IV. C-3 TASK FORCE REPORT

THE IMPACT OF C-3 RISK OF COMBINING
LINES OF BUSINESS

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I. INTRODUCTION

The C-3 risk has been defined as the risk that insurance company profits will be less than anticipated or even negative because of fluctuations in interest rates. There has been a great deal of interest recently in the concept of combining lines of business with different risk characteristics to reduce the C-3 risk. The idea is that if one line of business, for example, deferred annuities, benefits from falling interest rates and is hurt by rising interest rates, and a second line, for example, structured settlements, benefits from rising rates and is hurt by falling rates, then there should be some risk offsets when the two lines are combined. At worst, the risk arising from combining two lines cannot be worse than the sum of the risks of the two lines. At the other extreme, if the two lines are perfectly negatively correlated and the proportions of the two lines are right, then the result of combining the two lines will always be the sum of the mean results for the two lines, regardless of the scenario.

Correlation is a mathematical measure, which varies between -1 and 1, of the degree to which two variables tend to move together. A correlation of 1 means that the two variables move identically, while a correlation of -1 means that when the value of one variable is increased, the value of the other is decreased by a like amount. A correlation of 0 indicates that the two variables move independently.

In between these two extremes, the risks associated with two lines combined will generally be less than the sum of the risks of the two lines, and where there is a strong negative correlation, the risks of the two lines combined may be less than the risks of either line by itself. An extreme example of the type of case that would result in risks being strictly additive would be where a company issued a policy to an existing policyholder's identical twin. In this case, there would be no offset in the C-3 risk because the two policies would react identically to various interest scenarios. However, there would be reduction in the risk of random fluctuations in experience rates, such as the mortality rate.

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Typically, structured settlements are a long-tailed liability that cannot be matched by any fixed-income asset. Thus, a company that issues structured settlements faces a risk that interest rates will fall, particularly when the company purchases callable bonds to fund the structured settlements. Since the structured settlement cash flows do not fluctuate with interest rate changes, there is no exposure to risk when rates rise. On the other hand, deferred-annuity cash flows typically fluctuate with interest rate changes so that it is not possible to match the cash flows. Furthermore, companies that issue deferred annuities often find that it is necessary to buy medium or long-term assets to support a competitive rate. Thus, issuers of deferred annuities generally are helped by falling rates and hurt by rising rates.

This paper will review an actual case study to see how effective an approach based on combining these products might be in practice and it will also review the critical issues and implications of this concept.

II. CASE STUDY

Assumptions

The assumptions discussed below have been modified to protect the confidentiality of the material provided by the company involved, but the changes are cosmetic only and the actual assumptions used are not materially different from those discussed. The company in question had written a mix of about 50 percent deferred annuities and 50 percent immediate annuities and structured settlements, with the idea that doing so would allow management to take advantage of the risk offsets being discussed here.

The company provided projected cash flows and reserves for the immediate annuities and structured settlements. Other critical assumptions are shown in Tables 1 through 3. We looked at the 7 interest scenarios described by New York's Regulation 126, and we also looked at 50 randomly generated interest scenarios. The Regulation 126 scenarios are described in Table 4. We randomly generated scenarios by creating a universe of 15 possible yield curves and a set of probabilities of moving to any of the curves over 1 year, given the curve at the beginning of the year. Table 5 shows the possible yield curves; curve number 5 is the initial curve. Table 6 shows the probability of moving to any of the possible ending curves, given each of the possible beginning curves. The interest scenarios were generated from this yield curve universe and probability grid using a random number generator.

