SESSION 3

CASH FLOW ANALYSIS: A NEW APPROACH TO UNDERSTAND AND MANAGE RISK

MR. MICHAEL E. MATEJA: The focus of this seminar is on the latest methods of assessing solvency, specifically the practical application of cash flow analysis in the valuation process. Mr. James Geyer and I have devoted a lot of energy to the subject of cash flow analysis in the last few years. Our goal today is to share some of what we have learned with you.

My personal experience in this area began in earnest about three years ago when I directed the analysis of nonparticipating individual life insurance for the Society's C-3 Risk Task Force. More recently, as Chairman of the Society and Academy Combination of Risks Task Force (CORTF), I used cash flow methodology to analyze the problems of combination of risk. Through the course of these analyses, Mr. Geyer and I encountered many practical opportunities at Aetna where these tools could be used. In my presentation I will lay some groundwork by developing a theoretical foundation, Mr. Geyer will then discuss practical applications of what we have learned on the job. I will begin by addressing some very basic questions: the what, the why, and the how of cash flow analysis.

Let's consider the "what" of cash flow analysis. In Exhibit 3-1, the cash flows encountered in any analysis problem are outlined. Please note that I have separated the asset cash flows into two groups, those associated with the original investment (those that would be inhouse on the day of the valuation), and those associated with reinvestment. On the liability side, cash flows are separated

into those associated with benefits and those associated with the expenses incurred in providing those benefits. The benefits, of course, are those defined by contract.

The next cash flow is dividends, representing payments to owners. This is a very important cash flow. Here it makes a difference whether earnings are retained and held within a surplus account, or whether they are paid out. If all of the earnings are retained, it should be clear that the risk management capacity will be much stronger than it would be if all the earnings were paid out.

The last cash flow is reinvestment, which is simply the algebraic sum of the preceding cash flows. Assets are inflows, while liabilities and dividends are outflows. If the net of these cash flows is positive, there is cash available to purchase new assets, called a cash outflow. If it is negative, cash must be borrowed or assets liquidated. This is referred to as a cash inflow. In most of the examples discussed here, we will assume a borrowing position when cash is needed.

A very simple relationship exists among these various cash flows. In Exhibit 3-2, R_o represents a reinvestment outflow, equal to the asset inflows minus the benefit and tax outflows, minus the payment to the owners. By simple algebra, dividends, D, can be expressed as a function of the asset and liability cash flows. Note, in the second equation, that everything to the right of the equal sign represents an asset or liability cash flow that would normally be encountered in a cash flow analysis.

EXHIBIT 3-1

CASH FLOWS

Assets

- Original Investments
- Reinvestment

Liabilities

- Benefits and Expenses
- FIT

Dividends

- Payments to Owners

Reinvestment

- Outflow if +
- Inflow if - (borrowing)

EXHIBIT 3-2

$$R_o = (A_o + A_R) - (B + FIT) - D$$

THEN

$$D = (A_o + A_R) - R_o - (B + FIT)$$

FIT (Federal Income Tax)

The formula can be further expanded by summing the cash flows for all future years and then discounting them all to the valuation date. In Exhibit 3-3 note that the cash flows have been rearranged to group the reinvestment components together in the second term. R_o represents the outflow or the net cash flow that was reinvested. A_R represents the cash inflows derived from this reinvestment. It should be apparent that in a level interest-rate environment, these two present values will be equal. For example, if there is $1,000 of net cash flow to invest, the present value of the future cash inflows associated with this investment would also be $1,000. Moreover, if both values are discounted back to the valuation date, they will still be equal. Thus, the second term in the formula will be equal to zero. In a nonlevel interest environment, this second term will also be zero if the discounting is done properly.

EXHIBIT 3-3

$$PV(D) = PV(A_o) + PV(A_R) - PV(R_o) - PV(B) - PV(FIT)$$

When this second term cancels, a very useful relationship emerges. The present value of dividends is equal to the economic value of the assets less the economic value of the liabilities, as shown in Exhibit 3-4. This has been defined as cash flow based surplus (CFS). I'll describe the details of this in a moment.

EXHIBIT 3-4

$$PV(D) = (EVA)_i - (EVL)_i$$

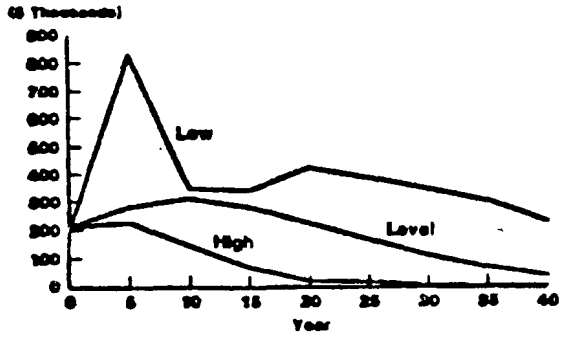
$$PV(D) = CFS_i$$

I want to move on now to the question of the "why" of cash flow analysis. I think the answer can be reduced to one word, risk. Of course, risk is not new to the

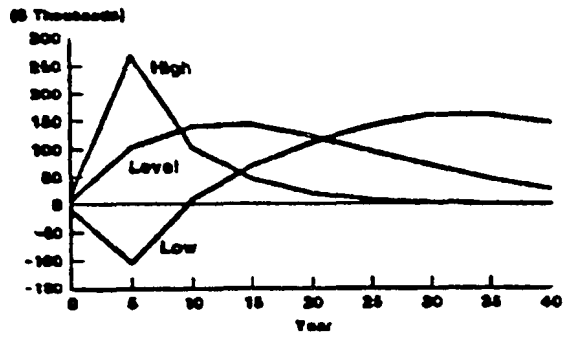
insurance business. It has been around since the first policy was sold. What is newly recognized is mismatch, or C-3 risk. I first dealt with this in the early 1970s when I was involved with pricing a forerunner of the GIC product. Those of us working on this raised enough of a fuss to keep our company from writing too much of this business at what has proven to be an inadequate price.

The large C-3 risk associated with the volatility in interest rates in 1979 prompted the formation of the Society's C-3 Risk Task Force, and Aetna's involvement with the analysis of nonpar individual life insurance. This is when many actuaries began to really understand C-3 risk, and developed a healthy respect for the losses that could develop from it. Cash flow shifts produce this risk. The following graphs illustrate how both the asset and the liability cash flows can shift for a nonpar individual life contract.

ASSET CASH FLOWS



INSURANCE CASH FLOWS



The important point is that these graphs are representative of the kinds of shifts in cash flows that can be experienced with one of the industry's products. If you look back at the CFS formula, in Exhibits 3-3 and 3-4, you will have some appreciation for how that CFS can move very dramatically.

The origin of C-3 risk is book value withdrawal rights. I personally don't believe C-3 risk will be brought under control until such time as some kind of a market value adjusted withdrawal for most products is adopted.

Work on the C-3 Risk Task Force also produced new insight into the financial operations of an insurance company. It became clear that by focusing on the relationship of actual cash inflows and outflows, one could understand something about the true financial condition of an insurance company. Concern about the statutory balance sheet assessment of financial strength is attributable to the fact that cash flows underlying the statutory balance sheet are idealized. This insight came by focusing on what was previously throught to be the actual cash flows. It was not enough to assume that no, or just modest, cash values would be paid out under all circumstances. As all of us here found out in 1979 that if interest rates go up, the cash withdrawals also go up. Many of us found out that one can encounter negative cash flow if assets are long in such a scenario. We should all understand by now that this is a loss situation.

This line of inquiry is what led to the simple notion that risk was manifest as cash flow deviations. This was fundamental to the concept of C-3 risk, cash flows shift in response to movement in the interest rate. As we began our work on the CORTF, it also became clear that cash flows really underlie the other risks assumed. Table 3-1 contains an illustration of the cash flows associated with mortality risk.

TABLE 3-1

PRICING RISK

Cash Outflows

$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	Estimated
$ 80	$ 80	$ 80	$ 70	$ 150	$ 80	Actual
1	2	3	4	5	6	

Duration

In the statutory balance sheet the underlying valuation assumption might be that claims are $100 a year. The pricing might assume that claims will be $80 a year. There would be variations around the pricing assumption representing deviations of actual experience from pricing assumptions. The real risk associated with pricing is catastrophic, as illustrated by the $150 cash flow in the fifth year.

The same kind of analysis applies to asset default, only the cash flow deviation is on the inflow side.

The statutory balance sheet provides for an anticipated cash inflow stream. When an asset defaults, this cash flow stream is altered. In Table 3-2, the second and third year cash flows do not materialize, and then the subsequent cash flows are reduced and extended. When discounting the reduced cash flow stream to the present, the result is a reduced value that is the manifestation of the risk we are concerned about.

TABLE 3-2

ASSET DEFAULT RISK

Cash Inflows

$ 100	$ 100	$ 100	$ 100	$1100			Anticipated
$ 100	$ 0	$ 0	$ 80	$ 80	$ 80	$ 880	Actual
1	2	3	4	5	6	7	

Duration

If you accept this view of risk as a deviation from expected cash flow, you arrive at this very simple conclusion: Solvency is a simple matter of understanding and controlling cash flows. I think this is the bottom line to the answer of the "why" of cash flow analysis. C-3 risk, however, is the driving force behind the attention given to cash flow analysis. In a level interest-rate environment, one could get along as in the past by choosing conservative mortality tables and reasonable valuation interest rates, computing reserves in accordance with the normal conventions.

FROM THE FLOOR: Where are premiums in the list of cash flows?

MR. MATEJA: If you have an in-force contract where you're contractually obligated to accept the premium, I would consider the premium an insurance cash flow and it would, in effect, be a negative liability cash flow. This analysis is valid only under the assumption that there is no new business. It could be extended to include premium associated with new business, but that would complicate the analysis considerably.

FROM THE FLOOR: Solvency is statutorily defined, unrelated to underlying economics. In many cases of insolvency, companies have still been able to mature their obligations a hundred cents on a dollar.

MR. MATEJA: That is a good point. We are not concerned about economic solvency when completing a statutory balance sheet. We are concerned about a statutorily defined formula that assigns values to various assets and liabilities. If the liabilities are greater than the assets, the company in effect, becomes insolvent. If we, as actuaries, can perfect the cash flow analysis, then we ought to have a persuasive case that the company is not insolvent when the regulator comes.

Let's move on to the "how" of cash flow analysis. I think this can be separated into two distinct parts. First, cash flows must be developed, and, second, those have to be interpreted.

Developing cash flows is not a simple task, but it does not have to be onerous either. Many interesting analyses can be completed by what I would call "armchair" methods. Much can be learned from simple analyses that can be carried out with a hand-held calculator. Many problems have been solved where cash flows were developed using a personal computer (PC). I think for most of the problems that you are likely to address, a personal computer is a very powerful tool.

Assumptions are really the key to developing cash flows, and the appendix to the Preliminary Report of the CORTF outlines the kind of assumptions that have to be made along with explanations of why those must be made. I'm not going to

review them in detail here. I only want to point out that there are a couple of troublesome assumptions —— taxes, dividends and the proper approach to discounting. Solutions to these problems have been developed. I'm going to share those with you in a moment.

