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THE FINANCIAL RISK TO LIFE INSURANCE COMPANIES FROM CHANGES IN INTEREST RATES

Moderator: CARL R. OHMAN. Panelists: JAMES A. GEYER, HOWARD H. KAYTON, PAUL KOLKMAN

MR. CARL R. OHMAN: The Society's Task Force to Study Risk of Loss from Changes in the Interest Rate Environment (C-3 Risk Task Force) was formed in March 1981 with the charge to quantify C-3 risk, as defined by the Society's Committee on Valuation and Related Problems in its preliminary report published in the Record 5:1, pp 256-284, and to make the results available to Society members for review and discussion in a one year time frame.

The Task Force made a preliminary report as part of a panel discussion on C-3 risk at the Society's October 1981 meeting in Atlanta. Three papers prepared by Task Force members were distributed at that session: (1) My report describing the formation of the Task Force, the nature of its assignment, its plan of operation, and a summary of the results to date, (2) Don Cody's paper providing an overall analytic formulation of the C-3 risk problem, and (3) Jim Tilley's paper providing preliminary C-3 risk calculations for guaranteed interest contracts. These papers were published as part of the discussion at that session in the Record 7:4, pp. 1349-1391.

As described in Atlanta, the C-3 risk problem is to determine whether the assets supporting a life insurance company's book of insurance or annuity guarantees on a valuation date will be sufficient to fund the obligations of the business over the entire period of the guarantees, and at the same time sufficient to assure that assets at each future valuation date while the guarantees remain on the books will be sufficient to cover statutory reserves on such dates, given the earnings potential and maturity structure of the company's assets on the valuation date and various assumptions as to future changes in interest rates and the movements of asset and liability cash flow in response to such changes.

The plan of operations adopted by the Task Force was to approach the calculations in four stages of increasing complexity of C-3 risk implications: first, calculations for guaranteed interest contracts; second, calculations for non-par individual whole life insurance; third, calculations for par whole life, deferred annuities, universal life; fourth, calculations involving two or more product lines with differing C-3 risk characteristics.

The first stage calculations on guaranteed interest contracts were performed at Equitable in the late summer and early fall of 1981 under the direction of Jim Tilley and Gordon Dinsmore, and are summarized in Mr. Tilley's Atlanta paper that was referred to earlier. That paper presents a methodology for testing a given reserve basis with respect to its adequacy for protecting against risk of loss due to interest rate fluctuations and determining the amount of surplus needed to protect against that risk, and applies that methodology in illustrative calculations for three sample companies, each with a specific book of guaranteed interest contracts in force on the valuation date and with a specific collection of assets supporting the guarantees.

The Tilley paper is of considerable interest in itself, but its real importance lies in the applicability of the methodology to an insurance company's actual inforce of interest rate guarantees and the company's assets supporting the business. The work was particularly timely in view of a new requirement introduced by the New York Insurance Department for the December 31, 1981 valuation of guaranteed interest contract reserves which waived a reduction in certain valuation standard interest rates that had been introduced in the Department's minimum reserve requirements the previous year, providing that a qualified actuary certifies that he or she has performed satisfactory tests to demonstrate that there is a reasonable matching of assets and liabilities relative to such contracts, such tests to include demonstrations that the expected cash flow is adequate to provide for the guarantees with appropriate protection against loss to the company in case of (1) premature prepayments of loans or investments (in case of falling interest rates) and (2) premature withdrawals by the policyholder (in case of rising interest rates).

For the December 31, 1981 valuation, a number of companies, including my own, performed the tests and submitted the certification required under the New York Department's new procedure. The Tilley methodology served as a blueprint for Equitable's tests (though with not all the same assumptions), and it may or may not have been used by other companies as well. Hopefully, now that the first round of such tests and certifications has been completed, the companies and regulators will take the opportunity to evaluate the experiences of the companies that made such submissions this year so as to determine what improvements can be made in the requirements for such submissions. No doubt guidelines will need to be developed for future compliance with such requirements, also qualification standards and standards of practice for the actuaries signing the certifications.

It is my belief that this requirement for specific tests of interest guarantee reserve and the supporting assets and for certification by an actuary that the tests have been performed, and the companies' responses to the requirement in the 1981 valuation constitute an important step toward a new valuation framework for guaranteed interest contracts, this new framework would continue the traditional concept of a statutory minimum reserve requirement as a safe harbor with traditional margins, but would provide more flexible minimums where an actuary has examined the company's liabilities and assets and the relationship between assets and liabilities, and performed tests to demonstrate the extent to which the company's assets (reserves plus surplus) really are sufficient to assure continued solvency of the business in a changing interest rate environment.

The second stage in the Task Force's plan of operation, calculations for non-par individual whole life insurance, began in the fall in 1981 at Aetna Life and Casualty under the direction of Alastair Longley-Cook, James Geyer and Michael Mateja, and the overall guidance of Robert A. Miller, III. Because of the longer historical time frame involved in both building up a mature book of individual whole life insurance business and running the business out to its maturity, the guaranteed cash surrender values and policy loan provisions required in these policies and the linkage of reserves to cash values, and also complexities in the incidence of federal income tax and expenses, the individual whole life calculations proved to be considerably more complicated and more extensive than those required for guaranteed interest contracts, and the Aetna calculations constitute a major research project in themselves. Messrs. Geyer and Mateja have prepared a paper describing the methodology and presenting the results of illustrative calculations. This paper will be discussed by Mr. Geyer later in this session, and the paper will be published in the Record for the Houston meeting.

We can expect to learn a great deal about the C-3 risk characteristics of non-par individual whole life insurance from the Aetna calculations and the assets needed to fund the obligations for such business in a changing interest rate environment. Conceivably, the Aetna research could lead to requirements for specific tests of adequacy of individual life reserves and for actuarial certifications that the tests have been performed along lines of the New York requirement for guaranteed interest contracts. However, it is important to emphasize that the C-3 risk problem is much more complicated for individual life than for guaranteed interest contracts, and that more research will probably be needed before we will be ready to suggest fundamental changes in valuation theory for these products or to suggest specific asset or surplus requirements for the business.

The Task Force has now commenced the third stage of its plan of operations, which will include two additional projects: (1) calculations to quantify C-3 risk for par individual whole life insurance, to be performed at New England Mutual Life under Louis Weisz and Terry Owens and with advice and guidance from Don Cody. It will attempt to quantify the implications of dividends for C-3 risk asset needs, and (2) calculations to quantify C-3 risk for deferred annuities to be performed at IDS Life under Paul Kolkman. Detailed plans for these calculations will be discussed by the Task Force at a May 23 meeting in Colorado Springs, and the calculations should be near completion in time for the Society's anual meeting in Washington this fall. The Task Force is also considering what additional calculations may be needed and feasible at this time for universal life.

The present plan of the Task Force is to complete the projects now underway, covering the first three stages of its original plan of operation, by the fall of 1982, and then stop and concentrate on preparing a final Task Force report to summarize what it has learned about the C-3 risk problem for presentation at a spring 1983 Society meeting, and for eventual publication in the Transactions. At that point, the Task Force as now consitituted will go out of business. This will leave much needed C-3 risk research yet undone, including the aforementioned fourth stage calculations. Projects remaining will include: (1) quantifying C-3 risk for a company with two or more products of different, and perhaps complementary, C-3 risk characteristics; (2) quantifying C-3 risk in combination with C-1 (asset depreciation) risk and C-2 (pricing deficiency) risk; (3) relating quantification of C-3 risk to the broader issues of asset and liability cash flows and relationships between the two, including questions of product design toward lower C-3 risk, methods of structuring assets to comport with liabilities so as to minimize C-3 risk, and new approaches to allocations of investment results among lines of business and within lines to assure that investment results are appropriately channeled to the products for whom such investments were acquired while assuring continued adherence to the principles of equity and risk sharing. The Society's Research Policy Committee will be asked to examine these research needs at its next meeting in May and to address the question of how best to proceed.

The research efforts of the C-3 Risk Task Force and others are certainly beginning to suggest new approaches to measuring surplus needs for insurance companies as well as new approaches to valuation theory. In concluding this report, however, I think it important to sound a note of caution against attempting to shortcut the process with any arbitrary or simple formula defining minimum surplus requirements for insurance companies. Such shortcuts would pose a potential danger by implying that a company can be deemed to be "sound" so long as surplus equals x% of premiums, or y% of reserves, without regard to other relevant factors such as matching of assets and liabilities. Our concern is that arbitrary tests of this type will divert the attention of valuation actuaries, company managements and regulators from the critical need to provide adequately for the risks that may impair the company's solvency, most especially in the present economic environment for C-3 risk.

MR. JAMES A GEYER: I have some good news and some bad news for you. The bad news is that we don't have all the answers yet. The good news is that we do have most of the questions. Also, we do have a few preliminary results.

Before I begin, though, I would like to give credit to those people who have contributed to the project: Linda Crout and Diane Arndt, actuarial students in our unit, for the considerable amount of study time and personal time that they have foregone to get us where we are today; Mike Mateja, my boss, who directed the overall project from the start, and who worked quite closely with me on the analysis phase; Bob Miller, who is a member of the C-3 Task Force, and provided direction and plenty of encouragement whenever the going got tough; Jim Bridgeman, Nick McLeod, Alastair Longley-Cook, and Linda Crout for their contributions to the model office over the last one to two years.

Methodology and Assumptions

The first step was to create a model office system. Much was built into this system, such as the ability to vary with interest rate levels the lapses, loans, calls on investments, and expenses; the ability to vary rollover rates by year of investment; and especially the ability to track separately almost any pre-defined subset of the total in-force.

Next, we created an in-force as of December 31, 1981, our assumed valuation date. We assumed policies were issued over the 20-year period from 1962 to 1981, the historical period, and then traced all such policies to 12/31/81. Naturally, all investments were also traced forward to develop the assets as of 12/31/81.

The policies issued were entirely hypothetical. We developed rates and values for these issues assuming:

(1) The 1980 Amendments to the Standard Valuation and Nonforfeiture Laws were always in effect, so that the valuation and nonforfeiture interest rates were based on then current new money rates.

(2) The "then current new money rates" were based on yields on seasoned corporate bonds, as published by Moody's.

(3) Reserves and cash values equal the minimums defined by these amendments.

(4) Pricing mortality (and experience mortality) always equal 100% of the 1965-70 Select and Ultimate tables.

Our results must be viewed in the context of these assumptions, and particularly the use of the 1980 Amendments. We believe this has a material impact on a company's exposure to the C-3 risk.

Finally, we were then in a position to test variations in future new money rates, over the next 40 years, which we have labeled the projection period. Our tests were of profitability, statutory solvency, and cash flows.

Because the C-3 risk is really the risk that asset and liability cash flows shift under various interest rate scenarios, so as to threaten solvency, the assumed variations with interest rates of asset calls, policy loans, and lapse rates are central to this study. The table below presents some sample rates that were used in the study.

SAMPLE ASSUMPTIONS

NEW MONEY RATE:	6%	10%	15%	20%	25%
LAPSE RATE (ISSUE AGE 45, POLICY YEAR 11+)					
MODERATE	2.0%	3.5%	5.4%	7.3%	9.2%
EXTREME	2.0	3.9	7.6	12.8	19.5
LOAN RATE (6% LOAN INTEREST, POLICY YEARS 13 THROUGH 18)					
MODERATE	14%	20%	27%	34%	41%
EXTREME	23	30	40	49	59

INTEREST SPREAD: (ORIGINAL LESS CURRENT)	0%	5%	1.0%	1.5%	2.0%	2.5%	3.0%
CALL PROBABILITY	0%	9.4%	15.0%	24.1%	38.8%	62.4%	95.0%

Our formulas for call probabilities, lapses, and loans were based on both AEtna and intercompany experience. For lapses and loans, we looked at two alternate formulas. We had started with the moderate lapse scale, but found that there was just no C-3 risk in increasing interest rate scenarios. We guessed at the time that our lapse rates did not react with enough volatility to increasing interest rates. Consequently, we developed the so-called extreme formula. As the table implies, this expression leads to very extreme lapse rates in the high interest rate scenarios. Similar comments can be made concerning the loan rates, though you'll note that the differences between moderate and extreme are not so great.

For calls, we assume virtually all assets will call when the spread between the current year's new money rate and the new money rate at the time the investment was made goes over 3%. There is, however, an assumed call protection period of five years.

I should note one more assumption before we proceed. Consistent with the direction of the C-3 Task Force, we assume that cash is borrowed when and if net cash flow for the year is negative. The alternative would be to assume assets have to be liquidated. As long as the borrowing terms are identical to what the investment terms would have been (which we do assume), the two approaches are equivalent on a present value basis. The timing differences are significant however, especially to tests of company solvency.

Cash Flows

An examination of cash flows will help to illustrate what the C-3 risk involves. The cash flows we have defined follow:

CASH FLOWS

ASSET CASH FLOWS:	
	NET INVESTMENT INCOME
	+ CALL PREMIUMS
	+ REDEMPTIONS
	+ MATURITIES
INSURANCE CASH FLOWS:	
	EXPENSES
	+ DEATH BENEFITS
	+ SURRENDER BENEFITS
	+ INCREASES IN POLICY LOANS
	+ FIT
	- GROSS PREMIUMS
	- POLICY LOAN INTEREST
DIVIDENDS PAID:	
	STATUTORY GAIN FROM OPERATIONS - FIT (IF POSITIVE)
CASH INVESTED:	
	ASSET CASH FLOWS
	- INSURANCE CASH FLOWS
	- DIVIDENDS PAID

Note especially that we have put policy loans and policy loan interest in with the insurance cash flows. For purposes of the C-3 study, we consider these to be associated with the business of insurance, as opposed to being a true part of the assets. Note also that the insurance cash flow as defined is positive when cash outflow exceeds inflow. The reason for defining it in this manner will be apparent.