TABLE 1

- Assets equal statutory reserves
- Bonds are assumed to be callable at 108% of par
- Bonds are assumed to be callable 5 years from the date of acquisition
- Bonds are assumed to be called when the rate on new bonds falls 2% below the coupon
- New investments are assumed to earn 105% of the Treasury rate, plus 75 basis points

TABLE 2

DEFERRED ANNUITY ASSUMPTIONS

Beginning Reserve	$1.1 billion
Market Credited Rate	20-year Treasury rate
Credited Rate	Earned rate less 150 basis points
Lapses	$8\% + 2 \cdot (MR - CR)^2 - 0.5 \cdot SC$; minimum of 10%
Premium Suspension	$10\% + 2 \cdot (MR - CR)^2$; minimum of 10%
Mortality	75% of 65–70 male ultimate, age 35
Expenses	$17 per policy maintenance expense 0.15% investment expense
New Issues	None
Investment Strategy	10-year bonds

TABLE 3

STRUCTURED SETTLEMENT ASSUMPTIONS

Beginning Reserve	$0.8 billion
Cash Flows	Projected by company
Future Reserves	Projected by company
New Issues	None
Investment Strategy	30-year bonds

TABLE 4

NEW YORK SCENARIOS

1. Level
2. Gradually rising (5% in 10 years)
3. Gradually falling (5% in 10 years)
4. Pop-up (3%)
5. Pop-down (3%)
6. Rising (5% in 5 years) then falling (5% in 10 years)
7. Falling (5% in 5 years) then rising (5% in 10 years)

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TABLE 5

YIELD CURVES

Curve Number	Short-Term NMR	1-Year Bond NMR	2-Year Bond NMR	3-Year Bond NMR	4-Year Bond NMR	5-Year Bond NMR	7-Year Bond NMR	10-Year Bond NMR	20-Year Bond NMR	30-Year Bond NMR
1	2.46	2.76	2.81	2.92	3.03	3.13	3.23	3.35	3.46	3.47
2	3.46	3.76	3.81	3.92	4.03	4.13	4.23	4.35	4.46	4.47
3	4.46	4.76	4.81	4.92	5.03	5.13	5.23	5.35	5.46	5.47
4	5.46	5.76	5.81	5.92	6.03	6.13	6.23	6.35	6.46	6.47
5	6.46	6.76	6.81	6.92	7.03	7.13	7.23	7.35	7.46	7.47
6	7.46	7.76	7.81	7.92	8.03	8.13	8.23	8.35	8.46	8.47
7	8.46	8.76	8.81	8.92	9.03	9.13	9.23	9.35	9.46	9.47
8	9.46	9.76	9.81	9.92	10.03	10.13	10.23	10.35	10.46	10.47
9	10.46	10.76	10.81	10.92	11.03	11.13	11.23	11.35	11.46	11.47
10	11.46	11.76	11.81	11.92	12.03	12.13	12.23	12.35	12.46	12.47
11	12.46	12.76	12.81	12.92	13.03	13.13	13.23	13.35	13.46	13.47
12	13.88	14.11	14.04	14.07	14.11	14.13	14.16	14.21	14.17	14.05
13	15.29	15.45	15.27	15.23	15.18	15.13	15.08	15.07	14.87	14.62
14	16.71	16.79	16.50	16.38	16.26	16.13	16.01	15.92	15.58	15.20
15	18.13	18.13	17.73	17.53	17.33	17.13	16.93	16.78	16.28	15.78

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TABLE 6

YIELD CURVE PROBABILITIES

| Ending Curve	Beginning Curve														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	33.33	20.00	16.67	7.22	3.00	—	—	—	—	—	—	—	—	—	—
2	25.00	26.67	16.67	15.46	7.00	3.00	—	—	—	—	—	—	—	—	—
3	25.00	20.00	22.22	15.46	15.00	7.00	3.00	—	—	—	—	—	—	—	—
4	11.67	20.00	16.67	20.62	15.00	15.00	7.00	3.00	—	—	—	—	—	—	—
5	5.00	9.33	16.67	15.46	20.00	15.00	15.00	7.00	3.00	—	—	—	—	—	—
6	—	4.00	7.78	15.46	15.00	20.00	15.00	15.00	7.00	3.00	—	—	—	—	—
7	—	—	3.33	7.22	15.00	15.00	20.00	15.00	15.00	7.00	3.00	—	—	—	—
8	—	—	—	3.09	7.00	15.00	15.00	20.00	15.00	15.00	7.00	3.09	—	—	—
9	—	—	—	—	3.00	7.00	15.00	15.00	20.00	15.00	15.00	7.22	3.33	—	—
10	—	—	—	—	—	3.00	7.00	15.00	15.00	20.00	15.00	15.46	7.78	4.00	—
11	—	—	—	—	—	—	3.00	7.00	15.00	15.00	20.00	15.46	16.67	9.33	5.00
12	—	—	—	—	—	—	—	3.00	7.00	15.00	15.00	20.62	16.67	20.00	11.67
13	—	—	—	—	—	—	—	—	3.00	7.00	15.00	15.46	22.22	20.00	25.00
14	—	—	—	—	—	—	—	—	—	3.00	7.00	15.46	16.67	26.67	25.00
15	—	—	—	—	—	—	—	—	—	—	3.00	7.22	16.67	20.00	33.33