Let us assume that you've been able to put together a model and understand the cash flows associated with an insurance product. You develop cash flows for two scenarios and your problem now is to understand what those cash flows are telling you. Interpreting cash flows is the tougher part of the "how" of cash flows. Your first choice is to lay the cash flows side by side. I can tell you that this is not going to be a very rewarding experience. You can confirm that the cash flows are perhaps different, but it will not reveal much about the inherent values represented by the different cash flow streams.

The next alternative is to start discounting the cash flows or accumulating them forward. You can discount with before-tax interest rates, after-tax interest rates, level interest rates and average interest rates. It was the task force's experience in doing this that something just did not seem to hang together with the answers. If you read the final report for nonpar individual life, there is an explanation of our early attempts at discounting cash flows.

About October or November last year, as the CORTF was facing the problem of putting together the combination of risk model, Mr. Geyer came into my office and announced that he finally had the answer to the problem of discounting cash

flows. The answer is cash flow based surplus. I am first going to review some of the ways that one should not do cash flow discounting. Understanding the problems with the incorrect approaches will reinforce your understanding of the correct methodology.

In Table 3-3 cash flows associated with a very simple insurance arrangement are summarized.

TABLE 3-3
BASIC CASH FLOWS

Duration	Inflows	Outflows
1	$ 140	-
2	140	-
3	140	-
4	1,140	$ 1,630
PV - BFIT	$ 1,000	$ 965
PV - AFIT	$ 1,167	$ 1,161

We assume $1,000 premium for a GIC contract guaranteeing interest at 13 percent for four years. This sets up a liability outflow of $1,630 at the end of the fourth year. We further assume that the premium is invested in a simple bond bearing 14 percent coupons and maturing at the end of four years. At the bottom of Table 3-3, the present values of these cash flows are given. Looking at the difference between the present values of the inflows and outflows, it is apparent that, either on a before-tax or an after-tax basis, it will be positive. On a before-tax basis, the difference is $35, whereas on the after-tax basis the difference is $6. So, the question is: "Which answer is correct? $35 or $6?"

The problem is a little more complicated than illustrated here. If you remember the "what" of cash flows, two have not yet been accounted for — taxes and dividends. These additional cash flows are presented in Table 3-4.

TABLE 3-4
OPERATIONS CASH FLOWS

	Annual Dividend			Final Dividend		
Duration	Gross Income	FIT	Div.	Gross Income	FIT	Div.
1	10.0	3.7	6.3	10.0	3.7	0
2	11.3	4.2	7.1	12.2	4.5	0
3	12.8	4.7	8.1	14.7	5.4	0
4	14.4	5.3	9.1	17.7	6.5	34.5
PV-BFIT	xx	12.7	21.9	xx	14.2	20.4
PV-AFIT	xx	14.3	24.6	xx	16.0	24.6

Two dividend assumptions are considered. On the left is annual shareholder dividends and on the right is what I call final shareholder dividends, which assume that all earnings are retained in the surplus account and then paid out at the time the liability matures. The numbers in the columns headed "Gross Income" represent the taxable income, equal to interest earned minus interest credited. Note that income is not a cash flow. In the first year there is income of $10. With a tax rate of 36.8 percent, the tax is $3.68. Notice that in the second year, under the final dividend assumption, income has gone up relative to the annual dividend assumption. The extra income represents interest earnings on the retained earnings of $6.30 paid out under the annual dividend assumption. At the bottom of Table 3-4, the present values of the cash flows are shown on before-tax and after-tax basis.

All of the present values for these cash flows have been combined in the following table.

TABLE 3-5

	Annual Shareholder Dividend		Final Shareholder Dividend	
	BFIT	AFIT	BFIT	AFIT
Assets (Inflows)	$1,000	$1,167	$1,000	$1,167
Liabilities (Outflows)				
- Benefits	$ 965	$1,161	$ 965	$1,161
- FIT	13	14	15	16
A - L	22	(8)	20	(10)
Shareholder Dividend	22	25	20	25

There are several interesting points I want to focus on here. The first is that the difference between the present values of asset and liability cash flows is equal to the present value of shareholder dividends for both dividend assumptions.

The next point is that the difference between the present values of asset and liability cash flows on the after-tax basis produced what I would call a nonsensical result. The results are negative. Since we clearly have an earnings element in this arrangement, we ought to get an economic value that is positive.

Next, notice that the difference between the present value of asset and liability cash flows on a before-tax basis depends on the dividend assumption. For the annual dividend assumption, I get a value of $22. For the dividend assumption, I get a value of $20. Somehow it does not seem reasonable that the economic value of the business should depend on the dividend policy.

Finally, and curiously, the present value of the shareholder dividend on the after-tax basis is the same in both cases, $25. The reason for this is that when earnings are retained, they accumulate in the surplus account at an after-tax rate. When the earnings are finally paid out, they are discounted at the same after-tax rate. Thus, the timing of the payment of dividends is immaterial.

These observations about the various present values led us to the conclusion that we probably should be using after-tax discount rates. But the task force members did not know how to produce reasonable results on an after-tax basis. That is, we got the -$8 and the -$10 in the above example. We suspected that somehow the difference between the present value of asset and liability cash flows should be $25, which is suggested by the basic formula that I presented at the beginning of my discussion.

After a lot of experimentation, we concluded that in order to use after-tax discount rates, one has to use after-tax cash flows as illustrated in Table 3-6.

TABLE 3-6

CFS BASIS
BASIC CASH FLOWS

Duration	Inflows	Outflows
1	$ 88	$ (48)
2	88	(54)
3	88	(61)
4	1.088	(69) + 1630
PV - AFIT	$ 1,000	$ 975

Note: (130) x (1 - .368) = (82)
(130) - (82) = (48)

The technique is to identify the inflow and outflow items that define the tax liability and tax effect as they occur. On the asset side, the taxable inflow is $140. When I multiply this cash flow by 1 minus the tax rate of 36.8 percent, I arrive at an after-tax cash flow of $88. On the outflow side, I have an interest credit of $130. When I tax this cash flow, something curious happens. This is illustrated in the note at the bottom of Table 3-6. When I tax the $130 credit, the result is $82. The net interest credit, however, is not a cash flow; it is simply an accounting entry. The difference between $130 and $82 is the $48 in the outflow column of Table 3-6. Note that this is a negative outflow, which in effect represents an inflow from the federal government. This inflow represents the balance of the $130 that the policyholder receives. This treatment of the outflow makes sense in relation to the treatment of the inflow. If on the inflow side I pay the difference between $140 and $88 as an outflow, then I need to recognize the corresponding tax effect of $(48) on the outflow side and treat it as an inflow. This is a very subtle concept, but we now feel comfortable with it. It is explained in the CORTF report.

In Table 3-7 CFS basis differences between the present values of asset and liability cash flows are presented.

TABLE 3-7

	Annual Shareholder Dividend	Final Shareholder Dividend
Assets (Inflows)	$1,000	$1,000
Liabilities (Outflows)		
- Benefits	$1,161	$1,161
- FIT	(186)	(186)
CFS = A-L	25	25
Shareholder Dividend	25	25

Here we see the equivalence I established in the basic formula for cash flows at the start of this presentation — the present value of shareholder dividends is equal to the present value of the asset cash flows minus the present value of liability cash flows. And that relationship will hold without regard to the dividend policy! The relationship of these cash flows is interesting for another reason. It is a function only of the cash flows that are in-house at the time of the valuation. There is no worry about reinvestment cash flows.

FROM THE FLOOR: How is the credit, assumed on the liability cash flow, reflected if the company has never paid taxes?

MR. MATEJA: Under those circumstances, one should reflect the actual cash flows, in which no credit results. Tax credits are a problem for companies that are owned in turn by a holding company.

FROM THE FLOOR: With regard to mutual companies, how is the tax on surplus reflected?

MR. MATEJA: To date, we have used this analysis only for nonparticipating contracts under somewhat idealized conditions, as noted in the answer to the previous question. We believe that the concepts are equally applicable on the mutual side, but have not developed the methodology that far.

I want to briefly consider the properties of cash flow based surplus. By definition, CFS is equal to the present value of shareholder dividends. That follows from the basic relationship among the various cash flows as illustrated earlier.

The more interesting relationship from the standpoint of a valuation actuary, and this is demonstrated in the CORTF report, is that CFS is equal to the amount of cash that can be removed and still mature the benefits. In effect, it represents the present value of future shareholder dividends under the assumption that the cash flows are fixed.

Once a relationship between CFS and cash is established, there is a basis for understanding something about risk. Remember that risk is represented by a deviation from expected cash flow. In the example considered previously, I could take any of the cash flows and assume that it increases or decreases because of some risk. This would change the present values of the asset and liability cash flows when I discount them. Thus, I get a new value of CFS. The difference between the original and the new value of CFS can be thought of as the cash cost of risk. Table 3-8 provides a simple illustration of how to determine the cash cost of risk.

TABLE 3-8

	CFS
Level 14%	$24.59
Increase to 14.4%	(.06)
Cash Cost of Mismatch	$24.65

The $24.59 is the CFS value of $25 from the previous example (to the nearest cent). The task force reran this model increasing the interest rate from 14 percent to 14.4 percent assuming that the liability would mature at the end of one year because of the exercise of a discretionary withdrawal right. It is a

classic example of mismatch risk. The CFS in that instance came out a negative $0.06. The difference of $24.65, in effect, represents the cash cost of that particular mismatch risk.

When you think about the ability to express a specific level of risk in terms of cash, I think you'll conclude, as we have, that you have something valuable. Everybody understands cash! We, on the task force, think that CFS can be used to quantify risk on a disciplined basis. This would also have more general applications to problems involving risk analysis and quantification within insurance companies. It would be of value in the preparation of actuarial opinions where valuation actuaries now are expected to analyze cash flows under varying circumstances.

One of the earlier questions focused on the relationship between statutory and economic solvency. The latter may be considered to be the ability to mature obligations without regard to statutory accounting conventions. I think CFS represents the means to define this relationship. CFS is an economic measure of surplus, not a statutory one. It is possible to have positive CFS, but still have a negative statutory surplus, either on the valuation date or at some future date. Thus, when CFS is used in the preparation of an actuarial opinion, care must be taken.

Lastly, the task force used CFS within the last several months to develop some bench mark surplus formulas. We found it very appealing to express a particular risk situation in terms of a series of cash flow deviations that we could equate

with a given amount of cash. We also developed the corresponding statutory surplus requirements which helped to understand the relationship between economic and statutory solvency.

I now want to discuss CFS analysis in practice. Everything I've said up to this point represents what I would call the ivory tower world where one controls all the variables affecting cash flows. When one attempts to do this analysis in practice, it is not so easy. The fundamental problem is developing the data. Insurance company accounting systems were not designed to support cash flow analysis, and do not contain all of the information needed to do that analysis properly. I have associates who worked on a GIC book of business over five years before they finally had everything under control. The simple message is that there's a tremendous gulf between the theory I've outlined here and practice in a viable insurance company.

Again, the fundamental problem is that the information required for statutory accounting purposes is not the same as needed for cash flow analysis. Some of the information necessary for cash flow analysis is sinking fund terms, refinancing dates, call information, and call premiums. However, items as simple as maturity date may not be available or may not be accurate. At Aetna, we had maturity dates in our asset records, but those were never used other than for Schedule D. In the course of some routine checks to develop call premium information, somebody discovered that some of the maturity dates were wrong. The process of editing data for a GIC portfolio, at the time, cost $8 - $9 billion and extended over several years. We did not get good control over the analysis until we got our cash flow model on line and in tune with the various asset and liability models that were used for the annual statement. Today, we do a

monthly reconciliation of these systems. We did our first reconciliation after several years of work and were $300 million off on the assets. That represented about 3 percent which had a profound affect on our analysis.