We have also isolated shareholder dividends. We have assumed that any positive gain from operations after FIT is transferred out of the company, and we have labeled such cash out as a shareholder dividend. I will explain later our rationale for this.

Finally, the investment cash flow is the amount of cash invested if positive, or borrowed if negative.

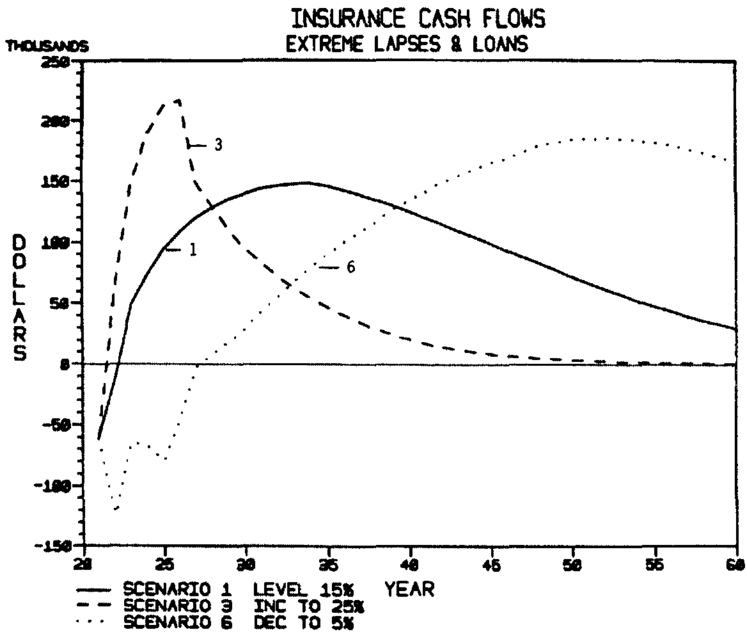
The cash flows I intend to illustrate correspond to the following new money rate scenarios:

PROJECTION PERIOD

NEW MONEY RATES

Year	Scenario 1	Scenario 3	Scenario 6
21 (1982)	15%	15%	15%
22	15	17	12
23	15	19	10
24	15	21	8
25	15	23	6
26+	15	25	5

The graph below vividly illustrates what happens to the insurance cash flows:



In the high interest case, insurance cash flows shoot upward, as lapses and loans take off. The insurance cash flows drop off quickly then, as the high lapse rates quickly shrink the in-force to virtually nothing. In the low interest scenario, just the opposite occurs: Lapses and loans fall as interest rates decline. In later years, the larger in-force relative to the other two scenarios leads to larger cash flows, from such things as death benefits, lapses and loans.

The in-force figures are dramatically different in these three interest scenarios, as is evident here:

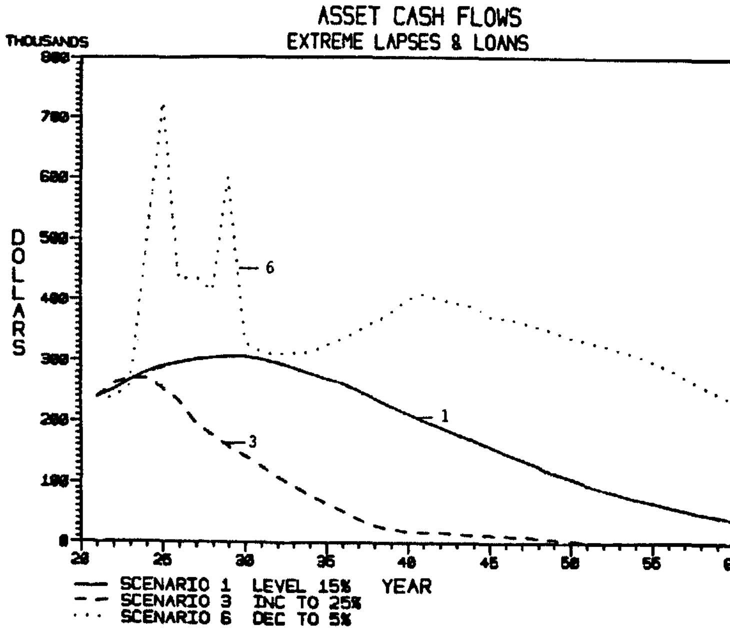
VOLUME OF INSURANCE IN-FORCE
(IN MILLIONS)

	DURATION				
SCENARIO NO.	20*	30	40	50	60
1 - LEVEL 15%	$22,282	$ 8,799	$3,325	$1,107	$ 294
3 - INCREASING TO 25%	22,282	3,454	329	28	2
6 - DECREASING TO 5%	22,282	14,028	9,553	5,717	2,730

*ASSUMED VALUATION DATE.

I should note that this assumes the extreme lapse adjustment formula. The results shown on the previous and following graphs would be similar, though less dramatic, had I used the moderate formula.

Now let's look at the asset cash flows. (Note that the scale changes.)



As expected, asset calls increase dramatically in the reducing interest scenario, creating spikes in the asset cash flow. The twin spikes result from the assumption of a five-year call protection period, combined with the past and projected new money rates.

Consistent with actual historical new money rates, our new money rates for 1962-1981 increase gradually from 4½% in the early 1960's, to 7% by 1969, then fluctuate around 8%-9½% throughout the 1970's, and then reach 11.5% and 13.7% in 1980 and 1981, respectively. Our average portfolio rate as of the valuation date is roughly 10%.

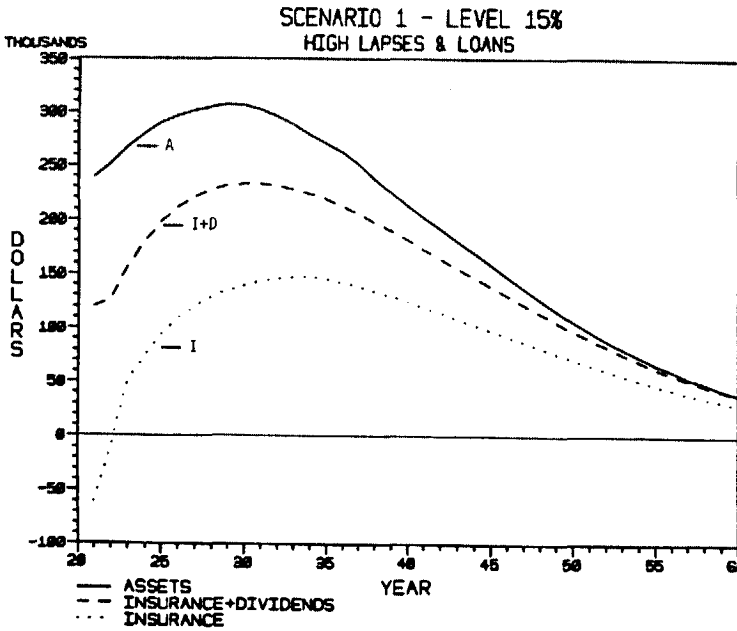
When new money rates decline from 15% in year 21 to 12% and then 10%, few assets call. In fact, these lower interest rates push asset cash flows below the base case. But then interest rates decline to 8% and then 6%, and virtually all assets call, forming the first peak. (Recall that when the interest rate spread between current and original goes over 3%, the call probability equals 95%.)

In the next year, new money rates decline to 5%, and yet the cash flow level is down considerably. This is entirely due to the 5 year call protection period; the investments made during the first peak cannot call for 5 years. When they do, we get the second peak.

In later years, the asset cash flows stay above the base case, largely because of the much larger in-force. Since interest rates are then level calls are no longer a factor.

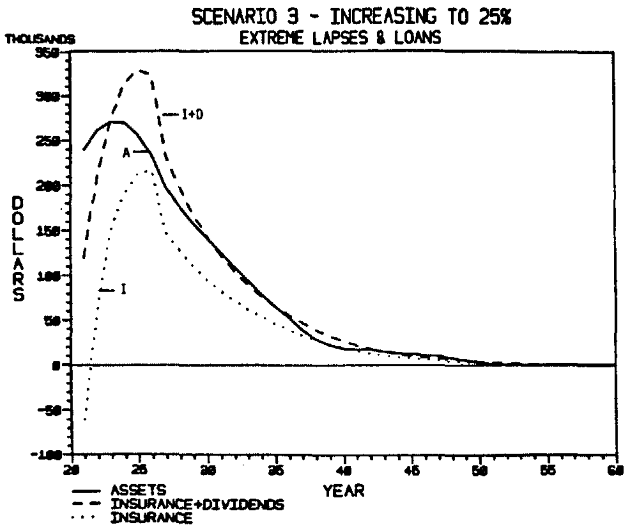
With increasing interest rates, there is a short period initially where the asset cash flows rise above the base case, which is due to the higher interest rates. But then these cash flows decline quickly. This reflects both the effect of borrowing at high rates but, perhaps more, the rapid decline of the book of business.

Let's look at the three scenarios one at a time now.



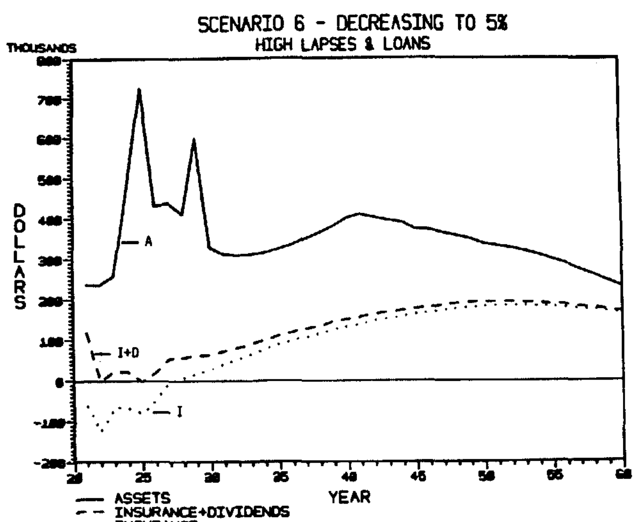
This graph shows the asset, insurance, and insurance plus dividend cash flows for the level 15% case. Note that the cash flows on the asset side are always sufficient to cover the insurance plus dividend cash needs, so that there is always positive cash to invest. I must admit that I was somewhat surprised that we always have so much positive cash flow. My explanation for it though is that the assumed rollover rate is 7-8% and the lapse rate is also 7-8%. The investment income from 15% new money rates then provides for plenty of cash to meet all other cash needs.

In the high interest scenario the situation is considerably different.



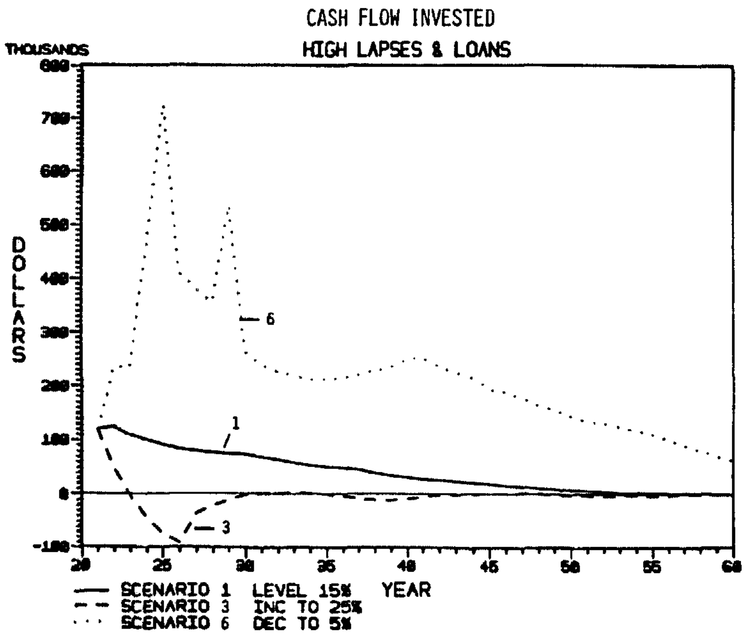
The total cash needs for the insurance side and for shareholder dividends have increased considerably in the early years, whereas the asset cash flows begin to drop off. The result is that we either must go out and borrow at those very high interest rates, or perhaps sell assets at large capital losses.

Now let's look at the decreasing interest scenario.



Here the asset cash flows react most dramatically. Due to the call provisions, in the assets, the assets all call as interest rates decline, producing a huge increase in the asset cash flow. At the same time, on the insurance side, lapse rates have declined considerably relative to the base case, and people are repaying policy loans. There is thus a huge amount of cash to invest at the very low interest rates.

The following graph nicely summarizes what the C-3 risk is all about.



In the increasing interest rate scenarios, the risk is a liquidity risk. Where the net cash is negative, we must go out and borrow at very high rates, or perhaps liquidate assets at a loss. With decreasing interest rates, the risk is an investment risk. Here the problem is that we have too much cash to invest just when interest rates are extremely low.