We used the profits-released approach, in which the book value of assets is always kept equal to statutory reserves. Under this approach, when there are excess assets, they are paid to surplus as profits, and when there are insufficient assets, the shortfall is borrowed from surplus as a negative profit or loss. The line is then evaluated on the basis of the present value of these payments to and from surplus. Often, in doing valuation actuary work, the asset earnings rate is used to discount profits, so that a positive present value of profits is approximately equal to the excess assets available initially, while a negative present value of profits is approximately equal to the assets that need to be injected initially to prevent ultimate shortfalls under that scenario.

Results

Table 7 and Figure 1 summarize the key results for the random scenarios and the Regulation 126 scenarios, respectively. Run A in Figure 1 represents the results for structured settlements; Run B represents the results for deferred annuities; and Run C represents the results for the two lines combined. Figures 2 through 7 show the present value of profits at the asset earnings rate for every scenario. Figures 2 through 4 are based on the Regulation 126 scenarios. Figures 5 through 7 are based on the randomly generated scenarios. Figures 2 and 5 show the deferred-annuity block. Figures 3 and 6 show the structured-settlement block. Figures 4 and 7 show the two blocks combined.

TABLE 7

SUMMARY OF RESULTS FOR 50 RANDOM TRIALS
PRESENT VALUE OF PROFITS AT ASSET EARNINGS RATE
(VALUES SHOWN IN MILLIONS OF DOLLARS)

	Mean	Low	10th Worst Result	Standard Deviation
Deferred Annuities	150.3	15.8	97.0	57.9
Structured Settlements	62.9	(24.4)	18.4	52.4
Combined	213.1	127.3	197.7	23.8

FIGURE 1

COMPARISON OF RESULTS IN NEW YORK REGULATION 126 SCENARIOS
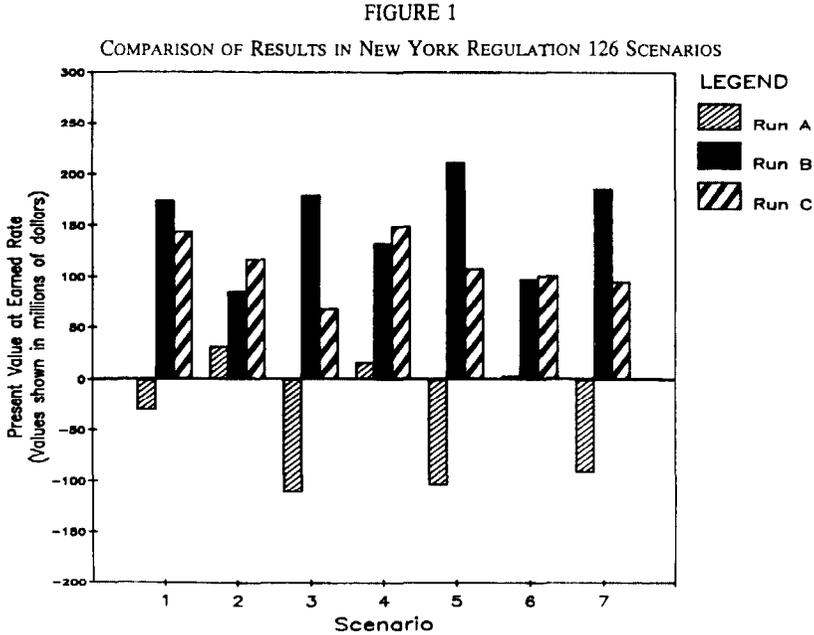
The results are striking. For both the Regulation 126 scenarios and the randomly generated scenarios, the results show much less fluctuation between scenarios for the two lines combined than for either line separately on both a relative and an absolute basis. In addition, under the randomly generated scenarios, the worst result for the combined lines is far better than the sum of the worst results for the two lines separately and in fact is significantly better than the worst result for either line by itself. Under the Regulation 126 scenarios, the worst result is slightly better for the deferred annuities than for the two lines combined, but the worst result for the two lines combined is far better than the worst case for immediate annuities. Both of these results indicate that there is substantially less risk for these two lines combined than there would be if the company had a comparable amount of business in either line by itself. In fact, given the assumptions used in this analysis, there is probably less risk for the two lines combined than for either line separately, even though the lines combined have twice as much reserves as either line has by itself.