The problem on the liability side was worse until we developed a reconciliation system under strict accounting control. This assured that the analysis began with the correct funds. However, projecting the cash flows related to these liabilities was another problem. Many of the liabilities do not have well defined cash flows. Thus, many assumptions were required to develop these and understand how the cash flows move in response to changes in the level of interest rates. A great extent of subjectivity is employed with cash flow analysis in practice.

I want to talk briefly about CFS for a company. We actually tried to do this for all of the Aetna Life Companies. It took us about a year. I can't remember exactly how much we were off on the assets, but it was something in the neighborhood of .5 percent. We had to do all of the work of developing cash flows for the assets in our Corporate Actuarial Department. There was a model available in the investment area that developed cash flows for GNMAs. That department volunteered to do this part of the job for us. When we reviewed the results, we found out that the model had been wrong for many years. Each asset class presented unique problems in developing cash flows. Many assets do not have well-defined cash flows.

The curious thing is that after all cash flows were developed and discounted on a CFS basis, we got an answer that was consistent with what we thought our real financial strength was. We also tested a high interest-rate scenario and a low

interest-rate scenario. Curiously enough, it was the low interest-rate scenario that showed the greatest risk. Refinancing associated with the call risk is something that I think is underestimated today. We in the industry got ourselves beaten up when interest rates were on the way up, and it is likely that we are going to get ourselves beaten up again if interest rates go down.

Next, I would like to consider cash flow analysis in support of the actuarial opinion. As you probably all know, the NAIC will be considering a guideline that will require the valuation actuary to explain the extent to which cash flow analysis is reflected in the actuarial opinion for annuities and other interest-sensitive products. The CORTF report recommends moving in a direction where cash flow analysis would be mandatory in valuing the totality of a company's business. Given the kind of experience I have been discussing, you can understand why I am incredulous about a cash flow analysis of a whole company, particularly if the analysis focuses on surplus requirements.

I firmly support the application of cash flow analysis at the product level. Such analysis has been successfully performed for GIC and for other lines of business. The fact is that valuation reserves are product specific, and an appropriate reserve reflects the inherent risks. I get concerned when I am expected to understand cash flows associated with the extremes of risk, which requires surplus. Surplus for a product has no meaning. Surplus has meaning only at a company level, and nobody I know of has a practical approach to developing surplus at a company level using cash flow (or any other approach). Our work on the CORTF has left me very skeptical about quantifying risk at the extremes.

Cash flow analysis for developing surplus at a company level may be in the future, but it is not in the near-term future, in my opinion. On the task force, we have done a great deal of work trying to quantify the extremes of risk, and I am convinced it would be impossible to gain any degree of discipline over this process. Cash flow analysis results are very sensitive to the assumptions that define the cash flows, for instance, withdrawals, interest rates, expenses, and the like. When one considers the extremes of these assumptions, results change dramatically. For example, if interest rates are 20 percent, one answer results; at 25 percent, a dramatically different answer is produced. If you look at the C-3 Risk Report, you can get some idea of the sensitivity of the results to the assumptions. With variations of this magnitude, it would be impossible to achieve consistency in reserve levels on an industry-wide level. The reserve plus surplus that I might set up at Aetna would bear no relationship to what Travelers might be doing; such a system simply won't work.

My final comments will be on valuation principles. These are much debated these days with little resolution. Here we are talking about using cash flow analysis to set valuation reserves. Thus we need principles to control procedures for working with cash flows. I do not know what all of the valuation principles are that will eventually be developed, but I recommend at least three as worthy of consideration. The first is that a valuation must consider all the material factors affecting financial condition. Anything that affects the cash flow then is material. In the computation of CFS, any changes in the cash flows will affect the answer.

The second principle is that assumptions should be consistent with experience. When working with cash flows, it becomes obvious that results are very sensitive

to assumptions. Any actuary worth his salt can choose asset of assumptions that will get him the answer he wants. Somehow, there must be an obligation to verify that those assumptions do reflect the experience of the company.

A third principle is that assumptions should reflect conservatism depending upon purpose. Much of our analysis has been focused on statutory considerations. Historically, conservatism is what underlies valuation reserves. Interest rates for valuing life insurance today are 6 percent. We are in a 12 percent interest environment. I would say the interest assumption for life insurance is conservative.

When I set up a reserve equal to fund value or fund value less surrender charge for a SPDA contract, I wonder whether that is conservative. Mr. Geyer will address this problem in a moment, and offer a couple of additional principles worthy of consideration.

I am not sure how to reflect conservatism in all of the assumptions that we actuaries will encounter in cash flow analysis, but somehow this must be done in order to fairly and appropriately state the financial condition of an insurance company.

I have one other thought on valuation principles. When I start discounting cash flow, I know that the present value is dividends. I also know that some part of the future dividend pay out will be generated by that business. An insurance company doesn't get all its earnings from new business. So, the problem is

whether to reflect dividends in the cash flow analysis, and the amount to reflect if this is done. We tried to address this problem in the CORTF paper, but there is no definitive answer.

FROM THE FLOOR: If there is a presumption of borrowing in the cash flow analysis, do you recognize that borrowing has its own risks related to timing?

MR. MATEJA: In the task force model, one can borrow on terms different than reinvestment terms. Borrowing can be for one year, five years or ten years. With twenty-twenty hindsight, one can always choose the borrowing strategy having the minimum cost.

For cash flow analysis supporting the actuarial opinion, we on the task force tried to assume neutral borrowing and reinvestment strategies. We customarily used a five-year reinvestment assumption, which is somewhere between short term and long term. We usually borrowed on terms that mirrored the investment strategy.

The alternative to borrowing is to sell assets. We also developed models on this basis. Theoretically, the results should be the same. In practice, I believe that borrowing from policyholders may reduce costs.

MR. GEYER: Until recently, most of us blindly followed the Standard Valuation Law (SVL), and presumed that statutory reserves were superconservative. Furthermore, we viewed reserves quite separate from assets. Reserves were just numbers we computed by applying the SVL. Someone else wrote the asset numbers in the statement and the balance was company surplus.

We now have a better view of life insurance accounting. When we think of reserves now, we think through to the underlying assets. In assessing reserve adequacy, we are asking whether the assets backing the reserves can mature the company's obligations. Reserves then are merely a way of apportioning total assets. Assets not needed to mature obligations represent surplus.

Mr. Mateja has described much of the theoretical aspects of CFS and cash flow analysis; my purpose is to illustrate how we use this and other analyses to test reserve adequacy. I will do this for three separate products: SPDAs, on-benefit annuities and GICs. Along the way, I want to establish some basic principles of reserve adequacy.

I will begin with an extremely simple example of a deferred annuity block of business. The basic assumptions are shown in Exhibit 3-5.

I will assume that there are no guarantees of interest about the valuation rate, so that the CARVM reserve equals the cash surrender value (CSV). I also intend to ignore interest-rate risk. Instead, I will assume level interest rates. While this sounds inconsistent with the topic, I believe we need to go back to basics; several fundamental valuation principles need to be discussed, and these can be illustrated with a simple model.

EXHIBIT 3-5

- ANNUAL DEPOSITS OF $100
- EXPENSES: 8% OF FIRST DEPOSIT
  2.5% OF RENEWAL DEPOSITS
  .5% OF INITIAL FUND BALANCE
- INTEREST EARNED RATE = 11.5%
- INTEREST CREDITED RATE = 10.5%
- "LAPSE" RATE: 10% ANNUALLY
- SURRENDER CHARGES: 5% FOR 5 YEARS, THEN
  4%, 3%, 2%, 1%, 0%
- EARNINGS PAID OUT AS SHAREHOLDER DIVIDENDS
- FIT = 36.8%

In any case, the simple model generates annual profits and losses for this block of policies as shown in Table 3-9. Cash flows underlie the earnings, but are really not of concern as long as interest rates are level. This is, of course, how we actuaries have priced and analyzed products and reserves for a long time.

I want to focus on the statutory earnings pattern. This is shown in the final column of Table 3-9. It is shown graphically in Exhibit 3-6. Note especially the fact that statutory earnings are negative in years six-ten. This results because

- statutory reserves = cash surrender values, that is, fund value less the surrender charge;
- surrender charges grade from 5 percent to 0 percent beginning in year six;
- the basic earnings margin (I^e-I^c-expenses) assumed is insufficient to absorb the increases in reserves caused by the reducing surrender charges.

TABLE 3-9

STATUTORY RESERVE = CASH SURRENDER VALUE

DUR	PREM	EXP	FUND BALANCE BOY	INT CREDITED @ 10.5%	LAPSES	FUND BALANCE EOY	SURR CHARGE	CSV	STAT RESERVE	INT EARNED @ 11.5%	TAX GFO	FIT	STAT GFO
1	100.00	8.50	100.00	10.50	10.50	99.45	0.05	94.48	94.48	10.52	-2.95	-1.09	-1.87
2	90.00	3.19	189.45	19.89	19.89	188.41	0.05	178.99	178.99	20.85	3.26	1.20	2.06
3	81.00	3.37	269.41	28.29	28.28	267.93	0.05	254.53	254.53	29.51	3.32	1.22	2.10
4	72.90	3.52	340.83	35.79	35.78	338.95	0.05	322.00	322.00	37.25	3.38	1.24	2.13
5	65.61	3.66	404.56	42.48	42.47	402.34	0.05	382.22	382.22	44.16	3.42	1.26	2.16
6	59.05	3.78	461.39	48.45	48.94	458.85	0.04	440.49	440.49	50.31	-1.63	-0.60	-1.03
7	53.14	3.88	511.99	53.76	54.88	509.18	0.03	493.90	493.90	56.32	-2.70	-0.99	-1.71
8	47.83	3.97	557.01	58.49	60.32	553.94	0.02	542.86	542.86	61.84	-3.58	-1.32	-2.26
9	43.05	4.05	596.99	62.68	65.31	593.71	0.01	587.77	587.77	66.91	-4.31	-1.58	-2.72
10	38.74	4.12	632.45	66.41	69.89	628.97	0.00	628.97	628.97	71.57	-4.89	-1.80	-3.09
11	0.00	3.14	628.97	66.04	69.50	625.51	0.00	625.51	625.51	71.97	2.79	1.03	1.77
12	0.00	3.12	625.51	65.68	69.12	622.07	0.00	622.07	622.07	71.57	2.78	1.02	1.76
13	0.00	3.10	622.07	65.32	68.74	618.65	0.00	618.65	618.65	71.18	2.76	1.02	1.75
14	0.00	3.08	618.65	64.96	68.36	615.25	0.00	615.25	615.25	70.79	2.75	1.01	1.74
15	0.00	3.07	615.25	64.60	67.98	611.86	0.00	611.86	611.86	70.40	2.73	1.01	1.73
16	0.00	3.05	611.86	64.25	67.61	608.50	0.00	608.50	608.50	70.01	2.72	1.00	1.72
17	0.00	3.03	608.50	63.89	67.24	605.15	0.00	605.15	605.15	69.63	2.70	0.99	1.71
18	0.00	3.02	605.15	63.54	66.87	601.82	0.00	601.82	601.82	69.25	2.69	0.99	1.70
19	0.00	3.00	601.82	63.19	66.50	598.51	0.00	598.51	598.51	68.86	2.67	0.98	1.69
20	0.00	1.50	598.51	62.84	661.36	0.00	0.00	0.00	0.00	68.66	4.32	1.59	2.73