The nature of the lapse, loan and call provisions is such as to cause and to magnify these problems. In high interest scenarios, we need extra cash to cover the increased lapses and loans. In decreasing interest scenarios we have cash moving in from the asset side at the same time that the cash needs for the insurance side drop off.

Statutory Surplus Requirements

As Carl has already noted, the C-3 risk problem is to determine whether the assets supporting a block of business on a valuation date will be sufficient:

(1) To fund the obligations of the block of business over the entire period of the guarantees, and

(2) To assure that assets at each future valuation date will be sufficient to cover statutory reserve requirements on such dates.

Stated slightly differently, our task is to determine the amount of surplus, if any, that will prevent statutory insolvency under various interest scenarios.

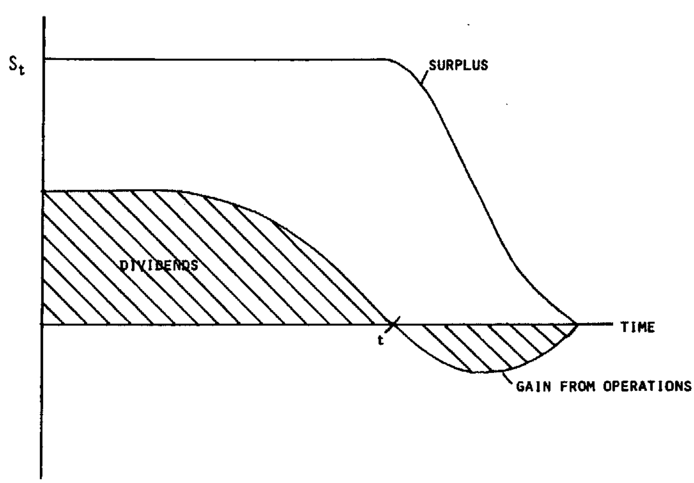
The Task Force directed that we assume no issues in the projection period. While this is a logical thing to do as a first step, it leads to some interesting problems. The main problem is that aggregate statutory gains from operations take off when new issues cease. These large gains in turn lead to very large amounts of surplus. In fact, this large surplus and the interest on the surplus become large enough so as essentially to eliminate any statutory solvency risk.

This simply is not realistic. For a going concern certainly, surplus would not be allowed to grow without bound; these gains from operations would instead be used to fund growth and/or pay dividends to shareholders.

To reflect this, we first tried to introduce a charge for funding new business. This proved difficult to do, given that interest rates vary, and that growth expectations would vary in different interest rate scenarios. Also, in years of negative gain from operations, it seems reasonable that management might take steps to reduce the amount of new business issued.

As a simpler alternative, we chose to assume that all positive gains from operations after federal income tax are paid out to shareholders, and any negative gains from operations after FIT reduce surplus.

The following picture illustrates what we have done. If at duration t an amount of surplus S_t is sufficient to cover all future losses, then S_t would be established as the required surplus. Our shareholder dividend policy is to pay out all gains prior to t.



The following table compares two approaches to dividends and provides a numerical illustration of the concept. With the dividend policy we have defined ("With Dividends" section), we need a great amount of surplus as of the valuation date to get us through the next 40 years. (Actually we probably need more to get us through the period beyond 60 years.) You can see though that the positive gains over the next 10 years go out as dividends and the losses thereafter reduce surplus.

COMPARISON OF SHAREHOLDER DIVIDEND POLICIES
(MODERATE LAPSE AND LOAN ADJUSTMENTS)

		WITH DIVIDENDS			WITHOUT DIVIDENDS	
YEAR	NEW MONEY RATE	SURPLUS	GFO AFTER FIT	DIVIDEND	SURPLUS	GFO AFTER FIT
20	13.71%	$787(43% OF RES.)	$ 83	$ 83	$187(10% OF RES.)	$ 83
21	15	787(40)	151	151	295(15)	108
22	11	787(37)	139	139	402(19)	107
23	7	787(34)	136	136	513(22)	111
24	3	787(31)	99	99	591(24)	78
25	3	787(29)	71	71	651(24)	60
26	3	787(28)	56	56	718(25)	67
27	3	787(27)	40	40	761(26)	43
28	3	787(25)	23	23	785(25)	24
29	3	787(24)	3	3	788(25)	3
30	3	787(24)	0	0	788(24)	0
35	3	729(20)	-18	0	730(20)	-18
40	3	618(17)	-25	0	619(17)	-25
45	3	475(14)	-31	0	476(14)	-30
50	3	316(10)	-32	0	317(10)	-32
55	3	154(6)	-32	0	156(6)	-32
60	3	5(0)	-28	0	7(0)	-28

The second set of figures reflects an assumption of no shareholder dividends. Here surplus starts off much smaller, builds to the same level as the first case, thanks to the large retained earnings in the early years, and then this large surplus is reduced at the same rate it is in the first case.

It should be clear then that there is no unique surplus requirement for the C-3 risk, as of the valuation date. The surplus required depends very heavily on the shareholder dividend policy chosen. Even the required surplus as of time t (year 30 in the above) depends upon the dividend policy. Although this amount is the same in the above comparison, it is easy to think of other dividend policies for which it would not be the same. For example, suppose there were dividends even in loss years (reasonable if our "dividends" are to include a charge for new business).

Our very simple shareholder dividend policy is merely the means to begin to study the C-3 risk. We firmly believe that by assuming no dividends, we would be seriously understating the risk as of a particular valuation date.

Results

The table below presents our basic results, for a set of simple interest rate patterns.

STATUTORY SURPLUS REQUIREMENTS

	BASE	INCREASING				DECREASING				
	1	2	3	4	5	6	7	8	9	10
	NEW MONEY RATES									
YEAR										
1982	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
1983	15	18	17	16	17	12	12	12	15	11
1984	15	21	19	17	19	10	10	10	15	7
1985	15	25	21	18	21	8	8	8	15	3
1986	15	25	23	19	23	6	6	6	15	3
1987	15	25	25	20	25	5	5	5	11	3
1988	15	25	25	21	27	5	4	4	7	3
1989	15	25	25	22	29	5	4	3	3	3
1990	15	25	25	23	31	5	4	3	3	3
1991	15	25	25	24	33	5	4	3	3	3
1992	15	25	25	25	35	5	4	3	3	3
1993-2022	15	25	25	25	35	5	4	3	3	3
	REQUIRED STATUTORY SURPLUS*									
LAPSE & LOAN RATE										
MODERATE	0%	0%	0%	0%	0%	0%	9%	40%	37%	43%
EXTREME	0	0	0	0	1	0	7	35	29	37

*AS A % OF RESERVE, AS OF THE VALUATION DATE.

The most surprising result here is the lack of any significant risk under the increasing interest rate scenarios. Note that this is true even with the extreme lapse and loan formulas, where as we saw earlier there are negative cash flows and consequently borrowing at high interest rates. Apparently, there are adequate statutory gains from other sources to cover the C-3 borrowing costs throughout the projection period.

One source of gain is the statutory gain upon lapse; given our assumed reserves and cash values ('80 Amendments, minimum values), the cash values are significantly lower than the reserves, creating a large statutory gain upon lapse. Another significant source of gain is the high interest rates relative to the valuation basis and pricing assumptions. Although this is of no help if cash flows are negative, cash flows are positive throughout the historical period and in the first few years of the projection period.

Still, we did not quite believe these results. We found some comfort by looking at asset market values. Our limited testing indicates that the market values of assets exceed the cash surrender values during the first five to ten years of the projection period, as long as interest rates are below 20-25%. Consequently, when people lapse, whether we go out and borrow or sell assets at their then market value, we are not in any trouble with respect to statutory solvency. In fact, the large gap between reserves and cash values gives us a large statutory gain in the year of lapse.

This fortuitous relationship between cash values and asset market values is largely a result of the structure of the cash values relative to the reserves. The book value of the assets equals or exceeds the statutory reserves. Although the market value of assets is certainly less than the book value of assets when interest rates have been rising, our cash values are so much lower than the reserves that the cash value is less than the market value of assets. In fact, in aggregate, the cash value is just 67% of the reserve as of the valuation date, where both are net of loans. This ratio increases to 78% in ten years and 84% in 20 years.

As noted earlier, this reserve/cash value relationship is largely a result of our use of the '80 Amendments, where the nonforfeiture interest rate is 125% of the valuation interest rate, and our use of minimum values. Another important factor is the large difference between reserves and cash values on recently issued policies where there is often no cash value for five years. These recently issued policies are heavily represented in the in-force as of the valuation date, due to the operation of lapse and mortality on the older issues, and due to the fact that we assumed the average size issued increased steadily over the historical period.

In summary then, our lack of significant risk under increasing interest scenarios is largely due to the relationships among cash surrender values, reserves, and market value of assets. I want to emphasize that this result would be unlikely for most companies currently, where cash values are much closer to reserves and market values of assets may be below cash surrender values.

Now consider the decreasing interest rate scenarios. In Scale 6, note that interest rates do not go below 5% and there is no surplus required. The average valuation rate for this block of policies is probably around 4½%. Furthermore, in pricing, we assumed interest rates would ultimately decrease to the 4-4½% level. As long as the interest rate stays above both the pricing and the valuation interest rate, one would not expect to have any threat to statutory solvency. The large shift in asset cash flows we saw before for this interest scenario is occuring, and will cause the average portfolio interest rate to decline dramatically; but it will not go below 5%. Thus, we have no statutory solvency problems here.

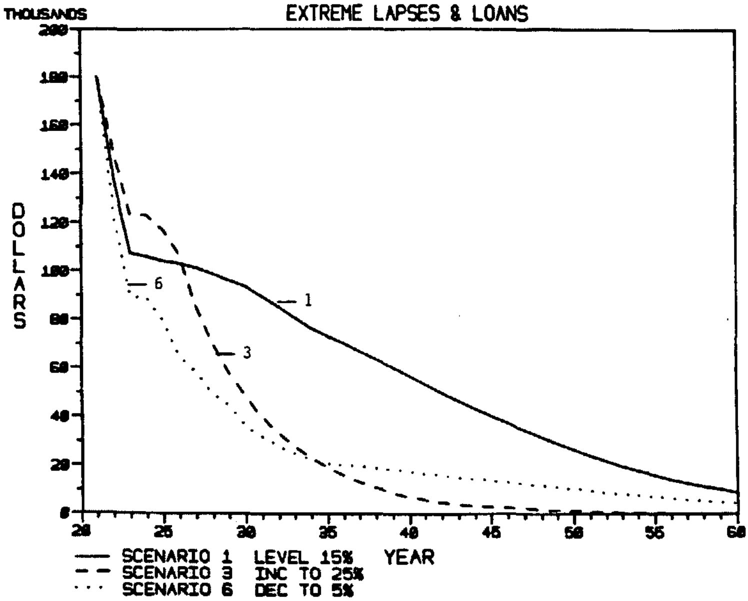
It is only when interest rates go below this 4½-5% level that we start requiring surplus. This is evident in scales 7-10.

We have also examined more exotic interest rate patterns, such as "up and down", "down and up", "up, down, up, down", and so on. The results are consistent with the above. There is minimal risk on upswings; on downswings, the risk is related to the length of time that new money rates remain below 5%.

Economic Costs

I noted that the C-3 risk poses a threat to statutory solvency only when the total statutory gain from operations is not sufficient to cover the C-3 risk costs. We saw that this was true in the increasing rate scenarios. To the extent that gain from operations is reduced though, profitability and, one could say, economic strength, is impaired. When interest rates increase, a company's need or desire to grow will likely be greater than it is in the level 15% scenario. If the reduction in economic strength prohibits such growth, the company has suffered a loss attributable to C-3 risk, even though it may remain technically or statutorily solvent. Let's look at one last graph.

4. DIVIDEND CASH FLOWS
EXTREME LAPSES & LOANS



For the increasing interest rate scenario, dividends increase initially due to the statutory gain upon lapse. But then dividends decrease as the effects of borrowing at high rates and the declining book of business take hold. In the decreasing scenarios dividends are below the 15% base case for all years.

We have not yet found a way to measure precisely or interpret these results. For example, with increasing interest rates, reduced dividend capacity should clearly be a problem. It may not be in the decreasing scenario though, as the company's growth and profit expectations should be lower in that environment.

Conclusion

Our general conclusion at this time is that in increasing interest environments, the greater risk is to economic strength, rather than statutory solvency. In decreasing interest scenarios, the reverse may be true, so that the greater risk is to statutory solvency.

Clearly, we have only scratched the surface of the C-3 risk as it relates to non par individual life business. We will be doing more work in the next few months, and I expect that we will have another opportunity to share our results with you.

MR. PAUL KOLKMAN: My comments are intended to summarize some of the work currently being planned to study the C-3 risk of products other than non-participating life insurance and guaranteed interest contracts. Since I am most familiar with the work related to the fixed deferred annuity line of business, the bulk of what follows will be devoted to that line. Comments concerning other products, such as participating life insurance and universal life, will be somewhat brief and general in nature.

The previous work on non-par life insurance and GIC's has defined a common framework within which the C-3 risk can be studied. The studies planned for fixed deferred annuities can best be summarized by describing the assumptions necessary to fit them into this common framework. The first step in the process is the historical development of an inforce block of annuity business.

