Increase for Policy Form	Percentage Increase in Lapse Rate
A............	20%	26%
B............	40	55
C............	50	73

A second sample involved about 600 policies on a policy edition that is a closed block of business and has been subject to several prior rate increases; at least one of the increases could be considered to be large. The analysis showed that slightly more than 80 percent of the policies, both of those that had persisted and of those that had lapsed, had a claim history. The average claim payment was, however, about 20 percent higher on the persisting policies than on the lapsed policies.

To the extent that a claim history can be considered as a valid basis for distinguishing "impaired" from "healthy" lives and thus can be used to measure the antiselection experienced on rate increases, the above analysis would indicate that there *is* antiselection at the time of rate increase. The study indicates that the degree of antiselection will likely vary with the conditions involved in each particular rate increase. These conditions would include the following:

1. The level of rate increase.
2. The history of prior increases, as to both frequency and magnitude.
3. The availability of replacement coverage with comparable benefits of comparable cost.
4. The ability of the individual (and his dependents) to meet the underwriting standards of a new carrier.

It is hoped that the study reported in this discussion will give health insurance actuaries some guidance in establishing the parameters in the CAST model so that they can make use of it in their own pricing studies.

Author's Review Of Discussion

William F. Bluhm

Mr. Paquin's reference to the "loss-ratio god" brings to the fore a controversy between regulators and insurers that existed before I entered this field, and likely will exist long after both Mr. Paquin and I have left it.

My personal opinion is that *properly formulated* loss ratios, using a CAST model, serve a valuable purpose as a "common ground" where actuaries can apply their expertise to arrive at numbers that can be relied upon by nonactuaries. The historical problem encountered by actuaries is that the loss ratios most generally used have not been sophisticated enough to be used without sophisticated caveats. Since users have sometimes paid scant attention to those caveats, confusion and erroneous conclusions have resulted.

The paper by John B. Cumming entitled "Regulatory Monitoring of Individual Health Insurance Policy Experience" (*TSA*, XXXIV, 617) investigates the problem of loss ratios in greater depth. I will postpone any further defense of loss ratios here, in favor of a discussion of that paper.

Mr. Paquin raises the interesting question of how my theory can start with the same claim costs as the classical theory yet end up with a net annual premium that is 131 percent of the classical net annual premium.

An earlier version of this paper assumed equal net premiums for the Section II development of hypothetical models. That is, one of the original constraints used was that aggregate claims in both cases must be equal. The result was, however, that the CAST parameters were limited in effect and duration by the overall claim cost limit. Since this contradicted my qualitative observations on the CAST effect, I spent quite some time thinking about where the model diverged from reality.

I began to think of the CAST and classical models as stationary population models, each with equal exposure at each duration. Then I realized that the committees developing the tables used claim cost, which generally did *not* differentiate exposures beyond the third year. The companies submitting data to the committees have probably (and I have not confirmed this) tended to ignore discontinued forms and lines of business, concentrating on current or recent products. Under the classical theory this was perfectly all right, since claim costs at duration 20, for example, would equal those at duration 3, so no distortion would result. CAST theory implies, however, that this situation results in understated claim costs, as those later durations that have been deleted become important.

On the basis of this reasoning, it seemed to me to be more reasonable to assume that the tabular claim costs would be correct in the first two years, and begin to diverge from reality thereafter.

I think it is important to point out that yearly renewable term insurance will not eliminate the need for reserves, despite current practice. The classical age-related reserve is eliminated, but the CAST duration-related reserve will unavoidably remain. The only way to eliminate the need for CAST reserves is to eliminate voluntary lapsation. Mr. Habeck has come to the same conclusion.

I think the questions Mr. Habeck raises regarding the potential tax, accounting, and regulatory status of CAST reserves can be answered only with time. Tax status is a function of regulatory acceptance, which in turn can be expected to happen only when and if the theory is fully accepted by the profession.

A policyholder's perception of his inability to obtain alternate coverage is not quite, as I have been thinking of it, the definition of an "impaired" life. Rather, it is the policyholder's perception of the probability and/or expected size of claim. A typical policyholder weighs the value of his policy to him against its cost. To the extent that his higher claim expectations make the policy more valuable, he is less likely to lapse.

Mr. Habeck raises a question regarding the nature of the constant used to derive q^{ai}. It seems to me that the constant would be primarily a function of the type of benefit and the choice of k_2 (and thus the level of impairment in $'l^r$). I also suspect that q^{ai} is not necessarily linear at the earliest durations, where differences in underwriting and preexisting conditions can cause major distortions.

Mr. Habeck asks what causes of lapsation are independent of health, and mentions what I feel is the foremost, a financial inability to pay premiums. What also come to mind are situations involving overinsurance, with nonduplication or variable deductible provisions making the policy of less value to the policyholder. Also, when looking at a block of policyholders of different ages, we should consider policyholders who will involuntarily lapse when they reach a limiting age.

I quite agree with Mr. Habeck's misgivings over seeking to implement the 59 percent increase indicated by the paper. There are certainly many considerations that go into a rate-increase decision, the theoretically proper level being just one such consideration.

I am disappointed that Mr. Habeck does not believe that a practical method of analysis can be derived. However, such analysis may not be necessary in the long run. It may suffice to derive CAST factors that could be applied to all policies of a certain type, much like Mr.

Habeck's factors, but being sure to extend them to far later durations.

Mr. Bolnick points out that CAST theory might apply to small-group pools. I also received a call from Mr. Vincent Zink, who felt that the CAST forces could be applied to renewable term life insurance. I think it would be productive to stay receptive to where the assumptions of CAST theory apply.

Regarding CAST effects in the small-group situation, I cannot but believe that there must be an alternative solution to the nonrenewal of groups with higher claim expectations. It seems to me that such situations are what health insurance was created to avoid. If competitive pressures keep insurers from properly prefunding durational reserves, perhaps the answer is a regulatory requirement for that prefunding applied to all insurers.

I quite agree with the four conditions listed by Mr. O'Grady and Mr. Dooley as contributing to the level of antiselective lapsation at the time of a rate increase. I would add one more: the magnitude of the premium itself, as opposed to the percentage increase in premiums.

I would like to thank all the discussants for their thoughtful and illuminating comments.

End Notes

1. *TSA, 1979 Reports*, p. 243.
2. "Abuses in the Sale of Health Insurance to the Elderly," a report published by the House Select Committee on Aging, dated November 28, 1978, Comm. Pub. 95-165, SN 052-070-04874-3. Results are shown in the chart on page 156 of the report.