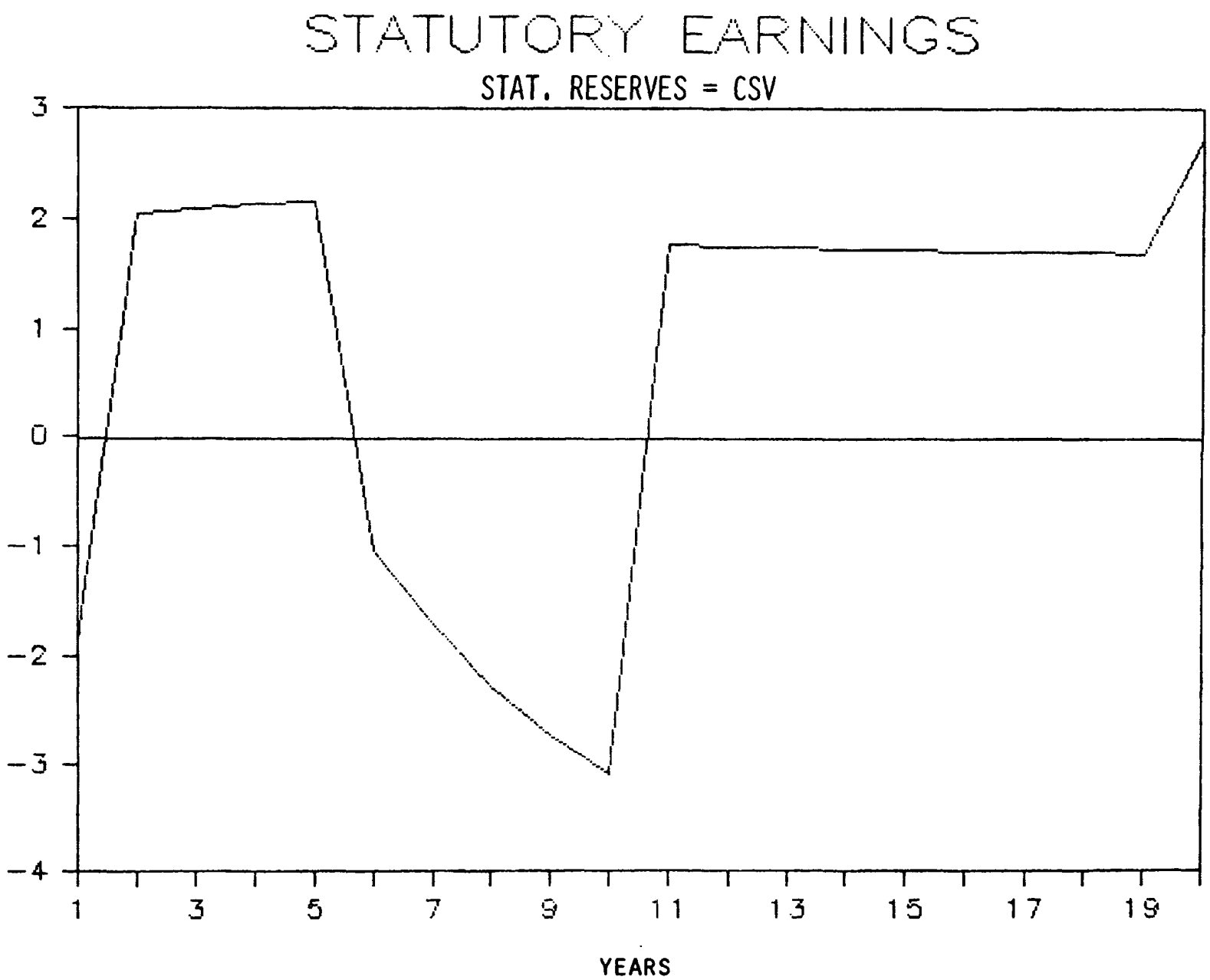
AFIT PV OF STAT GFO

EOY	THRU YR 10	THRU YR 20
1	0.67	7.32
2	-1.33	5.80
3	-3.53	4.12
4	-5.92	2.29
5	-8.51	0.29
6	-8.10	1.35
7	-6.98	3.15
8	-5.22	5.64
9	-2.88	8.77
10	----	12.50

ASSUMPTIONS:

ANNUAL DEPOSITS OF	$100.00
	8.00% OF FIRST DEPOSIT
EXPENSES	2.50% OF RENEWAL DEPOSITS
	0.50% OF MEAN FUND BALANCE
INTEREST EARNED RATE	11.50%
CREDITED RATE	10.50%
LAPSE RATE IN YEAR 1	10.00%
IN YEARS 2+	10.00%
FIT RATE	36.8%

EXHIBIT 3-6


STATUTORY EARNINGS
STAT. RESERVES = CSV
3
2
1
0
-1
-2
-3
-4
1
3
5
7
9
11
13
15
17
19
YEARS

The primary question I want to focus on is the following:

Is the reserve held, at the end of year five for instance, adequate?

Note that we are ignoring the possibility of anything going wrong. We are faced with this picture if everything goes exactly as planned. Before answering this question, we need to review some more data.

Exhibit 3-3 compares CFS to statutory earnings for years one through ten. Since earnings are assumed to be paid out annually (to surplus or to owners), CFS can be computed as the after-federal-income-tax (AFIT) present value of future statutory earnings.

The interesting point of the graph in Exhibit 3-7 is that, even at the end of year five, CFS is positive, though just barely. This tells us that the assets on hand at the end of year five are sufficient on an economic basis to mature the liabilities, given this scenario.

The earnings in years eleven through twenty have sufficient present value to offset the negatives in years six through ten. Thus, the assets on hand at year five are sufficient only if the business persists and everything goes as planned after year ten.

An example of what happens when things go wrong is illustrated in Table 3-10. Thus, if lapses increase substantially after year ten, CFS as of year five is negative; this in turn implies that the assets are inadequate as of that point, even on a pure economic basis.

EXHIBIT 3-7

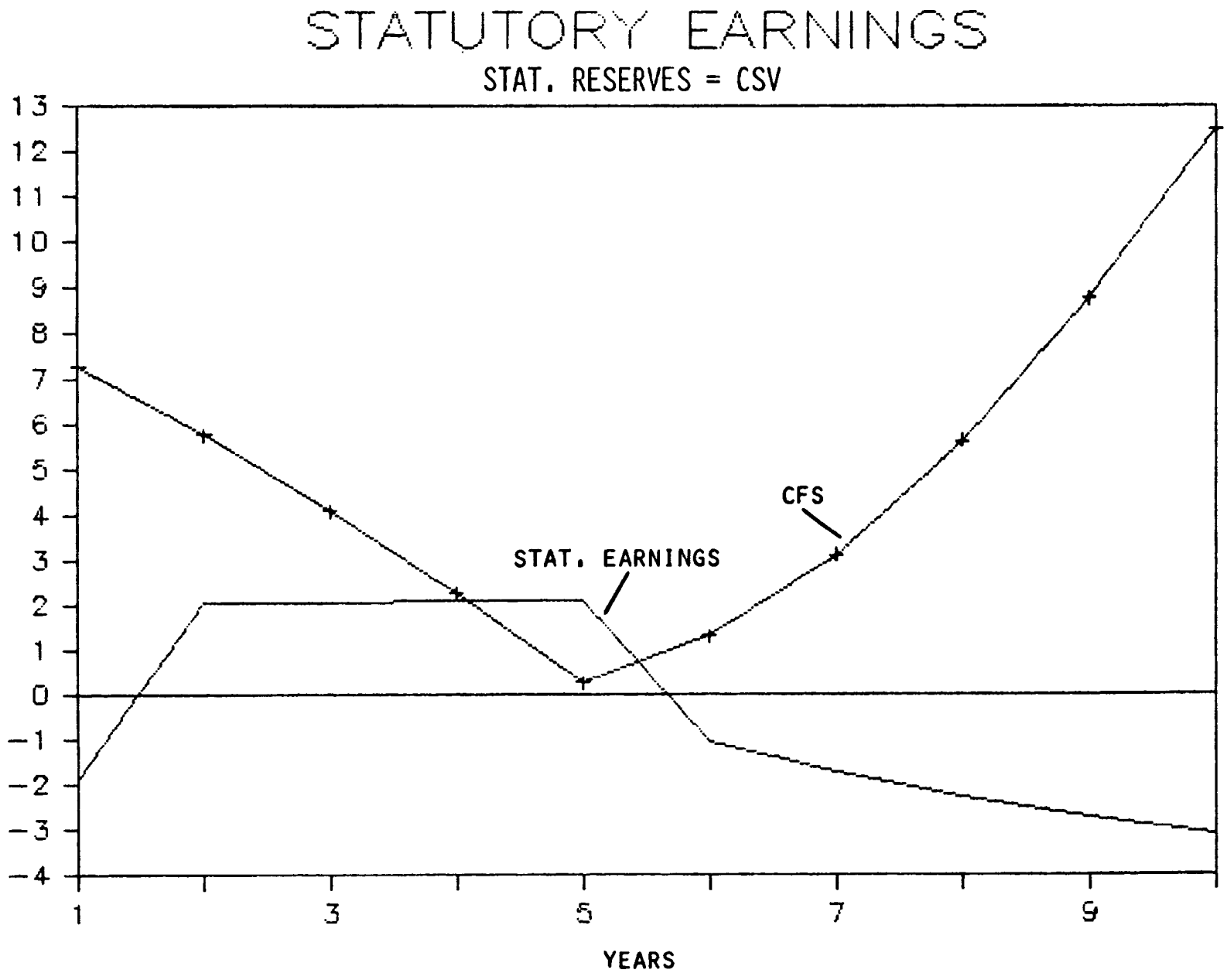

STATUTORY EARNINGS
STAT. RESERVES = CSV
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
1
3
5
7
9
CFS
STAT. EARNINGS
YEARS

TABLE 3-10

LASPE RATE EFFECTS ON CFS

END OF YEAR	LEVEL 10% LAPSE	10% 1-9 30% 10+
1	7.32	3.50
2	5.80	1.69
3	4.12	-0.28
4	2.29	-2.44
5	0.29	-4.78
6	1.35	-4.09
7	3.15	-2.68
8	5.64	-0.61
9	8.77	2.06
10	12.50	5.06

One possible approach then to the question of reserve adequacy would be to increase reserves slightly, so that even under adverse scenarios like this one, the assets would be adequate on an economic basis. For this high-lapse scenario, we would have to increase reserves by $4.78 in year five, which represents 1.3 percent of the CSV.

An important question we need to address is whether or not such economic tests are sufficient. In other words, in assessing reserve adequacy, can we ignore statutory accounting requirements and rely solely on these economic tests, with some adverse deviations thrown in? This is a fundamental question that has not been answered to date, and I know there are conflicting opinions on the matter, even within my company.