The assumptions used to develop an inforce block of annuity business differ substantially from those used to develop an inforce block of life insurance. It is only within the past decade that the deferred annuity business has become significant for many companies. Thus the length of the historical period will be much shorter than that used for life insurance. A period of five to ten years is probably best. During this short period, the investment strategies of annuity writers have changed dramatically. Ten years ago, new annuity money was commonly invested in long-term securities. During the past two years, new annuity money was often held in very short-term investments. The development of our initial asset portfolio should reflect this changing investment strategy.

In determining the types of contracts to consider, we must distinguish between flexible and single premium business as well as between tax qualified and non-qualified business. The significant blocks seem to be flexible premium qualified and single premium non-qualified.

Contract design will be of the "no-load" type with a reducing surrender charge and a prospective one year guarantee of the benefit accrual rate. For pricing purposes we will assume that the new money rate is level in future years and set the initial benefit accrual rate so that, at issue, the present value of premiums equals the present value of benefits plus the present value of expenses. The present values are at a rate j which bears some desired relationship to the assumed new money rate. In future years we will maintain this initially desired relationship among the benefit accrual rate, j, and the developing investment year rate.

The underlying guaranteed cash values will be at statutory minimums. These will be superceded by the prospective one year guarantees. Statutory reserves will be the largest of the present values of the benefits guaranteed on each future policy anniversary, or the current cash surrender value if larger. Valuation interest rates will be determined according to the 1980 amendments to the Standard Valuation Law.

As for federal income taxes, the interaction of the contract design and valuation law should virtually assure that this block of business will always be in a phase II-negative tax situation.

The most important design assumptions are those concerning the relationship between the projected new money rates in each scenario and the future cash flows from inforce business. As interest rates rise, surrenders increase dramatically while premiums on flexible contracts begin to decline. These relationships will have to be carefully specified. Most companies lack good experience data in this area, and those that have developed data find that results differ widely among companies. Any study of the C-3 risk of deferred annuities will have to be based on a wide range of assumptions concerning the sensitivity of surrenders to interest rates.

The foregoing summarizes the assumptions needed to develop an inforce block of annuity business and its corresponding asset portfolio. Once this has been done, the same choice of scenarios and techniques used to study the C-3 risk for like insurance can be used for deferred annuities.

As for participating life insurance, it seems to combine historical development similar to non-par life insurance and some projection characteristics similar to deferred annuities. The similiarities to deferred annuities stem from the fact that the dividend scale directly affects the surrender and loan experience of participating insurance in a manner similar to that in which the benefit accrual rate affects the surrender experience of deferred annuities. Thus dividends become like fixed expenses during periods of disintermediation. By combining elements of non-par life insurance and deferred annuities, participating life insurance should prove to be one of the more difficult areas to study.

As for universal life, detailed studies are probably not worthwhile at this time. The product seems to vary widely from company to company and there is very little experience data to rely on. However, the conclusions of both the participating life insurance and deferred annuity studies could have some significance. To the extent that universal life is marketed as a tax-deferred investment, its C-3 risk should be analogous to that of deferred annuities. To the extent it is marketed as a low-cost flexible life insurance product in which continuing premiums are encouraged, its C-3 risk may be more analogous to that of traditional participating life insurance.

MR. HOWARD H. KAYTON: My role on this panel is to explore the implications to actuaries of the measurement of the C-3 risk. Specifically, I will consider the impact on selecting and pricing insurance products, and on determining the financial position of life insurance companies.

Pricing of life insurance products entails the quantifying of each risk increased by an element of expected profits. We have identified the C-3 risk as an important factor in the financial well-being of a life insurance company; we have also listened to several ways of quantifying this risk. It is now appropriate to consider how the C-3 risk affects our product selection and pricing.

Assume that we include an annual charge in our profit studies or asset shares to enable us to build up sufficient assets to withstand what we believe to be a reasonable contingency, much as we establish catastrophe reserves or term conversion reserves. The problem that a company faces is the same as that faced by a new casualty insurance company wanting to insure jumbo jets; it may build up too little, too late. Also, of course, the development of the charge is totally dependent upon the selection of scenarios used in determining the annual charge, and the level of confidence desired.

Because of this, a company may want to limit the selection of products to those that are appropriate for its given level of surplus. A company issuing a diversified line of products may be better able to cope with the C-3 risk than a specialized company, for a given level of surplus. However, this goes against the trends in the industry, where because of inflationary costs, companies are tending more toward speciality lines than toward multi-line sales efforts. Instead of restricting a product line, a company may also protect itself by seeking reinsurance. I have not yet heard of the formation of the C-3 Reinsurance Company, but its application is probably close on the heels of the Mod-Co Reinsurance Company's application.

A company may also choose to avoid the C-3 risk entirely by shifting the risk to the policyholders. It cannot do this with competitively designed fixed products because of inflexible nonforfeiture laws, but it can shift into variable products, where the policyowner assumes all three investment risks. Another alternative that should be explored is the possibility of modifying the nonforfeiture laws to allow companies to issue fixed products that are not C-3 resistant, and therefore are less costly, but permit companies that can demonstrate adequate provision against the C-3 risk to advertise that fact. This would be similar to allowing companies to advertise use of the net level reserve basis versus the CRVM reserve basis. I'll explore an extension of this later.

Carl has already discussed the New York approach to valuations and actuarial opinions. This aproach can also be called the "encouragement approach." However, I would expect it to change rapidly to a mandatory part of the actuarial opinion. For those of us in smaller companies, even the New York approach is a problem. Our companies are put at a competitive disadvantage because of not being able to commit the resources to do what may be considered an adequate test. What alternatives exist?

The most appealing to all, including the regulators, would be a rule of thumb, such as product type "x" needs a surplus ratio of 15%, product type "y" a 5% ratio, and the requirements are additive. We are far from being there, although I'm sure we can get a lot further than we are. What is more likely, though, is that the actuaries of smaller companies will face up to the problem by doing less exhaustive tests than those described here, but they will at least make their managements aware of the problem. This itself is a remarkable leap forward.

In the future, actuaries certifying to the reserves of a life insurance company will have to include a statement such as "I have performed the actuarial tests necessary to conclude that the reserves make adequate provision to protect against the possibility of failure due to decreases in the value of the assets under likely economic conditions." Obviously, the development of standards for such an opinion raise many questions:

(a) What type of scenarios are appropriate for such tests? Would anyone in 1979 have used a scenario for 1980 and 1981 that approached what actually happened? What probability would have been assigned to that scenario?

(b) To what degree can we rely on economists? Could the opinion be qualified to read: "In reliance on Miltion Friedman's Scenario #43, dated 12/15/81..........?"

(c) What degree of assurance do we use? Is it sufficient to be 95% certain?

(d) How do we develop reliable models tying economic conditions to human behavior? As actuaries, we substitute facts for appearances. Does anyone have a factual model that ties policy loans to interest levels? Are historical relationships of any value?

(e) Are we required to issue an altered opinion during the year if our scenario's likelihood falls precipitously?

(f) Will the use of an adverse opinion put our industry at a competitive disadvantage with other financial institutions? Do S&L's have to protect against the C-3 risk?

(g) What impact will such opinions have on the general public? Can they understand the nature of the risk that we are evaluating? I remember being called many years ago by a knowledgeable investment analyst, when the GAAP audit guide was being discussed. He had heard that life insurance companies were adopting a new form of reporting that would increase their values substantially. He wanted me to confirm the rumor.

There is still another problem facing the actuary. We are now faced with the possibility of a company's value changing rather abruptly based on economic conditions. This is actually closer to the truth than what we had in the past. Our reporting systems have been geared to a very stable industry writing very stable products. As we began to compete more aggressively, we forgot to modify our reporting accordingly.

As far as the annual statement is concerned, the major questions is: How do we present the provision against the C-3 risk? Is it a reserve, allocated surplus or a contra-asset? This is a problem that the NAIC or AICPA will probably decide. Our only concern here is that we avoid double counting. If provision is made in the annual statement for such a contingency, then the "free surplus" needs should be diminished accordingly.

Let me now turn to a subject that is either enlightening or heretical, depending on your employer. I would like to consider whether a life insurance company has a right to fail.

Assume that a company's product development committee desires to issue product "k". Profit studies show it to be very profitable under several very likely economic scenarios. However, using its most likely projected sales volume and several less likely scenarios, the product will cause the company to be insolvent.

Clearly, a very conservative company would refuse to issue such a product. A less conservative company might issue it, but put a maximum on its sales volume until it can generate sufficient surplus to cushion against the possibility of insolvency. A most aggressive company (particularly a desperate company) might weigh the risks against the gains and decide to go ahead on a very aggressive basis.

Several of my colleagues believe that the life insurance industry does not have the "right to fail." They believe that we are vested with public trust, and therefore are committed to higher standards than automobile manufacturers, or investment counselors, or stockbrokers. Yet, we are in the risk business. So how much risk is permissible? Are we required to sell a policy on a basis where we can sustain every conceivable catastrophe? Can a company marketing solely in Los Angeles sustain a major earthquake? Can every company writing group insurance sustain a catastrophic industrial accident? What level of confidence must we have against failure? Is one chance in a million acceptable? How about one chance in a hundred?

Finally, shouldn't the public be permitted to purchase insurance at a lower cost if it is willing to risk a higher possibility of company failure in the same way that an investor can achieve a higher return if he or she is willing to assume some risk of capital loss? Could we develop a system similar to Best's (or Moody's) which gives a company an A+ risk rating for an actuarial opinion of 99.999% assurance against failure, an A risk rating for a 99.990% assurance, and so forth?

Before we dismiss this as frivolous, isn't this closer to the truth than we accept? A company starting out has no track record. It develops a product line based on assumptions as to mortality and interest, estimates expenses based on an assumed level of sales, builds in margins, and embarks on its sales program. In today's environment, we as actuaries are not asked to evaluate the likelihood that a business plan will succeed. We do however, pray for it to succeed, and hopefully look to sufficient surplus to cushion an adverse result. Couldn't we also approach the C-3 risk from the same viewpoint? If we get too concerned with protecting against the C-2 risk, will this be putting the damper on product innovation, either at product development time or, after a successful sales effort, at the time of valuation? Suppose a company is willing to take the risk, and fully understands the contingencies. Shouldn't it be allowed to fail?

I have probably raised more questions than I've answered. But then again, the previous speakers answered more questions than they asked. I, too, am very concerned about the potential hazards of the C-3 risk. In the March, 1982 Actuary, Jim Anderson's disturbing paradox is an alarming allusion to the C-3 risk (although it is very subject to misinterpretation).

I hope that our present focus on the C-3 risk will cause product actuaries to be more aware of this potential hazard, and design products that stress protection and income, rather than liquidity. This would be the best reaction to our panel's presentation, because this would treat the cause rather than measure the progress of the disease.

As actuaries, let's switch our effort from finding ways of avoiding onerous statutory requirements, and instead put the effort into designing products that avoid the problems that the requlations are seeking to prevent.

MR. CARL B. WRIGHT: Jim Geyer's work basically confirms what actually happened in my company in 1981. The rising interest rates led to increased lapse rates which, because of the differences between reserves and cash values, produced substantial statutory profit. Although we may not have a statutory solvency problem, we most certainly had a GAAP profit problem. In addition, we had a fairly severe cash flow situation. On a statutory basis, we had no problem declaring a dividend to our parent, but we experienced difficulty in actually paying it due to reduced cash flow.

I would like to present another scenario for your thoughts and possible testing. As interest rates rise, we product development actuaries are pressured to improve our premium rates. At the same time, we are making an effort to improve our conservation of business by allowing it to roll over, or be internally replaced, into our new products. This would seem to solve our cash flow problem, but now introduces a potential solvency problem. As this business rolls over, we still have the same low interest bearing assets, but now they are trying to support much higher interest assumptions. Thus, as interest rates rise, we actually may conserve ourselves into a down rate scenario without even realizing it, and there may be a significant unprovided C-3 risk that is deferred to the future. I suggest that, as you perform other tests, you take a look at this type of scenario.

MR. GEYER: You can compare that scenario to the situation of negative cash flow, where we go out and borrow, in a way deferring the pain. We will have to pay the high interest cost in all future years, but we have avoided captial loss in this particular year. What you're really saying is that instead of borrowing from the investment markets, we should borrow from our policyholders. In a way, you're getting cash back from them to pay out the surrender values, and you take it back and give them a better deal or higher guarantees. I'm sure that this increases your C-3 risk to the extent that you've decreased the profit margins. These profit margins are largely keeping us out of trouble, and if you take steps that decrease them you're subject to more risk in future years.

MR. KAYTON: Our company markets individual annuities, and of course individual annuity companies have faced this problem quite dramatically in the last few years. Our answer to it went back to product design. For the last year our major product is one which the customer can replace once, but once they buy this new one they cannot replace it quickly. It is an annuity in which half the funds cannot be surrendered; that amount can only be taken out in the form of annuity payouts. The contract actually states that the buyer is giving up his right to total cashout: he is irrevocably committing that these funds will eventually be paid out in the form of an annuity. We've been offering it for eighteen months and it has been selling. It doesn't sell as well as a product you can cash out completely the next day or twenty-one days later, but it is selling. It has a twenty-day free look and I am happy to say that most of the policies continue beyond twenty days.