FIGURE 2

PRODUCT: DEFERRED ANNUITIES
STRATEGY: FIXED
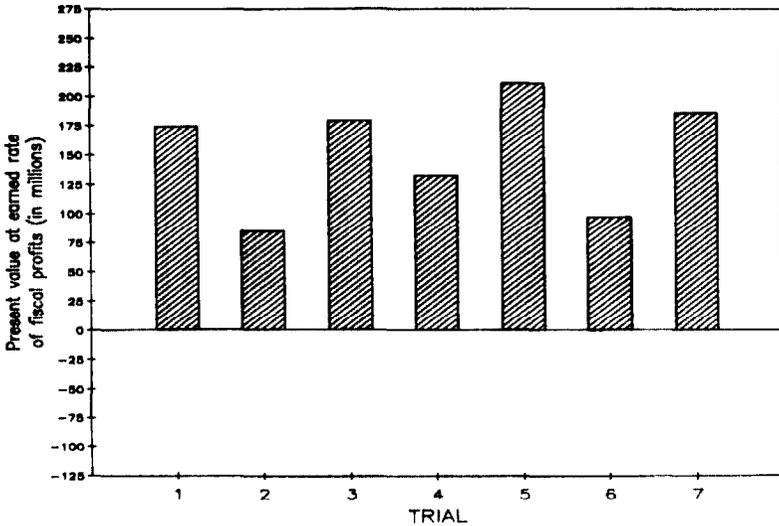
Most of the company's business was issued when interest rates were con-
siderably higher than at the time of the analysis. Thus, although the two
lines were priced for comparable profit levels, the actual experience to date
has been more favorable for the deferred annuities. The change in rates takes
on particular significance for the New York Regulation 126 scenarios, since
they are centered on current rates. In addition, the toughest of the Regulation
126 scenarios are more severe for structured settlements than for deferred
annuities, since the key risk for structured settlements is that rates will go
down and stay down, while the key risk for deferred annuities is volatility
and the Regulation 126 scenarios do not include much volatility.

These results support the intuitive conclusion that combining lines with
different risk characteristics can be an effective means of controlling risk.
In the case of the company studied here, the company may actually need
less risk surplus than it would if it were half as large but had only one line.