I believe that we cannot ignore statutory accounting requirements. For this block, I know that the minimum reserve is the CSV, which in five more years from my year five point will equal the full fund value. If this block of policies represents my only line of business, and I have no surplus, then even if all goes as

planned, I will soon be statutorily insolvent. If my current surplus is less than about two percent of liabilities, I will be insolvent in five years. It may be true that there is sufficient economic value to mature all the liabilities, but that is not much help if the regulators padlock the front doors.

At my company, we have found similar problems when studying the risk of asset default. Without worrying about statutory accounting rules, we could survive pretty heavy asset defaults. For example, if 10 percent of our assets go into default, with 50 percent of those ultimately recovered, the net long-term loss can be expressed as a loss of 50 basis points off the annual interest rate. We can survive such a loss. However, if someone comes in and writes down the value of the assets by 6-10 percent, we are out of business.

In any case, it is my position that statutory accounting requirements must be recognized. Let us see where this position takes us with respect to the deferred annuity example.

The first column of Table 3-11 presents the present value, at AFIT discount rates, of future gains from operations (GFOs) through year ten. For example, the negative 8.51 shown for future year five is the present value as of the end of year five of GFOs for years six through ten. The second column gives the present values through year twenty, and is equivalent to CFSs.

TABLE 3-11

END OF YEAR	PRESENT VALUE, GFOs THROUGH YEAR 10	THROUGH 20 (CFS)
1	0.67	7.32
2	-1.33	5.80
3	-3.53	4.12
4	-5.92	2.29
5	-8.51	0.29
6	-8.10	1.35
7	-6.98	3.15
8	-5.22	5.64
9	-2.88	8.77

If all reserves in the first ten years are increased by the negative of the figures in the first column, future statutory losses will be eliminated. You can see this by working backwards from year ten. To eliminate the loss in year ten, I need to increase the end-of-the-year-nine reserve by the negative of the AFIT present value* of the loss at the end of year ten. The end-of-year-ten reserve remains at the full fund value.

To zero out earnings for year nine, we need to increase the end-of-year-eight reserve to fund the loss at the end of year nine and to fund the increase in the ending-year-nine reserve that was necessary to zero out the year ten earnings. We accomplish this by increasing the end-of-the-year-eight reserve by the negative of the AFIT present value of the GFOs for years nine and ten.

*Since we do not get a tax deduction for these extra reserves, I have to use after-tax discount rates rather than before-tax rates.

The second column in Table 3-12 shows the reserves that produce zero statutory GFOs in years one through ten. Note that the biggest percentage increase is at year five, 2.2 percent. This is so because the negative GFOs were in years six through ten; the year five reserve is increased by the then present value of all the losses. The year six reserve has only four negative earnings, whereas in year four, the losses are partially offset by year five earnings.

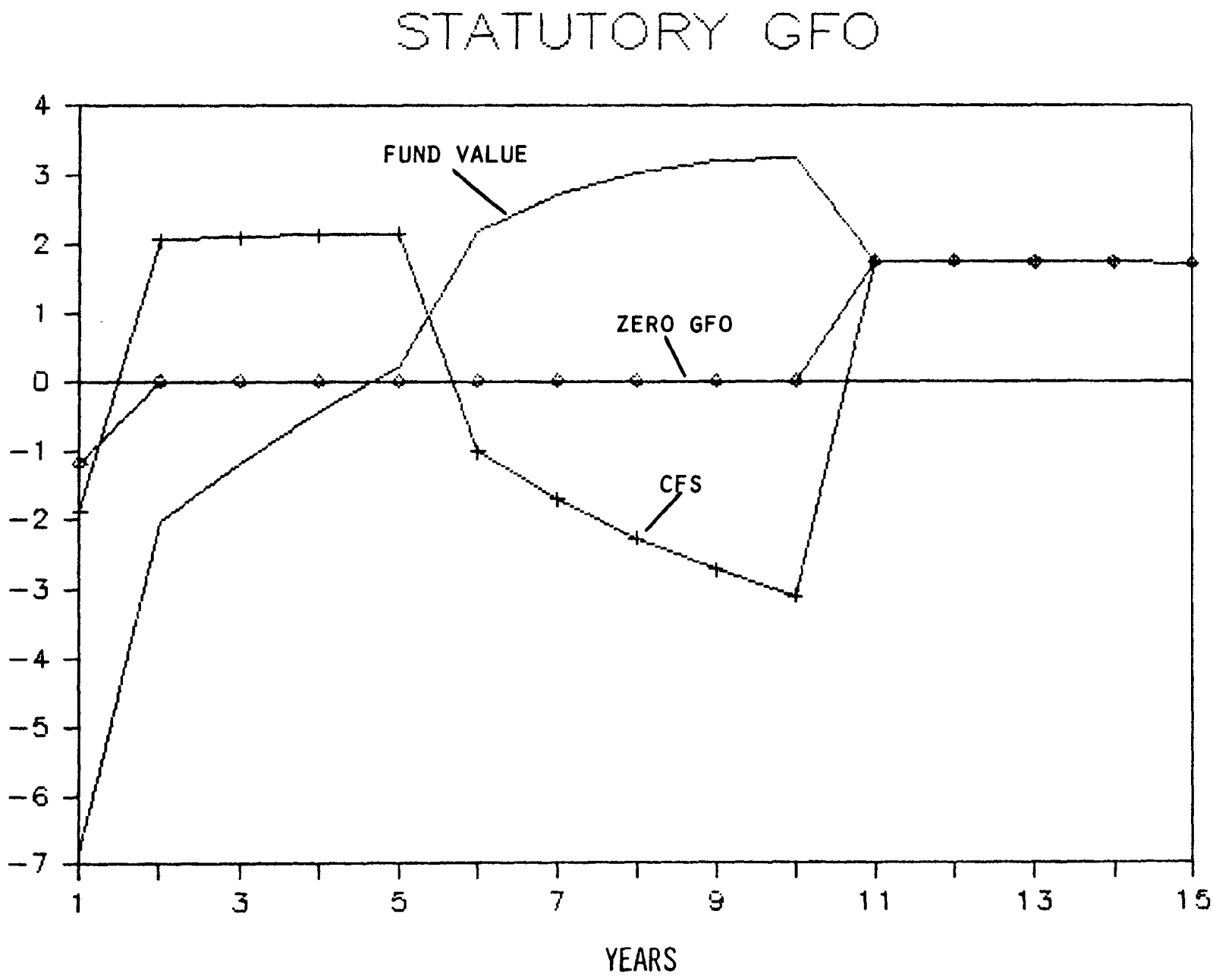
TABLE 3-12

ALTERNATE RESERVES

YEAR	CSV	STAT. RESERVES WHICH PRODUCE ZERO GFO's	% INC.
1	94.48	93.80	-0.7%
2	178.99	180.32	0.7
3	254.53	258.06	1.3
4	322.00	327.92	1.8
5	382.22	390.73	2.2
6	440.49	448.59	1.8
7	493.90	500.88	1.4
8	542.86	548.09	0.9
9	587.77	590.65	0.4
10	628.97	628.97	0.0

Exhibit 3-8 contrasts the earnings patterns for three different reserve bases. With full fund value, initial earnings are depressed the most, and earnings in years six through ten are the greatest. With CSVs as reserves, we get the pattern we saw earlier of positives in two through five years, followed by negatives in six through ten years. The zero-GFO reserve basis generates earnings between these two extremes. After year ten, the resever equals full fund value on all three, so that the GFOs are the same.

EXHIBIT 3-8


STATUTORY GFO
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−7
FUND VALUE
ZERO GFO
CFS
1
3
5
7
9
11
13
15
YEARS

There are three more things we need to consider:

1. Nonguaranteed elements
2. Mix of policy issue years
3. Adverse deviations

All of these results presume a level interest environment, and that management maintains credited interest at the initial level. The statutory losses I have been worrying about occur only if management maintains the credited rate. If rates were reduced 50-100 basis points, the statutory losses would disappear. Thus the incremental reserves developed are created by treating a nonguaranteed element as fixed in this scenario. This may appear pretty heretical to some of you.

My rationale for this approach is that I have been looking only at a level interest scenario. These policies are marketed with the clear expectation that the credited rate will not be decreased in a level interest scenario. It is inconsistent with this expectation to then go to regulators and argue for lower reserves on the basis that we will cut the credited rate beginning in year six to offset the reduced surrender charges. If you clearly disclose plans to later reduce the credited rate in the policy approval process and marketing materials, then you have a better argument for lower reserves.

Another thought along these lines is that most responsible managements would want to avoid cutting the credited rate in the level interest scenario. To do so would damage the company's credibility and threaten new business opportunities.

In any case, I argue that when assessing reserve adequacy, in such a level interest scenario, we should assume that the current crediting rate (or dividend scale for participating policies) applies. However, in some adverse scenarios, it may be entirely appropriate to reflect the fact that these elements are not guaranteed. For example, if we test a scenario where new money rates drop 500 basis points, the credited rate should not be assumed to be maintained at the initial rate, but instead should reflect what management would most likely do.

Under CARVM, when we project out at guaranteed rates and discount back at the valuation rate, we are primarily worrying about reinvestment risk; when interest rates fall, it is entirely appropriate to reflect the relationship of guaranteed and valuation rates. However, we have come to understand that there is more to C-3 risk than reinvestment risk. Thus, we need to modify our traditional practices and approaches.

This brings me then to a proposed principle or perhaps a standard of practice with regard to testing statutory reserve adequacy:

> Nonguaranteed elements should be consistent with the underlying economic scenario.

Once again, whether or not this ever becomes a principle remains to be seen. Until it is decided though, one way or the other, we really cannot arrive at agreement on what an adequate reserve is.

In assessing reserve adequacy, another principle could be to have adequacy at the lowest possible cell level; if you know each of your various cells are adequate,

then reserves for the whole company must be adequate. In the past, the philosophy of the SVL has been to get a conservative reserve on a policy-by-policy basis so that it was clear that aggregate reserves were conservative. For example, with deficiency reserves, we were not allowed to offset deficiencies on some policies with sufficiencies on others.

However, when we get to examining asset and liability mismatch, it does not make any sense to study adequacy of single policies or even small blocks. For one thing it is not practical, but also it may create too much conservatism.

On the other hand, testing reserve adequacy for the entire company would be difficult to do and it would be difficult for regulators to check for consistency between companies with different mixes of business. A reasonable compromise then is to define fairly large blocks of business for which the valuation actuary should assess reserve adequacy. For example, one might define all deferred annuities as one block; other blocks would be all GICs, all universal life contracts, all permanent traditional contracts, all term and so on. If the actuary can analyze and provide assurances that the total reserves for each of these large blocks is adequate, then clearly reserves for the total company are adequate. Furthermore, this approach gives the regulator and other interested parties the ability to make rough comparisons between companies to see what is being done.

On the other hand again, company solvency is clearly defined at the company level. Thus, if one of my large blocks is deficient, but aggregate reserves are okay, the company is clearly still solvent. My point is that in reporting the testing and status of the company's reserves to regulators, we should use fairly

well-defined blocks of policies. Furthermore, if the valuation actuary finds that reserves for one of these blocks is inadequate, the company should take steps to strengthen those reserves.

Table 3-13 provides an illustration of the effect of using a larger block than the single issue year. If I have issued this same policy, with the assumed pattern of surrender charges, for five years, then the future statutory GFOs would emerge as shown. This assumes no further issues in later years, which is appropriate given that we are assessing reserve adequacy for the then in-force business. The present value of these gains and losses through year thirteen, which is the year of the last loss, equals negative .9 percent of the total year-end five reserve. Recall that this compares to 2.2 percent for the fifth year for the single issue year example.