SUPPLEMENT

C-3 Risk Calculations for Non-Participating Whole Life Insurance

James A. Geyer and Michael E. Mateja

I. Introduction

This paper presents the results of AEtna's work to date on the analysis of the C-3 risk for Non-Par Individual Life Insurance. The primary purpose is to describe both the conceptual and practical approach that we have developed to analyze the C-3 risk for Non-Par Whole Life Insurance. This work has been performed at the AEtna under the general direction of Bob Miller, a member of the Society's C-3 Task Force.

At a practical level, during the last 6 months, we have developed a very sophisticated model for a Non-Par Individual Life operation. The model provides great flexibility in the choice of assumptions that determine the results of both insurance and investment operations. On the investment side, for instance, we have the ability to vary the interest rate, maturity and rollover pattern by calendar year of investment. On the insurance side, we are able to keep track of all cash flows in great detail. This model was adapted from an even more generalized model office that was in the development process at the time that Mr. Miller accepted responsibility for the second stage C-3 work.

We have expended considerable effort in reaching an understanding of how to put dimension on the C-3 risk. Our understanding in this regard has changed rapidly as we have examined the results of various tests, and we anticipate further changes to occur as we complete additional tests and analysis.

We have included initial numerical results consistent with our present understanding of the C-3 risk, but they must be qualified as preliminary. Moreover, the results must be viewed in the context of the model we have constructed and may not be representative of any particular company's actual exposure to the C-3 risk.

Many individuals at AEtna have contributed to various stages of our overall effort. Jim Bridgeman and Nick McCleod laid the groundwork for the Model Office system over two years ago. Linda Crout and Alastair Longley-Cook began the actual process of building the model and adapting it to the C-3 risk study. Bob Partridge from the AEtna Operations Research staff directed the systems design and programming. Jim Geyer replaced Mr. Longley-Cook during the final stages of checking the model and directed the effort to organize and interpret the results. Linda Crout and Diane Arndt devoted considerable time in the past month generating and regenerating last minute results. Mike Mateja is manager of the Corporate Actuarial unit where the work was done and was involved with the project from the start.

II. C-3 Risk Defined

Before venturing into the realm of the C-3 risk, it is essential that we have a clear idea of just what constitutes a C-3 risk.

The C-3 risk problem, as has been described by Mr. Ohman, is to determine whether the assets supporting a block of business on a valuation date will be sufficient:

(1) To fund the obligations of the block of business over the entire period of the guarantees, and

(2) To assure that assets at each future valuation date will be sufficient to cover statutory reserve requirements on such dates.

Such determination must recognize the current configuration of the company's assets and an appropriate range of future changes in interest rates.

In our early thinking, we found the distinction between C-2, the pricing inadequacy risk*, and C-3 risks to be fuzzy in some respects. For example, if we price assuming a 10% level interest rate, and actual interest rates drop to 3%, is this a C-3, or a C-2 problem? The C-3 Task Force has defined this problem to be a part of the C-3 risk. Basically, all consequences of fluctuating interest rates are considered C-3. C-2 then is defined as the pricing inadequacy risk, other than those defined as C-3.

A similar problem exists with expenses. If very high interest rates are projected, it is natural to assume that expenses will be correspondingly inflated. Is this a C-2 or a C-3 problem? Within the context of the C-3 Task Force's definition, we think this is a part of the C-3 risk because of the tie-in to interest rate levels.

III. Methodology

We have assumed that we are looking at a life insurance operation as of year-end 1981, the valuation date. The period 1962 through 1981 is defined as the historical period and the 40 year period subsequent to 1981 is defined as the projection period.

The in-force block of policies as of the valuation date was developed by issuing a constant number of policies during the historical period, and tracing the persisting policies forward.

* In the Preliminary Report of the Committee on Valuation and Related Problems (referred to as the Trowbridge Report--Record of the Society of Actuaries, Volume 5, No.1, Pages 241-84), three types of risks were defined: C-1 is the risk of asset default; C-2 the pricing inadequacy risk, i.e., the risk that actual experience will be less favorable than originally assumed at pricing; and C-3, the risk of fluctuating interest rates.

III. Methodology (Contd.)

The investment portfolio as of the valuation date was developed by investing cash flows from both insurance and investment operations in debt instruments with an average life of 12 years. This is representative of a combination of longer term bond and mortgage investments.

The in-force book of business and supporting assets as of the valuation date were projected forward under various interest scenarios. We have assumed no new issues during the projection period.

Accounting within the model follows the NAIC statement. The only noteworthy issue is the treatment given to negative cash flow in a given year. If the net cash flow is negative, we assume that assets will not be liquidated to produce capital gains and losses. Instead, we assume money is borrowed at the then current new money rate and on the same maturity terms as investments. The result is consistent with actual investment experience for a company that allocates interest among lines on a select and ultimate basis and maintains a positive cash flow in total so that a line with negative cash flow may borrow from a line with positive cash flow. This approach is conceptually equivalent to raising cash through asset sales, but the capital gains or losses are spread over time. The spreading approach is believed to be both reasonable and realistic for large, multi-line companies, but perhaps not for smaller companies. If outside borrowing is necessary, the borrowing terms would affect results, and in extreme situations, assets sales could be required.

IV. Statutory Surplus Requirements

Consistent with the direction of the C-3 Task Force, our initial goal was to develop a statutory balance sheet for a block of individual life policies, and determine the amount of surplus as of the valuation date that would prevent insolvency under the various interest scenarios.

The Task Force further directed that we assume a going-out-of-business scenario, i.e., that we assume no issues in the projection period. This approach is the logical first step in getting a handle on the C-3 risk. It simplifies the work considerably, but very much affects and to some extent complicates, the interpretation of the results.

Not surprisingly, we found that the assumption of no new issues and the relationship of "actual" interest rates to valuation interest rates produced very large statutory gains from operations in the early years of the projection period. These gains reflect the flow of statutory earnings under a non-par life plan and represent a combination of repayment of surplus originally invested in the business, and the actual return on that surplus. When these gains were retained, very large surplus levels were

IV. Statutory Surplus Requirements (Contd.)

developed in the early years of the projection period. In our initial tests it became clear that the surplus and the interest thereon grew to be so large (usually exceeding the statutory reserve) as to essentially eliminate any statutory solvency risks during the projection period.

Recognizing that surplus would not be allowed to grow without bound, we concluded that it would be necessary to introduce a going-concern concept into the management of the surplus account. For a going-concern operation, once surplus is at a satisfactory level, any additional gains from operations would be used to fund growth and/or pay dividends to stockholders*. For simplicity, it is sufficient at this point to assume that any amounts removed from the surplus account are dividends.

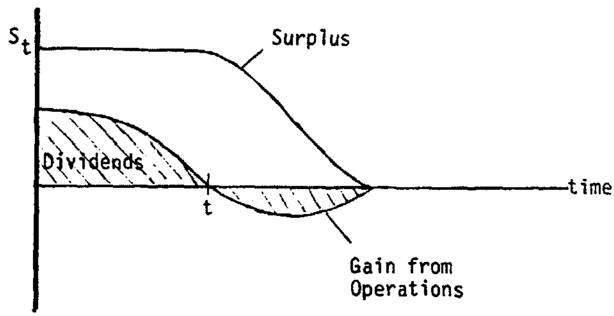
From a practical standpoint, we found that there are two basic approaches for managing the surplus account consistent with our goal to analyze the C-3 risk. On the one hand, the amount of surplus can be fixed at any reasonable level at the beginning of the projection period, and a shareholder dividend policy can then be determined to assure solvency. On the other hand, the shareholder dividend policy can be defined, and then the amount of surplus required to both support this policy and assure solvency throughout the projection period can be determined. Thus, there is no unique solution to the amount of surplus required to manage the C-3 risk. A unique surplus solution can only be defined relative to a shareholder dividend policy.

We chose the second approach above. Our shareholder dividend policy was to release all statutory gains after FIT, and our goal was to find a surplus level to support this policy, mature all benefits, and maintain statutory solvency throughout the projection period.

* We recognize that there may also be Phase III tax implications under these circumstances. In the interest of simplicity we have ignored this complication at this time.

IV. Statutory Surplus Requirements (Contd.)

The following diagram may be helpful in understanding the approach:



If at duration t an amount of surplus, S_t, is sufficient to cover all future losses, then S_t would be established as the surplus target level prior to time t, and the shareholder dividend policy would cause all gains prior to t to be paid out.

We recognize that our shareholder dividend policy is somewhat arbitrary and probably not representative of any company. Still, it does not appear to be grossly off, and in any case, serves as a starting point for the analysis.

V. Economic Strength vs. Statutory Solvency

In attempting to measure the C-3 risk, our first concern has been statutory solvency, and we have calculated surplus requirements as described above which will assure statutory solvency. In the process, we quickly realized that the full impact of the C-3 risk goes beyond the solvency test. Shareholder dividends vary much more dramatically among the various interest rate scenarios than the C-3 surplus requirement. Clearly, the fact that the level of shareholder dividends varies indicates variation in economic strength. If these dividends have to be reduced significantly in a given interest scenario, the company's ability to grow and/or compete effectively would be impaired, although it may remain technically solvent. This is a very real part of the C-3 risk. For this type of business it may be the major part.

In the work done last year by Mr. Tilley on guaranteed interest contracts, the issue of economic strength did not arise. It was possible to focus entirely on the surplus required to manage this mismatch risk and understand the total costs associated with the risk. This is because there were no sources of gain and loss other than interest.

V. Economic Strength vs. Statutory Solvency (Contd.)

With individual life business, we routinely expect statutory gains other than interest gains in renewal years. These gains can and would be used to cover C-3 risk costs. To the extent that total gains are reduced by C-3 risk costs, the reduction would represent an economic loss. By focusing only on statutory solvency such economic losses are obscured.

Within our model the economic loss associated with the C-3 risk is first evident in a reduced level of shareholder dividends. In fact, C-3 surplus is required only when total C-3 costs exceed the gains from operations that would otherwise occur.

This led us to the conclusion that the way to approach measuring the full economic costs associated with the C-3 risk is to compare the present value of the dividends to shareholders under various future interest scenarios. Although these present values are very greatly affected by the varying lapse rates and the absolute magnitude of the interest rates, this is all part of the C-3 risk, as defined by the C-3 Task Force. We computed several present values on this basis, and the results have helped us to understand the total costs associated with the C-3 risk.

Another approach to understand the C-3 risk is to directly examine the actual cash flows. This gets us away from the statutory balance sheet, except to the extent that statutory assets and liabilities determine the shareholder dividend paid out, which is a "real" cash out-flow.

For this purpose, the actual cash flows have been defined as follows:

CFA_t = Cash flow in year t generated by the assets owned. This includes net investment income, call premiums, redemptions, and maturities. It does not include policy loan interest.

CFI_t = Cash flow in year t generated by the insurance policies. This equals expenses plus death benefits, surrender benefits, increases in policy loans, and FIT, minus gross premiums and policy loan interest.

DIV_t = Dividends to shareholders in year t.

INV_t = Dollar value of cash invested at the end of year t. This is equal (CFA(t) - CFI(t) - DIV(t)). If negative, this amount is borrowed.

A close study of these cash flows reveals a great deal about what happens to create C-3 risk. As long as INV_t is close to zero the C-3 risk is small. If INV_t is a large positive, i.e., the

V. Economic Strength vs. Statutory Solvency (Contd.)

total cash inflow exceeds cash outflow, the C-3 risk is the investment risk. Any reduction in the level of the overall investment return because of the need to reinvest at low rates may be considered a manifestation of the C-3 risk. In a declining interest rate scenario the investment problem is exacerbated due to the call provision in the investments.

If INV_t is a large negative, i.e., the total cash outflow exceeds cash inflow, the C-3 risk is the liquidity risk. Any reduction in the level of the overall investment return because of the need to borrow at high rates may be considered a manifestation of the C-3 risk. In an increasing interest rate scenario, the liquidity problem is exacerbated by increasing lapses and loans.

These are certainly not revolutionary or even new thoughts. Still, they are the key to what really is driving the C-3 risk. Consequently, we have analyzed the shifts in the patters of these cash flows under the various future interest scenarios. The results have confirmed our understanding of the C-3 risk.

VI. Assumptions

Development of both the in-force book of business and the investment portfolio required an extensive number of assumptions which are presented in detail in the Appendices. At this point it is important to note that the major factors affecting asset and liability maturities within the model are dynamic and vary with the level of the assumed interest rate. Thus, loans and lapses increase as interest rates increase, and investments are called with greater frequency as interest rates decrease from levels at the time the investment was made. This is illustrated in the following table:

New Money Rate:	6%	10%	15%	20%	25%
Lapse Rate (Issue Age 45, Policy Year 11+)					
Moderate	2.0%	3.5%	5.4%	7.3%	9.2%
Extreme	2.0	3.9	7.6	12.8	19.5
Loan Rate (6% Loan Interest, Policy Years 13 through 18)					
Moderate	14%	20%	27%	34%	41%
Extreme	23	30	40	49	59

Interest Spread: (Original less Current)	0%	.5%	1.0%	1.5%	2.0%	2.5%	3.0%
Call Probability	0%	9.4%	15.0%	24.1%	38.8%	62.4%	95.0%

VI. Assumptions (Contd.)

Since loan and lapse rates are the major factors that change liability cash flows, we had an immediate interest in determining the effect on required surplus levels of variations in these rates. The two sets of loan and lapse rates we have chosen provide some basis to understand the sensitivity in this regard.