FIGURE 3

PRODUCT: STRUCTURED SETTLEMENTS
STRATEGY: FIXED
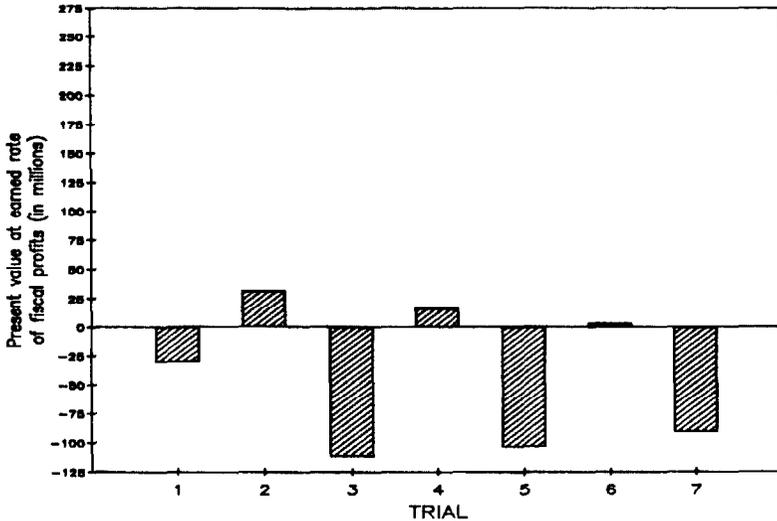
This type of result has critical implications for companies where the avail-ability of risk capital is a significant constraint on growth, as well as the obvious implications for considering the solidity of companies.

III. ISSUES

The critical determinant of the effectiveness of combining two lines of business in containing risk is the degree of correlation between the two lines. Where the correlation coefficient is -1, the results will be independent of the scenario if the proportions of the two lines are chosen appropriately. At the other end of the spectrum, if the coefficient of correlation is 1, then combining the two lines will result in the risks being additive.

Where the correlation between two lines is strongly negative, such as with deferred annuities and structured settlements, combining the two lines will generally reduce the company's relative risks (that is, the risk per dollar of reserve), as opposed to just issuing one or the other line and it may reduce

FIGURE 4

PRODUCT: COMBINED STRUCTURED SETTLEMENTS AND DEFERRED ANNUITIES
STRATEGY: FIXED
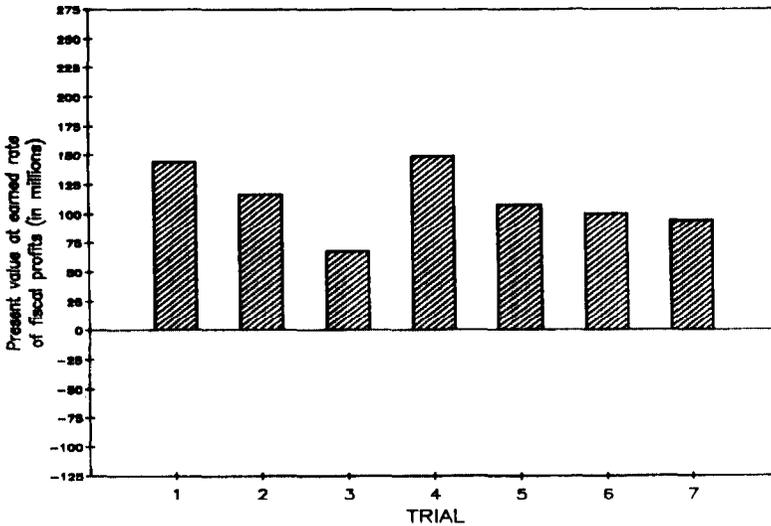
the company's *absolute* level of risk, as in our case study. This occurs
because scenarios that are bad for one line tend to be good for the other
line.

However, unless the coefficient of correlation is −1, there is the possi-
bility of encountering a scenario that is unfavorable for both lines. For
example, if deferred annuities are combined with structured settlements and
rates go way up for three or four years, so that most of the deferred annuities
lapse, and rates then fall way down, so that the assets backing the structured
settlements are called and reinvested at low rates, then results will probably
be unfavorable for both lines. Similarly, if rates fall far enough and the
deferred annuities have significant rate guarantees, then results may be un-
favorable for both lines. Typically, where there is a strong negative corre-
lation between lines, the types of scenarios that are unfavorable for both
lines are fairly unlikely, but the actuary should be aware of those scenarios
and should make management aware of those scenarios so that management