TABLE 3-13

MIX OF POLICY YEARS INFORCE

SINGLE ISSUE YEAR		LEVEL SALES FOR 5 YEARS	
POLICY YEAR	STAT. GFO	YEAR	STAT. GFO
1	-1.87	6	7.42
2	2.06	7	3.65
3	2.10	8	-0.71
4	2.13	9	-5.56
5	2.16	10	-10.82
6	-1.03	11	-8.02
7	-1.71	12	-4.56
8	-2.26	13	-0.55
9	-2.72	14	3.91
10	-3.09	15	8.73

Thus, as seen in Table 3-14, we would have to increase the reserves at the end of the fifth year in total by .9 percent to offset the future negative earnings. If we

issue no more business, then the required additions to the reserve for years six through eleven are as shown. However, if we issue more business for two more years, when we actually get to the year seven reserve and make similar projections, we would have to increase total reserves only by .8 percent. If we issue this business for twelve years and then look at the GFO projections, the pure cash surrender values would be adequate reserves for the level interest scenario.

TABLE 3-14

% ADDED TO CSV FOR ZERO GFO

SINGLE ISSUE YEAR		LEVEL SALES FOR 5 YEARS	
POLICY YEAR	% ADD	YEAR	% ADD
5	2.2%	5	0.9%
6	1.8	6	1.2
7	1.4	7	1.3
8	1.0	8	1.1
9	0.5	9	0.9
10	0.0	10	0.4
		11	0.2
		12	0.0

In any case, I am now ready to present a principle or definition, of statutory reserve adequacy:

For a reasonably large block of similar policies, if

1. the current CFS is greater than zero (that is, the assets are sufficient to mature the obligations on a true economic basis),
2. the present value of statutory GFOs to each future year are nonnegative (that is, the present values for the next one year, two years, three years, four years, and so on), and

3. these two conditions hold under reasonably adverse conditions,

then statutory reserves are adequate.

Actually, if condition 2 is true, condition 1 has to be true. I included condition 1 here as it helps me think about the meaning of reserve adequacy.

I think we have more than adequately covered conditions 1 and 2. Now we need to consider what the reasonably adverse conditions imply. The primary interest in this regard is adverse interest-rate conditions and C-3 risk.

Up to this point, I have essentially ignored the asset side, and have relied on a very simple model with level interest. I have demonstrated that, even in this environment, questions of reserve adequacy can arise, and I have proposed some basic principles of how one might define an adequate reserve.

In this environment of level interest, cash flow analysis is reasonably straightforward and can be readily done with most companies' existing pricing or earnings programs. Any program that generates statutory GFO will do, perhaps with a few minor alterations.

To extend the analysis to consider C-3 risk, one needs to add an asset model. This would, at a minimum, include the terms listed in Exhibit 3-9. To measure C-3 risk, we need to focus on cash flows initially. We will ultimately want to go back to measure statutory GFOs, but to analyze the impact of C-3 risk on statutory GFOs, we must start with the cash flows. Cash flows and CFS are not

ends in themselves. They are merely tools that allow us to do what we have always done, namely measure earnings under different scenarios.

EXHIBIT 3-9

ASSET MODEL

- o BONDS
- o MORTGAGES
- o INPUT PARAMETERS VARY MIX AND LENGTH
- o CALL RISK
  - CALL PROTECTION PERIOD
  - CALL PROBABILITIES
  - CALL PREMIUM
- o GNMAs
  - OPTIONAL
  - PREPAYMENT SPEED ASSUMPTIONS
- o SELECT AND ULTIMATE APPROACH
- o YIELD CURVES - OPTIONAL
- o ACTUAL ASSETS VS. REPRESENTATIVE ASSETS

To do cash flow analysis, one must identify all elements of cash flow and study and/or model the cash flow relativities. Further, one must consider how cash flows move when interest rates move. Thus, on the asset side we worry about such things as prepayment speeds under GNMAs and call risk under other assets.

On the liability side, we must consider such things as withdrawal rates and how they might be a function of interest rates. The rates shown in Exhibit 3-10 were derived from work done for the Society's Combination of Risks Task Force's study of SPDAs. It was based on limited available data and a lot of subjective judgment. I understand that some actuaries have become more sophisticated recently and have added terms to their formulas to account for surrender

charges. Thus lapses are expected to be lower when surrender charges are high, but the "pent-up pressure" for lapse during the period of high surrender charge leads to significantly higher lapses when the surrender charges wear off. Also, some people put in a time factor, so that lapses increase at a given interest rate level the longer interest rates have remained at that level. In any case, this process of analyzing how cash flows react to changing interest conditions is a fundamental part of cash flow analysis. For today, these rates will do for the simple examples we are considering.

EXHIBIT 3-10

LAPSE FORMULA

LAPSE RATE = FUNCTION OF D

$$D = I^N - I^C - .01$$

$I^N - I^C$	LAPSE RATE
1%	7.5%
2	11.0
3	15.0
4	19.5
5	24.5
6	30.0
7	33.0
8	35.0

Now that we have built a model to work with cash flows, we are ready to go back to our simple deferred annuity example and consider what effect C-3 risk has on the issue of reserve adequacy.

Table 3-15 illustrates the increases in reserves needed as of year five for the single issue year, for different interest rate scenarios. The 2.2 percent result at 11.5 percent is the same result as shown in Table 3-12.

TABLE 3-15

INCREASE IN RESERVE REQUIRED
12 YEAR MORTGAGE (D^A=4.6)

NEW MONEY RATE	REQUIRED SURPLUS
11.5%	2.2%
12.5	2.2
13.5	2.2
14.5	2.2
15.5	2.9
16.5	5.0
17.5	6.8
18.5	8.4

Note that for small increases in interest rates, there is no effect on the additional reserve required. At these interest rates, lapses are low enough that C-3 losses are minimal. At higher rates, lapses increase to such an extent that large increases in reserves are required.

A significant question that arises here is how severe a scenario should reserves be sufficient for. Some people differentiate between reasonable and plausible, with reserves to cover all reasonable scenarios, and surplus intended to cover the more extreme, but still plausible scenarios. For reserve tesing at my company, we tend to view reserves as being good for interest rate fluctuations of plus or minus 500 basis points. I believe this is consistent with the testing that went into the DVL standards, though that testing assumed very gradual interest rate changes, for example, 9.5 percent grading down to 4.5 percent over 10 years.

Table 3-16 contains an illustration of the reserve impact of the plus 500 basis point interest-rate change for different assets. As expected, the required reserve increase is very sensitive to the length of the underlying assets.

TABLE 3-16

INCREASE IN RESERVE REQUIRED
INTEREST @ 16.5%

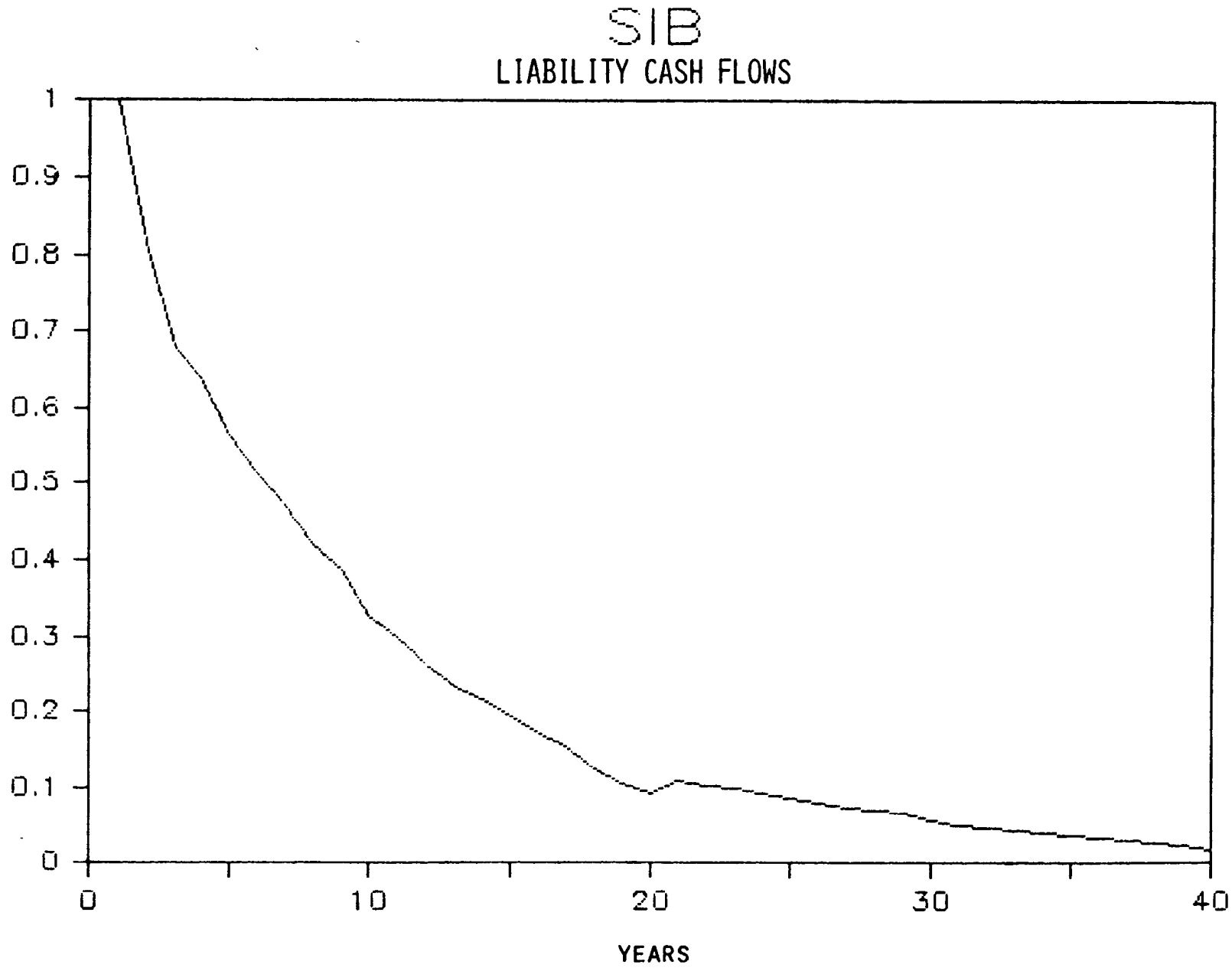
ASSET	D^A	REQUIRED INCREASE
8 YR. MORT.	3.2	2.2%
9 YR. MORT.	3.5	2.3
10 YR. MORT.	3.9	3.1
12 YR. MORT.	4.6	5.0
15 YR. MORT.	5.7	8.2

Another fundamental tool of cash flow analysis is Macauley duration. I assume that most of you are familiar with this concept; if not, I would strongly urge you to become familiar with it, and its various strengths and weaknesses.

I would now like to switch to an entirely different product, which has a quite opposite C-3 risk problem. I believe this provides a good example of a practical application of cash flow analysis.