Although expense inflation may be considered part of the C-3 risk as discussed in Section II, we felt it was necessary to produce results eliminating the unit expense adjustment within our model. We had two reasons for doing this. First, the expenses in later years under the high interest rate scenarios became so large as to obscure any manifestation of the C-3 risk. Secondly, if one assumes other than a going-out-of-business analysis, a company's normal growth may be enough to control unit expense inflation. For the moment we have chosen to simplify the analysis by ignoring future expense inflation. The Task Force will certainly want to raise this issue in its future studies, and especially when the C-2 and C-3 risks are studied together.

It is also important to understand that we have assumed that the 1981 amendments to the Standard Valuation and Nonforfeiture Laws applied throughout the historical period. Minimum reserves and cash values have been determined in accordance with these amendments. The use of minimum values and the 1.00-1.25% difference in interest rates imply that cash values are significantly lower than reserves. This in turn produces material gains upon surrender at all durations.

VII. Results

A. Statutory Surplus Requirements

The statutory surplus requirements to assure solvency throughout the projection period are presented below. As explained in Section IV, we assume that all statutory gains after FIT are paid out as dividends. A different shareholder dividend assumption could produce materially different surplus requirements.

Required statutory surplus is expressed as a percentage of the statutory reserves (including policy loans) as of the valuation date (12/31/81). Required surplus was developed for 16 different interest scenarios assuming both the moderate and extreme lapse and loan formulas. All scenarios begin with an interest rate of 15% for 1982.

The first set of results presented in the following table are based on simple increasing or decreasing interest rate trends to high or low ultimate rate levels respectively.

VII. Results (Contd.)

A. Statutory Surplus Requirements (Contd.)

	Base	Increasing				Decreasing				
	1	2	3	4	5	6	7	8	9	10
	New Money Rates									
Year										
1982	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
1983	15	18	17	16	17	12	12	12	15	11
1984	15	21	19	17	19	10	10	10	15	7
1985	15	25	21	18	21	8	8	8	15	3
1986	15	25	23	19	23	6	6	6	15	3
1987	15	25	25	20	25	5	5	5	11	3
1988	15	25	25	21	27	5	4	4	7	3
1989	15	25	25	22	29	5	4	3	3	3
1990	15	25	25	23	31	5	4	3	3	3
1991	15	25	25	24	33	5	4	3	3	3
1992	15	25	25	25	35	5	4	3	3	3
1993-2022	15	25	25	25	35	5	4	3	3	3
	Required Statutory Surplus									
Lapse & Loan Rate										
Moderate	0%	0%	0%	0%	0%	0%	9%	40%	37%	43%
Extreme	0	0	0	0	1	0	7	35	29	37

Following are several observations based on these results:

(1) There is no C-3 surplus required for the level 15% scenario. This was not an unexpected result since the 15% assumed interest rates in the projection period significantly exceed the 4-5% valuation interest rate as well as the interest rates used in pricing. Under these circumstances there will be substantial interest gains if there is positive net cash flow. There was in fact substantial positive cash flow throughout the projection period.

(2) There is little or no C-3 surplus required for the increasing interest scenarios even when interest rates and loan and lapse rates reach extreme levels.

The risk in this case is that liabilities shorten, i.e., loans and lapses increase, creating a need to borrow at high rates relative to the invested assets. While this in fact occurs in these scenarios, gains from other sources are sufficient except in the most extreme case to offset C-3 costs as they materialize.

VII. <u>Results (Contd.)</u>

A. <u>Statutory Surplus Requirements (Contd.)</u>

Significant sources of gain are very high interest yields relative to both the valuation and pricing basis, and the difference between statutory reserves and cash values which produces statutory gains upon lapse.

This result was somewhat surprising. The explanation lies in the relationships among cash values, reserves, and market value of assets. As would be expected, the asset market values are significantly lower than the reserves in these increasing scenarios. Our cash values are so significantly below the reserves however*, that they are actually even below the asset market values. (See Section VII F for further details.)

In scenario 5, where interest rates go to 35%, the asset market values do ultimately drop below the cash values. By the time this happens, however, the in-force has dropped so precipitously, that only minor amounts of surplus are required, relative to the 12/31/81 reserves.

It is important to note that these results are probably not representative of the C-3 risk for a real-life company. In reality, most companies' cash values are much closer to their reserves, both of which will exceed the market value of assets as interest rates increase. Thus, the actual C-3 risk for a real-life company in increasing interest scenarios is likely to be considerably greater than indicated by these results.

(3) In the decreasing interest scenarios, there is no C-3 surplus requirement until interest rates fall and remain below the valuation interest rate, which averages between 4 and 5% for this block.

Because of the operation of the call provisions, assets shorten dramatically. Average yields drop very quickly, but, of course, the average yield never falls below the lowest assumed new money rate. Statutory interest losses would not occur as long as the aggregate yield exceeds the average valuation interest rate.

*At year-end 1982, the cash value is 72% of the reserve, 62% if policy loans are taken out of both! Even 10 years later, the percentages are 82% and 70%.

VII. Results (Contd.)

A. Statutory Surplus Requirements (Contd.)

(4) The C-3 surplus required in the decreasing scenarios appears to be related to the loss of investment income on assets.

From a visual inspection of the last four scenarios, it seems likely that the greatest loss of investment income on assets would be for scenario 10 followed in turn by scenarios 8, 9, and 7. Actual results are consistent with this observation and is reflected in the ranking of the surplus levels. It is also noteworthy that the rate of decline is not as important as the timing of the decline.

(5) In the decreasing interest scenarios, the surplus requirement is lower with the extreme loan and lapse formulas.

This is to be expected. Lower lapse rates imply a larger in-force for which we are guaranteeing 4-5% and earning 3%. Lower loans hurt since the policy loan interest rate exceeds the later years' new money rates.

It is clear that we have significantly more work to perform in this area. There is a clear need to study variations in the assumptions that determine both insurance and investment cash flows, and in the end, we need to get a better handle on exactly what is driving our various results. The next section is our initial attempt with respect to this last point.

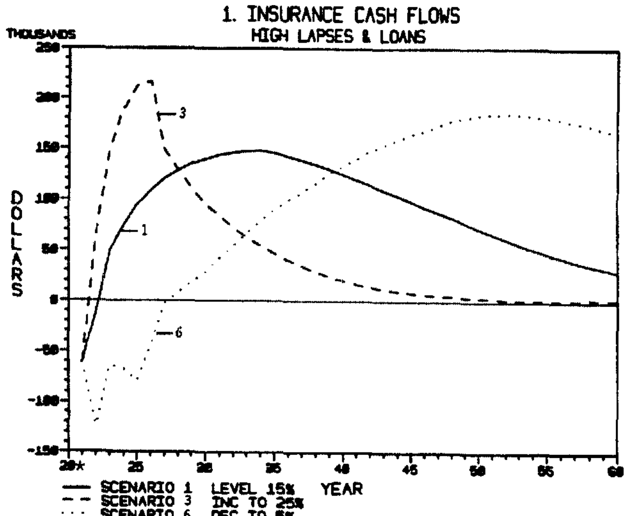
B. Cash Flows

We have found that the analysis of cash flows provides great insight into the dynamics of the C-3 risk, and we have prepared a series of graphs that clearly illustrate the changing relationships of asset and liability cash flow.

VII. Results (Contd.)

B. Cash Flows (Contd.)

Graph 1 illustrates the effects on insurance cash flows:



*The assumed valuation date is duration 20.

As expected, liabilities shorten in the increasing interest case, i.e., cash outflows in the earlier years are materially greater than in the base case and cash flows in later years are less. In the decreasing interest scenario, exactly the reverse is true.

The early years' results clearly reflect the effects of materially different loan and cash surrender rates. For later years' results, the relative size of the in-force is key. For example, in the high interest scenario, high lapse rates produce high early cash outflows, but persistent high lapse rates shrink the in-force so that the total insurance cash flow quickly tends towards zero. In the low interest scenario, death benefits on the larger in-force in the later durations become material.

VII. Results (Contd.)

B. Cash Flows (Contd.)

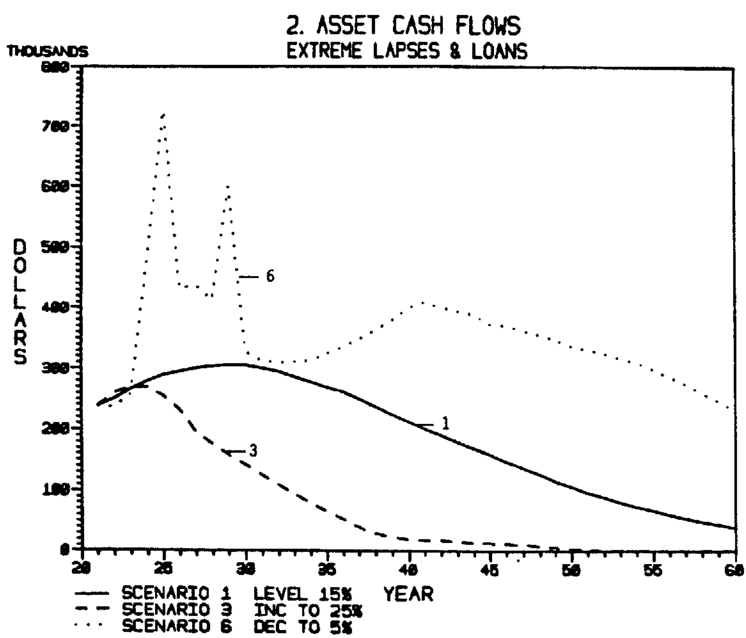
The following figures present a clear picture of just how significantly the in-forces differ for these three scenarios:

Volume of Insurance In-Force
(in Millions)

Scenario	Duration 20*	30	40	50	60
1 - Level 15%	$22,282	$8,799	$3,325	$1,107	$ 294
3 - Increasing to 25%	22,282	3,454	329	28	2
6 - Decreasing to 5%	22,282	14,028	9,553	5,717	2,730

* Assumed valuation date.

Graph 2 provides corresponding asset cash flows for the same interest scenarios (beware the change in scale):



VII. Results (Contd.)

B. Cash Flows (Contd.)

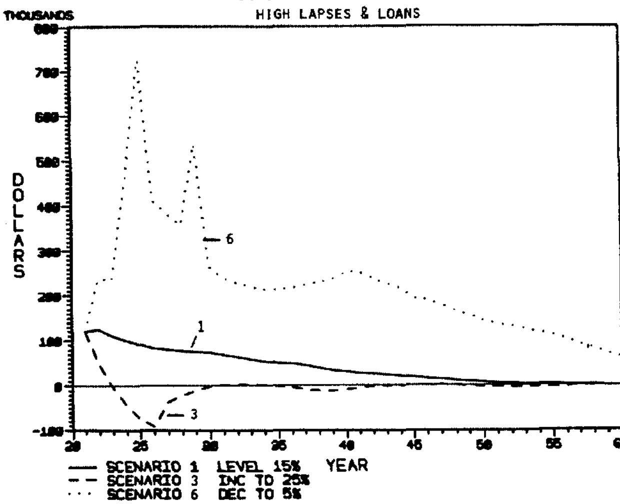
Again, as expected, assets shorten in the decreasing interest scenario because of the operation of the call provision. The effect is evident in the spikes* in asset cash flows. The ultimate level of the cash flows is not lower than the base case, however. Although interest yields are substantially lower relative to the level 15% case, the in-force is significantly greater, and the net effect is higher asset cash flows.

With increasing interest rates, the graph indicates a rapid decline in asset cash flows. This reflects both the effect of borrowing at high rates, and perhaps more importantly, the rapid decline of the book of business.

The combined effect of these shifts in asset and liability cash flows can be clearly seen in the following graph of amounts invested, i.e., INV_t. Recall that these amounts include the shareholder dividends paid.

3. INVESTED CASH FLOWS

HIGH LAPSES & LOANS



*The second spike results from the 5 year call protection assumption. Almost all assets call and are reinvested when interest rates drop to 8% and 6% in years 24 and 25 respectively. Although new money rates then fall to 5% in year 26 these assets will not call again until the 5 year period expires, and then we get the second peak.

VII. Results (Contd.)

B. Cash Flow (Contd.)

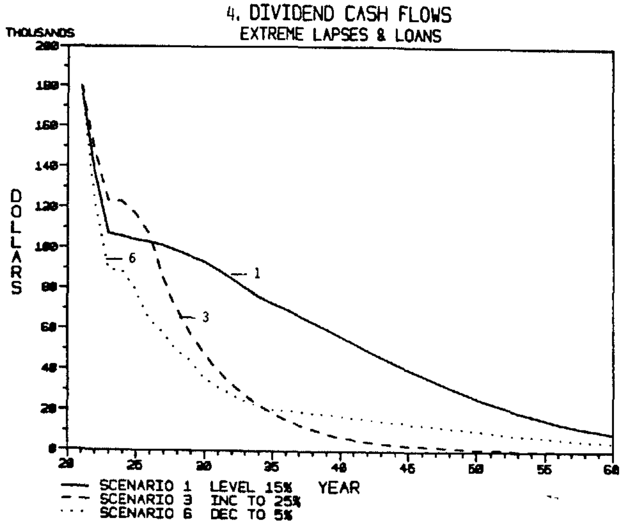
Note that in the increasing interest scenario there is negative net cash flow, i.e., borrowing at a time when interest rates are high. In the decreasing interest scenario on the other hand there is an abundance of cash for investment when rates are low. This nicely summarizes the risk we are studying here.