FIGURE 5

PRODUCT: DEFERRED ANNUITIES
STRATEGY: FIXED
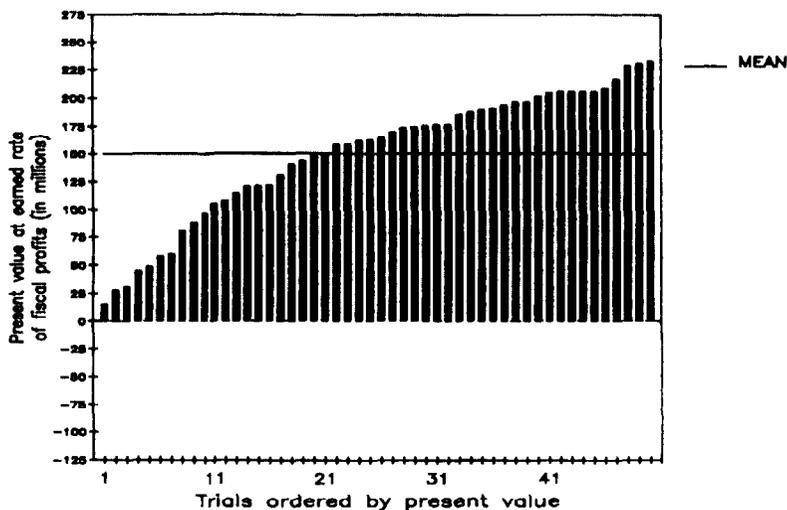
can evaluate whether the probability of those scenarios occurring merits concern.

IV. CONCLUSIONS

Implications for Valuation

The most obvious implication of these results for valuation work is that valuations such as those required by New York Regulation 126 will tend to overstate required reserves or required surplus if the required reserves or surplus are determined separately for each line and then added up rather than being calculated for the company as a whole. Typically, determining reserves for each line separately will result in an overstatement of required reserves or surplus, and in some cases it will result in a gross overstatement, although in some rare cases, determining the reserves or surplus separately will produce the correct total reserve or surplus. The overstatement will tend to be small if results for the different lines are positively correlated.

FIGURE 6

PRODUCT: STRUCTURED SETTLEMENTS
STRATEGY: FIXED

Trials ordered by present value
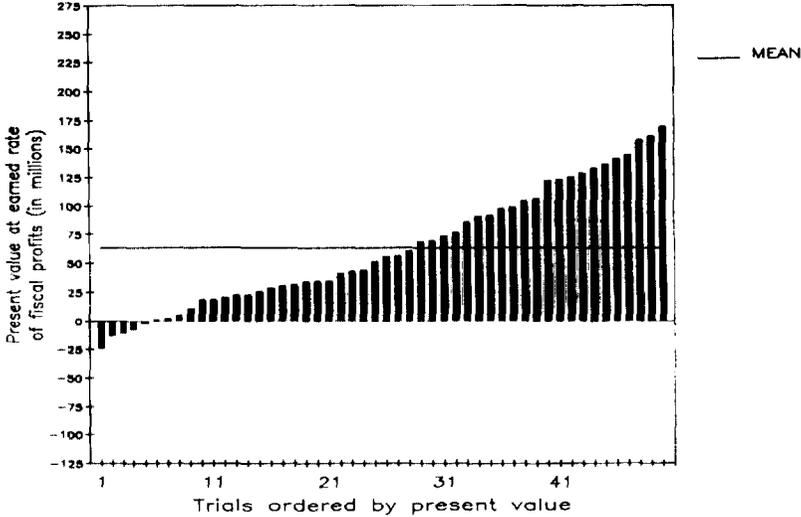
In evaluating the impact of combining lines of business on required re-
serves and surplus, the actuary needs to be aware of the impact of scenarios
that are unfavorable for both lines and make a judgment as to whether the
probabilities of those scenarios occurring lies inside or outside of the desired
probability of adequacy.

An analogy can be drawn between the impact on the C-3 risk of combining
different lines with the impact on the mortality risk of issuing policies to
multiple lives. A company that issued one term policy would need to hold
reserves and surplus equal to the face amount of that policy to ensure that
it could pay the potential claim. If the company issued 10,000 term policies
to different people, it clearly would not need reserves and surplus equal to
anywhere near the total outstanding face amount because the correlation
between outcomes (living or dying) for different people is nearly zero. To
clarify the correlation between lives, the correlation would be zero for in-
dependent lives, strongly positive for members of an Army platoon in war-
time, and strongly negative for two people fighting a duel.