Exhibit 3-11 shows representative liability cash flows for group survivor income benefit (SIB) payouts. This coverage provides monthly cash payments to survivors of a deceased employee under a group life insurance plan. There is, in effect, a lump-sum consideration arising at time of death and then an immediate commencement of payments. Thus, these benefits are analogous to single premium immediate annuities (SPIAs). However, unlike most SPIAs, the

EXHIBIT 3-11


SIB
LIABILITY CASH FLOWS
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
YEARS

annuitants under SIB are quite young. Thus, the liability cash flows stretch out for an extremely long period of time.

The payments made under SIB contracts can be viewed as guarantees of principal and interest, paid at book value according to the terms of the contracts. Withdrawals of lump sums by the annuitants or plan sponsor are not allowed.

The graph in Exhibit 3-12 compares the asset and liability cash flows. At current interest rates, we do have reasonably good matching. In fact, the Macauley durations for the assets and liabilities are essentially identical. However, the asset cash flows cease after twenty to twenty-five years, while there are material liability cash flows stretching out through the fortieth year. Given that the asset cash flows exceed or equal the liability cash flows through about fifteen years, and given that there are no discretionary withdrawal rights, there is no serious liquidity risk. In other words, if interest rates rise from current levels, we win. Even in later years, where this graph suggests that the liability cash flows exceed the asset cash flows, there will be additional asset cash flows from reinvestment of the earlier positives, so that there is no liquidity risk out there.

The risk instead is a reinvestment risk, that is, a risk that interest rates drop and investment income becomes insufficient to support both reserve increases and the ultimate liability cash outflows.

Although the cash flows match reasonably well in Exhibit 3-13, if interest rates actually do drop, asset calls will serve to increase the mismatch and the resultant losses.

EXHIBIT 3-12

SIB

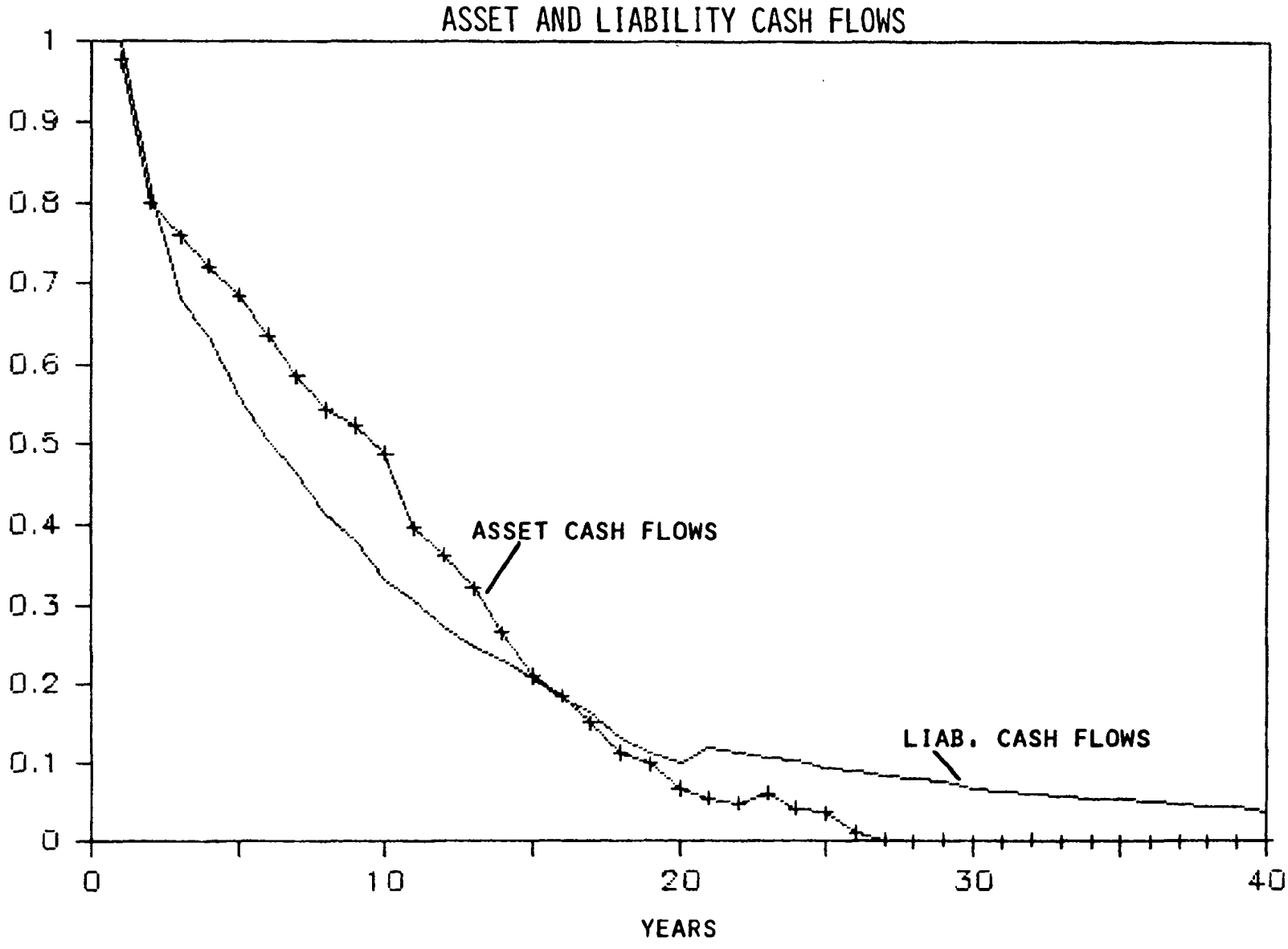
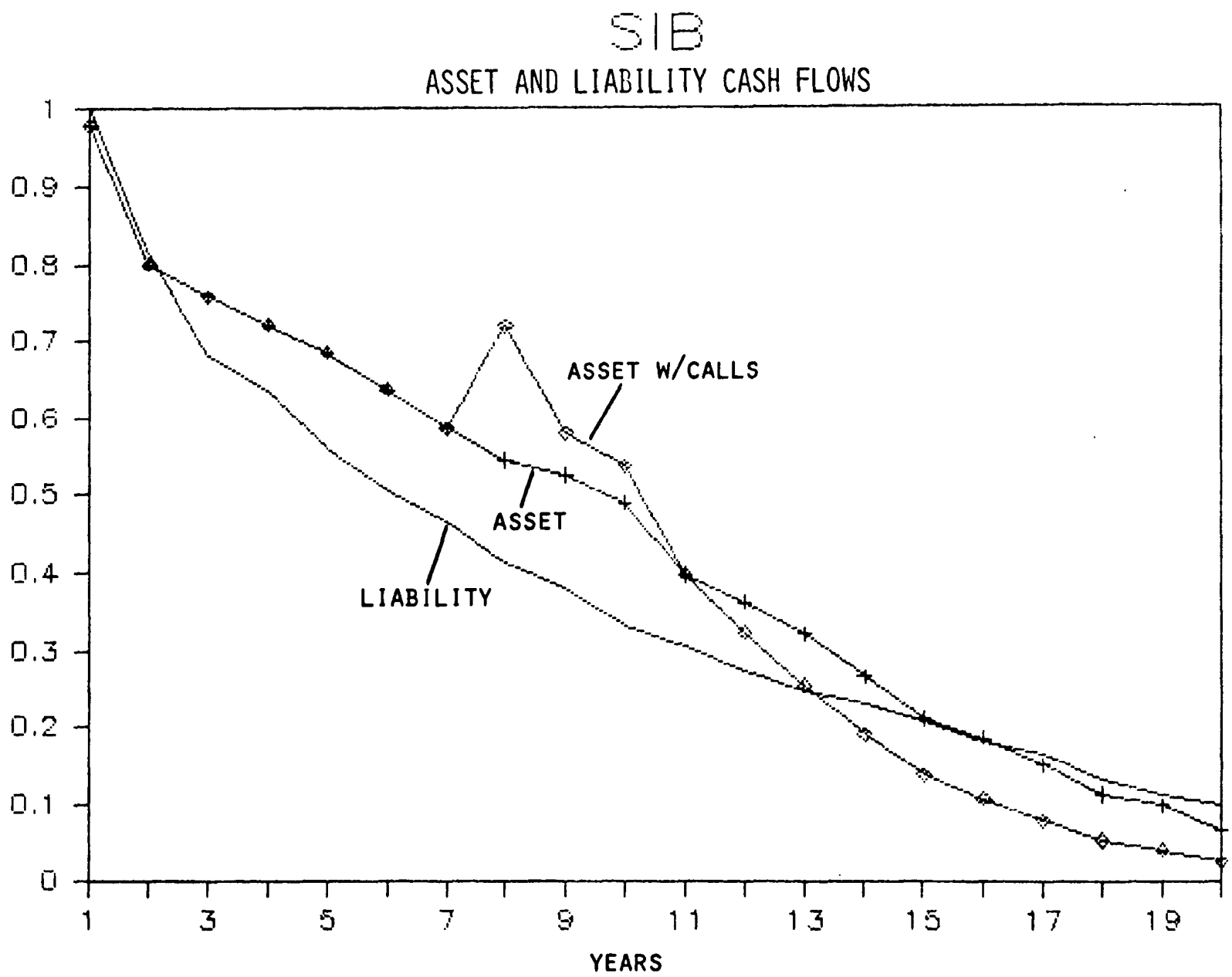


EXHIBIT 3-13


SIB
ASSET AND LIABILITY CASH FLOWS
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
3
5
7
9
11
13
15
17
19
YEARS
ASSET W/CALLS
ASSET
LIABILITY

Under New York's version of the DVL, we could have used a valuation interest rate of 9.5 percent without performing the detailed actuarial certification that New York requires to use higher valuation interest rates. With certification, the maximum valuation rate would have been 11.25 percent last year.

For competitive reasons, my company needed lower reserves than produced by the 9.5 percent assumptions. Thus it began to look at alternate bases in the context of the New York certification.

Those of us who worked on this at my company set out to test reserve adequacy for different reserve bases under a variety of scenarios. As expected, we learned that increasing interest scenarios were not a problem regardless of reserve base. We also learned that increasing, then decreasing, scenarios were not any problem. The biggest problem, again as expected, were decreasing interest scenarios. Things looked worse the faster and further that interest rates were projected to drop.

For testing reserves, my company has generally limited the choice of scenarios to ones in which rates fluctuate within plus/minus 500 basis points from the initial rate. This is consistent with the testing that went into the DVL provisions (9.5 percent to 4.5 percent by .5 percent). More extreme scenarios are certainly plausible, but that is the realm of surplus testing.

Table 3-17 presents representative results for three reserve bases. The first line shows reserves at 11.25 percent. The reserve on this basis equals the present value of the projected annuity cash payments at 11.25 percent. As you can see,

if interest rates decrease substantially, even if they do so quite slowly, this reserve basis will prove inadequate.

TABLE 3-17

SCENARIO 10: 13.5% DECREASING .5% YEAR TO 8.5%

	STAT. REQ. SURPLUS		
RESERVE BASIS	EARNINGS RETAINED	EARNINGS PD. OUT	CFS
11.25%	5.6%	41.6%	--
9.5%	0.0	3.5	11.2
11.25%/9.5%/6.0%	0.0	.5	10.9

I still think we can rely on the test of the present value of future statutory GFOs. We need to recognize though that unless some earnings are retained in the early years, reserves in future years will be inadequate, if these scenarios begin to unfold.