C. Economic Strength

As explained in Section V, normal annual gains from interest, mortality and lapse are in effect the first line of defense against C-3 risk costs, and it is only when C-3 risk costs exceed gains from these other sources that C-3 surplus is required. To the extent that C-3 risk costs reduce the total statutory gain, dividend capacity, and hence economic strength, is impaired.

The following graph illustrates this reduction in dividends:

4. DIVIDEND CASH FLOWS
EXTREME LAPSES & LOANS



Total dividends have clearly been reduced in both the increasing and decreasing interest scenarios. Under the increasing interest rate scenario, the reduction is probably more a function of the rapid decline in the book of business because of lapse rather than a direct result of borrowing costs. As noted earlier, this is defined as part of the C-3 risk, and represents unrealized or forgone gains because of premature lapse.

VII. Results (Contd.)

C. Economic Strength (Contd.)

In the decreasing scenario, there is a significant decline in dividends, even though the in-force is substantially greater than the base case. This is primarily attributable to the reduced interest rates.

It is not clear how exactly to measure these results. We have started with present values, as shown below. We have calculated these both with level 15% discount rates, and with discount rates that match the corresponding new money rates. Neither is wholly satisfactory: the first ignores the differences in the interest environments, while the second does not take into account the impact of rollover*. We believe the level 15% figures are more meaningful though, since the resulting present values are not distorted by grossly different discount factors.

Present Values of Dividends
(000 Omitted)

	Discount Factors	
Scenario No.	15%	New Money Rates
1 - Level 15%	$ 718,521	$ 718,521
3 - Increasing to 25%	639,632	560,669
6 - Decreasing to 5%	522,219	688,140

Even with these figures in hand, it is not clear how exactly to interpret them relative to economic strength. For example, a decline in dividend capacity may not be critical in the decreasing interest scenario, as growth expectations should be lower than in the base case. In the increasing interest scenario, the reduction in dividend capacity does appear critical, as growth expectations should be higher than in the base case.

These results do support the position that C-3 risk costs extend beyond surplus requirements but clearly additional work must be done in order to put dimension on these costs on a basis consistent with the development of statutory surplus requirements. We expect to refine our model to produce such results in the months ahead. For purposes of this report we believe it is appropriate to conclude that at least in the increasing interest rate scenario, for our hypothetical "company", the reduction in dividend capacity may be the most significant manifestation of the C-3 risk.

*Both approaches also ignore FIT effects.

VII. Results (Contd.)

D. More Statutory Results

In order to round out our initial tests of statutory surplus requirements, we wanted to look at additional interest scenarios where interest rates moved in patterns other than trends to either high or low ultimate levels as presented in Section VII-A. The following table shows several up-down type interest scenarios that were tested and the statutory surplus requirements to assure solvency throughout the projection period.

New Money Rates

Year	Up & Down 11	Up, Down, Up 12	Up, Down, Up, Down... 13	Down & Up 14	Down, Up Down 15	Down, Up, Down, Up... 16
1982	15%	15%	15%	15%	15%	15%
1983	17	18	18	13	12	12
1984	19	21	21	11	9	9
1985	21	25	25	10	7	7
1986	23	25	25	9	5	5
1987	25	25	21	8	3	5
1988	25	25	18	7	3	7
1989	25	25	15	6	3	9
1990	25	21	15	5	3	12
1991	25	18	18	4	3	15
1992	23	15	21	3	5	15
1993	21	13	25	3	7	12
1994	19	11	25	3	9	9
1995	17	10	21	3	12	7
1996	15	10	18	3	15	5
1997	15	10	15	4	18	5
1998	15	10	15	5	20	7
1999	15	10	18	6	20	9
2000	15	13	21	7	20	12
2001	15	15	25	8	20	15
2002	15	15	etc.	9	20	15
2003	15	15	(repeat	10	18	etc.
2004-2022	15	15	cycle)	11 (to 15% then level)	15	(repeat cycle)

Required Statutory Surplus

Lapse & Loan Rate	11	12	13	14	15	16
Moderate	0%	0%	0%	6%	1%	0%
Extreme	0	0	0	5	0	0

VII. Results (Contd.)

D. More Statutory Results (Contd.)

Following are several observations based on these results:

(1) Following the pattern observed in Section VII-A, there is no material statutory solvency risk where interest rates follow an increasing pattern at the start of the projection period.

It seems reasonable that if no risk was found with interest scenarios where interest rates increased to and remained at lofty levels, there would be no risk when interest rates returned to starting levels. Any borrowing that is required when interest rates were at a maximum could be refinanced as interest rates decline producing a net reduction in risk.

We anticipated scenario 13 to be troublesome because the expectation would be for funds to be paid out when interest rates were 25% while most funds were invested when interest rates were at 15%. It appears that the margins relative to valuation and pricing are enough to prevent any threat to solvency.

(2) Decreasing interest patterns to levels below the valuation rate produce material risk.

This observation is also consistent with previous findings. The degree of risk is related to the amount of time that interest rates remain below 4½-5%.

E. Cash Flow Timing Assumptions

In our effort to understand some of the results presented above, we found that the cash flow timing assumptions have a material impact on the results. The impact was significant enough in our opinion to include this among our major findings.

The model we built to analyze the C-3 risk reflects traditional cash flow timing assumptions as follows:

Timing		Cash Flow
Beginning of the Year	:	Premiums, Rollover
Middle of the Year	:	Death Benefits
3/4 Through the Year	:	FIT
End of the Year	:	Surrenders, Change in Policy Loans, Interest on Policy Loans, Shareholder Dividends, Net Investment Income

VII. Results (Contd.)

E. Cash Flow Timing Assumptions (Contd.)

It was not until results of our tests indicated little C-3 risk that we focused on the implications of these assumptions. The practical effect is that even when the net cash flow for a year is negative, indicating a need to borrow, then is a substantial amount of investment income earned on the cash flow during the year. This result is attributable to the fact that the bulk of the cash inflows occur at the beginning of the year and earn interest for the entire year while the bulk of the cash outflows do not occur until the end of the year. In periods of high interest, this leads to a significant overstatement in the amount of net investment income, relative to what would be realized with more realistic assumptions, i.e., a uniform distribution of the various cash flows (other than FIT and shareholders dividends).

Our analysis of our high interest scenario 3 indicates that the effect of our cash flow timing assumptions may be a 20% overstatement in total net investment income. While this is certainly cause for concern, our tests indicate that our statutory solvency results still appear valid. In other words, even if a more realistic model were constructed, there would be minimal statutory solvency risk in the increasing interest scenarios we tested. However, it seems clear that there would be a considerable adverse impact on "economic strength."

F. Market Values

We have done some very preliminary studies of this relationship. As our analysis progressed it was clear that the relationship of cash values to the market value of assets would be a key determinant of risk in the increasing interest rate scenarios.

It was possible to calculate true market values since we keep track of the net amount invested each year and the corresponding amount that persists in each succeeding year. Thus, at the end of a given year, we know exactly what portion of our assets are invested at what rate. Armed with this data, the future rollover rates, and assuming for the "market discount rate" the next year's new money rate, we computed market values.

VII. Results (Contd.)

F. Market Values (Contd.)

Sample results are shown below for the increasing interest rate scenario #3:

Scenario 3
Assets, Reserves, Cash Values
(Net of Policy Loans, End of Year, -000.000 omitted)

Year	New Money Rate	Book Assets	Statutory Reserves	Market Assets	Cash Values
20	13.7%	$1,316	$1,316	$1,066(-19%)	$837(-36%)
25	23.0	992	992	684(-31)	644(-35)
30	25.0	432	432	303(-30)	301(-30)
35	25.0	180	180	136(-24)	134(-25)
40	25.0	69	69	55(-20)	54(-21)

The percentages in parenthesis are the percentage reductions from the corresponding statutory values.

As noted earlier, we believe that the favorable relationship between market values of assets and the cash surrender values is largely responsible for the lack of solvency risk in this and other increasing interest rate scenarios.

G. Asset Liquidation vs. Borrowing

With the market value of assets available, it was possible to test the effect of liquidating assets when net cash flow was negative rather than borrowing at the current new money rate. Surprisingly, we found very little effect, although admittedly we have tested only one scenario, #3, and the negative net cash flows were never terribly large.

For this analysis, we assumed market values of assets would be determined using the current year's new money rate as the discount rate. Also, we first liquidated the most recent year's positive assets, which have the highest interest rates and thus produce the smallest capital loss.

A comparison of investment results for these two approaches is shown below. Year 23 is the first year that the net cash flow was negative. The largest negative cash flows occurred in years 23-26, where interest rates are increasing. By year 30, net cash flow was positive.

VII. Results (Contd.)

G. Asset Liquidation vs. Borrowing (Contd.)

Scenario 3

Year	New Money Rate	Net Investment Income: Borrowed Money Method	Net Investment Income: Asset Liquidation Method*
23	19%	$194,200	$193,693
24	21	189,507	183,483
25	23	174,653	162,880
26	25	151,104	138,281
27	25	115,842	129,710
28	25	95,317	119,623
29	25	79,070	101,580
30	25	66,321	93,512

*Reflects capital loss.

Overall, the results for the two methods are not significantly different. As expected, the asset liquidation method depresses NII most in years 23-26, where the negative net cash flows are concentrated. The cost of borrowing on the other hand is largely deferred to later years.

Interestingly, in this increasing interest scenario, liquidation of assets is the preferred approach. Under the borrowing approach, the borrowing costs increase in future years as the amounts originally borrowed rollover at higher interest rates. Or, viewed differently, if you know your assets will be worth less in the future, due to higher interest rates, you are better off jettisoning them now, than holding onto them and borrowing money at rates that will increase in the future.

The other concern with asset liquidation though is whether one can absorb the capital losses without threatening solvency. In VII F, we noted that for this interest scenario, cash surrender values are below the corresponding asset market values. Because the negative net cash flows are largely caused by cash surrenders, this relationship implies that we can liquidate assets without a risk to statutory solvency.

H. Economic Values

In addition to examining the pattern of the various cash flows, we have done some very preliminary studies of the present values of the cash flows. These are defined as follows:

Economic Value of	=	Present Value of
Assets (EVA)		Asset Cash Flows - Amount Invested
Insurance (EVI)		Insurance Cash Flows
Surplus (EVS)		Dividends

VII. Results (Contd.)

H. Economic Values (Contd.)

These have been defined rather loosely; in particular, we have simply taken present values as if all the cash flows occurred at the year-end. It can be shown, if one is more careful in calculating the present values, that the EVA defined will equal the true market value of assets, provided that all future new money rates are level and equal to the discount rate used in the market value calculation.

Nevertheless, the magnitude of our results should be reasonable, and they do lead to several interesting observations. For example, consider the following summary of the level 15% scenario (the present values were taken at 15%).

Scenario 1 - Level 15% New Money Rates
Extreme Lapses and Loans

	End of Year				
	20	25	30	35	40
Economic Values					
Assets	1,196	1,393	1,298	1,075	817
Liabilities	478	841	856	741	580
Surplus	718	552	442	334	237
Statutory Values					
Assets*	1,316	1,472	1,339	1,100	835
Liabilities*	1,316	1,472	1,339	1,100	835
Surplus	0	0	0	0	0
Cash Values*	837	1,029	1,006	868	683

*Net of Policy Loans.

Several observations:

(1) The economic value of liabilities is substantially lower than the corresponding statutory value.

In the Trowbridge report, it was noted that the C-3 risk could be provided for in either the liabilities or surplus. Given our prior results, it would appear that the C-3 solvency risk is largely provided for within the statutory reserve, and perhaps only a small amount of additional surplus is required.

(2) As noted earlier, the cash surrender values are less than the economic (or market) value of the assets.

As long as this is true, the C-3 statutory solvency risk associated with increasing lapses and loans is not significant.

VII. Results (Contd.)

H. Economic Values (Contd.)

(3) The market value of surplus substantially (perhaps dramatically) exceeds statutory surplus.

If level 15% new money rates actually materialize, this would be an extremely profitable block of business!

I. Unit Expense Inflation

As stated in Section VI, it was generally assumed that there would be no unit expense inflation in the projection period. We have presented some results below though, which indicate the potential significance of uncontrolled unit expense inflation:

Level 15% New Money Rates
Moderate Lapse and Loan

Inflation Factor*	Statutory Surplus Required
None	0
1 + (i - .04) (.25)	.5%
1 + (i - .04)	7.0%

* (The unit expenses, other than per dollar premium unit, are equal to the given factor times the corresponding unit expenses from the prior year. i is new money rate for the prior year.)

Perhaps more revealing is the relationship of expense to premiums for these three cases:

General Insurance Expense*/Gross Premium

Inflation Factor	Year 21	30	40	50	60
None	9%	10%	11%	13%	15%
1 + (i = .04) (.25)	10%	12%	18%	27%	41%
1 + (i = .04)	10%	24%	75%	251%	859%

* Renewal years only; year 21 corresponds to year 1 of the projection period.

Clearly, the expenses get entirely out of hand in the later years.