In much the same way, the appropriate reserve and surplus level will
generally be quite different for a line that stands by itself from the level that

FIGURE 7

PRODUCT: COMBINED STRUCTURED SETTLEMENTS AND DEFERRED ANNUITIES
STRATEGY: FIXED
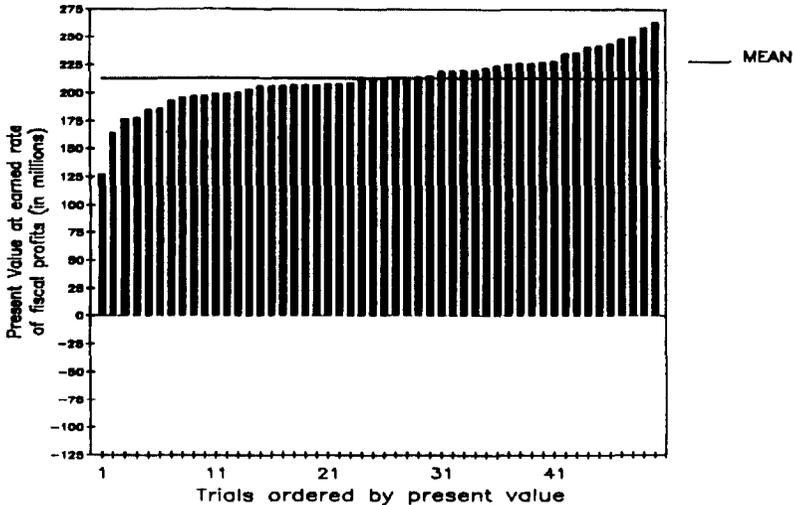
would be required if the line were combined with other lines with risks that
were either largely independent of the risks for the first line or negatively
correlated with those risks.

Implications for Management

   The issues discussed here have significant implications for the way that
companies manage their business. In this discussion it is assumed that con-
trolling risks is an important goal for insurance company managements and
that a probability of ruin above some level is unacceptable to management.
   The risks for a company with two or more lines of business will tend to
be less than the risks for a company with only one of those lines of business
by itself, if the two companies have comparable levels of assets and reserves.
Where the lines are strongly negatively correlated, this lessening of risk can
be substantial. This result implies that a multiline company may be able to
issue far more business at the same level of risk than a single-line company.
In addition, a multiline company may be able to pursue more risky strategies
than a single-line company without facing greater overall risk. For example,
a deferred annuity writer might find that it could back deferred annuities

with 10-year bonds rather than 5-year bonds if it also issued structured settlements. Using 10-year bonds to back deferred annuities is generally more risky than using 5-year bonds, but this incremental risk might be offset by issuing the structured settlements so that the overall risk is the same as if the company just issued deferred annuities backed by 5-year bonds.

There are several caveats that management needs to be aware of in pursuing a multiline strategy. First, the impact of combining lines depends on a number of factors including product types, the markets the products are sold in, and management's view of the future. Thus, management needs to do some analysis to evaluate its own situation before embarking on such a program, rather than relying on results for another company. Second, while there may be risk control advantages to issuing multiple lines, doing so also requires more work and the tradeoffs between increased costs and reduced risks need to be evaluated on a case-by-case basis. Third, where one line of business has a substantially more favorable risk/reward profile than another line, it may be appropriate to issue only the first line even if there is a strong negative correlation between the lines.

Other Lines

The examples in this paper have focused on the risk offsets between deferred annuities and structured settlements. There are many other lines that may have advantageous risk offsets. For example, where a company is deliberately buying longer bonds to back GICs, the risks could be offset against the reinvestment risks for structured settlements or other long-tailed fixed-benefit annuities. Similarly, mature universal life blocks often face a significant risk of rising rates, particularly when they are backed by intermediate or long-term bonds; this risk could also be offset by a structured settlement block. Older traditional life blocks that are believed to be fairly insensitive to interest rates may have risk characteristics similar to those of structured settlements.