VIII. Conclusion

A great deal of effort has been expended in order to present the above results, and yet in some respects we feel that we have only scratched the surface. Perhaps the most significant accomplishment was building a model capable of addressing the C-3 risk for non-par individual life insurance. But even in this respect we feel the job is not done. The analysis has suggested several refinements would be appropriate which could have material impact on the results. The obvious refinements that could be made include the following:

(1) The cash values/reserve relationships should be more realistic; in particular, the cash values should equal the reserves after 10-20 years.

(2) The cash flow timing assumptions should be made more realistic.

(3) Further testing of the effects of liquidating assets at market value vs. borrowing is required.

(4) New business should be assumed to be issued during the projection period, which will dramatically alter the aggregate cash flows.

In the process of building the model, we developed a healthy respect for the many assumptions that were required to duplicate insurance and investment cash flows for a book of individual life business. The interaction of these assumptions is not understood well enough. Much more work could be done for instance to better understand how the cash flows change as interest rates change.

Many of the findings presented herein confirm our intuitive understanding of the C-3 risk, particularly those with respect to decreasing interest scenarios. The surprise is the apparent absence of material statutory C-3 risk with respect to increasing interest scenarios. On the other hand, there appears to be potential for serious erosion of "economic strength" with increasing interest scenarios, and this is an area which must be more carefully investigated in the future.

APPENDIX 1

Experience Assumptions

A. Interest Rates

The new money rates for the years 1962-1981 are based on the composite yields on seasoned corporate bonds as published by Moody's. The new money rate for each year is defined as the 12 month average, ending June 30th of the current year. The following table shows the historical new money rates that were used:

Year	New Money Rate	Year	New Money Rate
1962	4.68%	1972	7.81%
1963	4.53	1973	7.59
1964	4.55	1974	8.22
1965	4.57	1975	9.54
1966	4.89	1976	9.42
1967	5.55	1977	8.61
1968	6.31	1978	8.64
1969	6.80	1979	9.50
1970	8.01	1980	11.51
1971	8.30	1981	13.71

For the projection period, we tested 16 different scales, as shown on pages 8 and 16 of the report. Each future scale begins with 15%, which corresponds to 1982.

B. Rollover

Rollover rates reflect scheduled repayment of principal within the investment portfolio. Although we can vary rollover rates by investment year and duration, for simplicity we chose to differentiate our rollover rates only between the historical and projection periods. Our assumptions follow:

Duration	Historical	Projection
1-5	2.7%	3.1%
6-10	5.0	5.9
11-15	7.5	8.3
16-20	3.2	2.3
21-30	.8	.2

B. Rollover (Cont.)

The average life of an investment was 12 years in the historical period and 10.9 years in the projection period. We believe these are fairly typical of a combination of longer term bonds and mortgage investments. The rates for the projection period are reasonably close to our current experience, where interest rates are in the 15% range.

We had originally intended to vary the rollover rates for the projection period according to the then current year's new money rate. Thus, if interest rates were high, the rollover rates for investments made in that year would increase and the average maturities shorten. If interest rates were low, the opposite would occur. However, time pressures in the end did not allow for this refinement.

C. Calls

Assets are subject to call when interest rates decline and if called will produce penalty income. We assumed that a five year call projection period was included in all investments. After 5 years, we defined the probability of call as an exponential function of the spread between the original interest rate and the then current new money rate, as follows:

$$\text{Probability of call in year } v \text{ for a bond purchased in year } u = \begin{cases} 0, & \text{spread}^* \leq 0 \\ .058e^{94(\text{spread})}, & 0 < \text{spread} \leq .02943 \\ .95, & .02943 < \text{spread} \end{cases}$$

*Difference between new money rate in year u and in year v.

This expression was based upon AEtna experience. The following table presents sample results:

Spread	Call Probability
≤0%	0%
.5	9.3
1.0	15.0
1.5	24.1
2.0	38.8
2.5	62.4
2.95+	95.0

D. Call Premium

When an investment is called, the borrower pays or "we collect" penalty income based on the following formula:

$$\text{premium} = \text{coupon} - \left(\frac{\text{coupon}}{\text{life}}\right)(\text{age} - 1)$$

Where:

Coupon = the new money rate in the year of investment.

Life = the life of the investment.

To get the total dollar amount of call premium paid in a given year for a given investment, this premium is multiplied by the amount called.

Because of the new money rates used and the 5 year call protection period, there were no calls during the historical period. But the various interest rate scenarios used in the projection period made calls and call premiums a critical component of the analysis of the C-3 risk.

E. Lapse Rates

In increasing interest rate scenarios, the C-3 risk is closely tied to the risk of increasing lapses. Consequently, we decided to test two different expressions for relating lapse rates to interest levels, one implying only moderate increases; the other much more dramatic increases.

Both start with the same set of base lapse rates that apply whenever the new money rate is 6% or less. They were developed from the LIMRA Intercompany Lapse reports, and are close to LIMRA's 1971-1972 permanent lapse rates.

The first, a linear equation, was determined by a least squares analysis of intercompany lapse rates for 1970-1980 (1981 Life Insurance Fact Book, page 55). The formula is as follows:

$$q' = .378\,(i-.06) + q\ ,\quad i > .06$$

$$= q\ ,\quad i \leq .06$$

where q = base lapse rate

q' = adjusted lapse rate

i = new money rate

E. Lapse Rates (Cont.)

The second equation's development was more arbitrary. We wanted to approximate the above equation at lower interest levels, say 9-10%, but then produce constantly increasing increments to the base rates as interest rates increase, reaching perhaps 25% if interest rates were to go to 30%. This led to the following quadratic equation:

$$q' = .35\,(i-.06) + 3\,(i-.06)^2 + q, \quad i \quad .06$$

$$= q\ , \quad i \leq .06$$

The table below compares the results of these formulas for issue age 45 given various interest rates.

Lapse Rates, Issue Age 45

New Money Rates:	6%		15%		25%	
Policy Years	Mod.	Ext.	Mod.	Ext.	Mod.	Ext.
1	8.1%	8.1%	11.5%	13.7%	15.3%	25.6%
2	4.0	4.0	7.4	9.6	11.2	21.5
3-5	2.4	2.4	5.8	8.0	9.6	19.9
6-10	2.1	2.1	5.5	7.7	9.3	19.6
11+	2.0	2.0	5.4	7.6	9.2	19.5

F. Loan Utilization Rates

As with lapses, we wanted two equations to relate policy loan usage to the new money rate level. Here though, the so-called extreme case was based on actual data.

This first formula was developed performing a least squares best fit to intercompany data for years 1970 to 1980 (source - 1981 Life Insurance Fact Book). We assumed in this analysis that the policy loan interest rate was 6%. Our formula:

$$u' = \left[8.46(i-j) + 1\right] u$$

where

- u = base loan utilization rate (percentage of cash value)
- u' = adjusted loan utilization rate
- j = policy loan interest rate
- i = new money rate

The base loan utilization rates were determined by starting with AEtna's loan experience of the past several years, and then using the above formula to project back to a lower interest rate environment. These base loan rates vary by policy year only.

F. Loan Utilization Rates (Cont.)

The results of the above formula appeared to be sufficiently extreme. For example, the loan utilization rate increased from 23% at 6% new money to 59% at 25% new money, for durations 13 through 18.

The second alternate equation was developed, somewhat arbitrarily, to yield more moderate increases with increasing interest rates. It is as follows:

$$u' = \left[6.26(i-j-.06) + 1\right] u$$

Results for the two formulas are shown below:

Loan Utilization Rates

New Money Rate:	6%		15%		25%	
Policy Year	Mod.	Ext.	Mod.	Ext.	Mod.	Ext.
1	2%	3%	3%	5%	5%	7%
13	14	23	27	40	41	59
28+	12	20	24	35	36	52

G. Expenses

All expenses except percentage of premium expenses were adjusted for inflation during the historical period. This adjustment was based on the new money rate less 4%. During the projection period, the model was generally run without this adjustment. (See Part VI of the report).

H. Mortality

Mortality rates used were 100% of the 65-70 Basic Table for men, age nearest birthday, for both the historical and projection periods.

I. Federal Income Tax

Federal income tax was computed as if the model office represented a separate company filing its own FIT return. Advantage was taken of the net level premium adjustment and the special deductions available in connection with non-participating life insurance. The $250,000 statutory deduction was reflected but the company was large enough so that this was not a major factor ($250,000 was less than 1% of gain from operations on average). Phase III taxes were ignored for simplicity. Net operating losses were carried back three years and forward 15 years to offset any gains in those years.

Because of the large losses associated with issues, and the operation of the loss carry forwards, the company paid no taxes throughout the historical period. In the projection period, the tax phase began with Phase II for all interest scenarios, but then shifted between Phase II and Phase II negative depending on the actual interest rates.

APPENDIX 2

Pricing Methodology

I. Procedure and Profit Target

The first step for this study was to develop premiums, reserves, and cash values, i.e., "ratebooks," for issue years 1962-1981. We took this approach as opposed to using actual past AEtna ratebooks to enable us to better control and isolate items affecting the C-3 risk.

The number of years a given ratebook was to be in effect was determined by essentially two factors. Our basic test was to change ratebooks whenever the premium at age 45 changed by at least 5%. In addition though, we intended to adopt an 8% loan interest rate in the late 1970's and a variable loan provision in 1980, whether or not the premium changes were significant.

A gross premium for a given cohort (defined as a given issue age, issue year combination) was considered satisfactory if at the end of 20 years assets equal liabilities (i.e., we break-even) plus some margin of profit. This required margin was tied to the initial interest rate; thus, we required greater margins in a 10% interest environment than in a 5% environment. We also computed internal rates of return and checked these for reasonableness relative to the initial year's interest rate. In this way, we assured ourselves that our gross premiums were adequate but not unreasonably high.

II. Pricing Assumptions

A. Interest Rates

The interest rates used for pricing were developed directly from the new money rates used in the historical period. The rates to be used for a given issue year started with the highest rate evenly divisible by .25% and less than the new money rate in the year just prior to the year of issue. The pricing new money rates then declined by .1% for 5 years and then by .25% thereafter until 4% was reached. They remain level at 4% in all subsequent years. This process was repeated for each year of issue.

B. Reserves and Cash Values

Reserves and cash values were calculated based on the 1980 amendments to the Standard Valuation and Nonforfeiture Laws, using 1980 CSO mortality. The reference rates used to calculate the valuation interest rates are related to the new money rates described in Appendix 1. Both are based on monthly averages of composite yields on seasoned corporate bonds as published by Moody. They differ however, in that reference rates are the lesser of the 12 month and 36 month average, ending June 30th of the previous year.

The nonforfeiture interest rate equals 125% of the valuation rate.

II. Pricing Assumptions (cont.)

C. Adjustments Based on the New Money Rate

Consistent with the declining interest rates described above, lapses and expenses were not adjusted during the pricing procedure. Loan utilization rates, however, were adjusted. During pricing, policy loan interest rates are actually higher than the new money rates for most of the 20 year pricing period. This indicates lower total loan amounts than our base loan utilization rates. The adjustment formula used is the "extreme" formula described in Appendix 1.

D. Federal Income Tax

For pricing purposes, federal income tax in a given year is .46 times the gain from operations using the net level premium adjustment. This assumes Phase II negative, ignoring the 250,000 statutory deduction. Net operating losses are assumed to all be carried forward to a given year (i.e., the company as a whole is assumed to be in a negative position until this given year at which time it becomes positive). After this year, all losses are used in the year in which they occur, and all gains are taxed.

E. Average Size Policy

The average size policies represent current industry experience and are taken from information given in the 1981 Life Insurance Fact Book. For simplicity, the average size policy changes only when a new ratebook goes into effect. The average sizes given in the Fact Book were raised slightly to reflect AEtna's experience and are given in the next section on "Results."

F. Results

The following table shows the results of the pricing procedure:

	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5
Issue Years	1962-1968	1969-1971	1972-1976	1977-1979	1980-1981
Valuation Rate	3.5%	4%	4.5%	5%	5%
Loan Interest Rate	5%	6%	6%	8%	Variable
Average Size Policy	$10,800	$16,400	$18,800	$27,700	$40,600
Age 45 Gross Premium (Per 1,000)	$25.49	$23.24	$21.43	$20.86	$20.86

APPENDIX 3

General Assumptions

Methodology and Cash Flow Timing

The only plan of insurance is individual whole life insurance.

All policies are issued at the beginning of the year; policies are issued in the historical period only.

Premiums are level at all durations and paid throughout the life of the policy. They are assumed to be annual premiums and are paid at the beginning of the year.

Call premiums are paid at the beginning of the year.

All policyholders are male.

Issue ages are 25, 35, 45, 55, and 65.

Issues remain level at 100,000 new policies every year.

The distribution of the 100,000 policies by age is representative of current industry experience, our source being the 1980 "Life Insurance Fact Book" published by the ACLI.

Death benefits and death expenses are paid halfway through the year.

Surrender benefits and lapse expenses are paid at the end of the year, immediately prior to the following year's premium payment.

All other expenses are paid at the beginning of the year.

Federal income tax is paid three quarters of the way through the year.

Policy loans are made and policy loan interest is received at the end of the year.

Dividends to stockholders are paid at the end of the year, and only during the projection period. Dividends are equal to the gain from operations after FIT, if positive.