Reserve adequacy thus depends on what happens to the positive earnings in the early years. Since the initial assets earn 13.5 percent, and interest rates decrease gradually, statutory earnings do not become negative until seven to ten years later. If all earnings are retained, the required increase in reserve at time zero essentially equals the negative of the present value of all statutory gains and losses. (Note that the losses continue indefinitely. Thus, this is equal to CFS, with opposite sign.)

If some or all of the early earnings are paid out in these decreasing scenarios, there will be future statutory losses. At some future point, the reserves under the given reserve scale will not be adequate.

As Mr. Mateja pointed out, the dividend assumption can have a very material effect. However, I believe different approaches are called for when assessing current reserve adequacy versus surplus requirements.

We looked at two somewhat more conservative reserve bases. The 9.5 percent basis is the minimum reserve that we could use without certification. This would provide an adequate reserve if the initial earnings are retained, but there are material statutory losses in later years if interest rates ultimately drop below 9.5 percent.

For the third basis, we compute reserves as the present value of the benefit payments, where the discount factors reflect an assumption of 11.25 percent for the first ten years, 9.5 percent for years eleven through twenty, and 6 percent thereafter. On this basis, the reserves are basically adequate even if the earnings in the early years are all paid out.

We, on the company team, decided we liked this third reserve basis precisely because it provides greater conservatism in future years where there is greater uncertainty regarding interest rates. Given the fact that the initial assets were earning roughly 13.5 percent, given the call protection in the assets, and given the reasonable cash flow matching in the early years, we felt reasonably confident that we could earn 11.25 percent in the first ten years. Beyond that, if interest rates did drop substantially, it was very unlikely that we could maintain an 11.25 percent earned rate. However, the 9.5 percent rate seemed to be a reasonably conservative target. Beyond twenty years, there is such great uncertainty regarding interest rates, that we reduced the interest-rate assumption to 6 percent.

The graph in Exhibit 3-14 shows the pattern of earnings for this reserve basis under the scenario where interest rates drop half-a-percent a year and ultimately reach 8.5 percent. The earned interest rate exceeds the reserve interest rate through year sixteen. At that point the earned rate is close to 8.5 percent, and there are a few years of statutory losses. However, the losses are sufficiently modest that if such a scenario began to unfold, the earnings from years twelve through sixteen could be retained, that is, strengthen reserves beginning in year twelve, and be able to absorb the losses in years seventeen through twenty. After year twenty, it is necessary merely to earn more than 6 percent to avoid statutory losses. Thus, in this scenario, statutory gains appear after year twenty.

In Table 3-18 the 11.25/9.5/6.0 reserves are compared to the 11.25 percent and 9.5 percent reserves. At the end of year one, the three-rate reserve is 1.8 percent greater than the 11.25% reserve, but 6.6 percent less than the level 9.5 percent reserve. By year five, it is roughly half-way between the other two reserve bases. Further out, the percentage increase over the 11.25 percent basis becomes substantial, but it is not so substantial in dollar terms, since the reserve level falls off pretty quickly. It is also of interest to note that this reserve basis is actually more conservative than the straight 9.5 percent reserve after the eighth or ninth year. This reflects the assumption of 6 percent interest after twenty years.

EXHIBIT 3-14

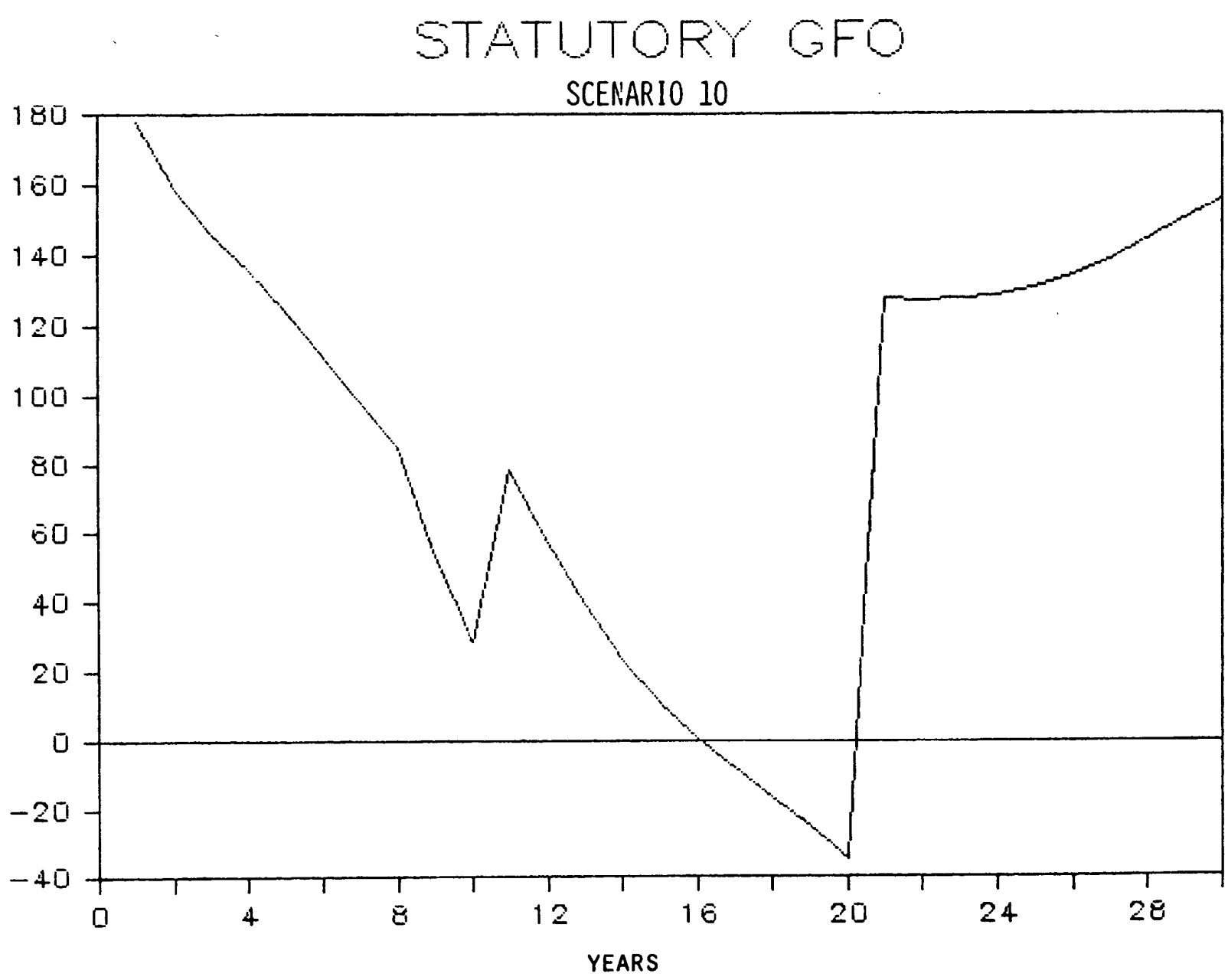

STATUTORY GFO
SCENARIO 10
180
160
140
120
100
80
60
40
20
0
-20
-40
0
4
8
12
16
20
24
28
YEARS
RESERVES @ 11.25%/9.5%/6%

TABLE 3-18

RESERVES @ 11.25% FOR 10 YEARS
9.5% FOR 10 YEARS, 6% THEREAFTER

YEAR	RESERVE	% INC. OVER RESV, @ 11.25%	% INC. OVER RESV. @ 9.5%
1	431	1.8%	-6.6%
5	282	4.2	-4.7
10	183	11.9	2.0
15	122	20.3	9.1
20	93	33.3	20.7
25	68	31.9	20.9
30	43	25.6	16.8
35	23	16.1	10.7
40	4	5.0	3.3

What makes this reserve desirable from our company team's viewpoint then is that the initial reserve is quite close to the minimum reserve (and thus to the tax reserve), but it provides greater conservatism with time. The increasing conservatism is substantial in percentage terms but not so substantial in absolute dollar terms, relative to the level of the initial reserve. Furthermore, we felt that if interest rates remained at high levels for the next several years, we would be willing to weaken reserves by assuming that the 11.25 percent rate stretched out for another ten years from the point of reserve weakening. Thus, we could maintain the reserve at a level roughly 2 percent to 3 percent over the 11.25 percent interest-rate reserve.

From working with the SIB reserves as well as with other annuity reserves, we have seen several areas where the DVL does not work as well as it could.

For life insurance, the formula for the valuation interest rate depends on the guarantee duration of the contract. Thus, for longer-term contracts, greater conservatism is introduced through a slightly lower valuation interest rate. This

is evident in Table 3-19. Based on our company studies, we believe this produces too much conservatism in the early years and too little conservatism in the later years. If companies were to guarantee 6 percent interest on their universal life contracts, which they are permitted to do under the DVL, they could face a very substantial reinvestment risk in the future. Who is to say that interest rates will not be below 6 percent ten or twenty years from now. If you look back twenty years, rates were below 6 percent, and indeed the historical rates prior to the last ten or fifteen years averaged just 3 to 4 percent.

TABLE 3-19

DYNAMIC VALUATION LAW

$$I = .03 + w(R_1 - .03) + w/2(R_2 - .09)$$

GUARANTEE DURATION	w	I, IF R=13.5
≤ 10	.50	7.0%
$>10, \leq 20$	.45	6.75
> 20	.35	6.0

An alternative approach would be to use a sliding rate scale that might start out at perhaps 10 percent for the first five years grading down to perhaps 4 percent for years twenty and beyond.

I would now like to describe certain aspects of experience, at my company, with certifying reserve adequacy for our group pension GICs. We have had three or four years of experience with these certifications now and understand some of the issues in deciding whether or not the assets supporting the reserves make good and sufficient provision for the liabilities.

Consider an example where, for three years, interest rates fluctuate as shown in column 1 of Table 3-19. At the end of the first year new money rates stand at 11 percent. Assume we go through the analysis of cash flows and testing different scenarios as we have been describing. We learn that we can survive any of the decreasing scenarios and most of the up and down, or down and up, scenarios, but see that there is risk if interest rates rise immediately to a very high level. However, even with the increasing interest scenarios, we learn that the reserves are adequate up to 16 percent. If interest rates were to rise above 16 percent, the assets on hand would not be sufficient. We are satisfied, however, that the reserves are appropriate and no increases or decreases are necessary.

TABLE 3-19

RESERVING FOR MISMATCH

END OF YEAR	NEW MONEY RATES	RESERVES SUFFICIENT FOR	INCREASE/ DECREASE RESERVES TO SURVIVE
1	11%	16%	16%
2	15	16	20 ?
3	10	16/20	15 ?

One year later, interest rates actually do rise to a fairly high level, 15 percent for instance. Now we go through the same cash flow analysis and reserve testing, and learn again that the increasing interest scenarios could be a problem. We see that reserves are adequate if interest rates go to 16 percent, but not above. Although this is the same rate as last year, we have much less comfort this year, since 16 percent is just 100 basis points away from 15 percent. Furthermore, we have seen that in one year interest rates can rise 400 basis points, so another 100 basis points now appears pretty plausible, if not likely.

The question we ask now is: Do we have to increase reserves substantially in order to be able to certify that the reserves have as much of a margin as they had one year ago?

By the following year, interest rates have actually fallen (to 10 percent), not increased, and in fact have decreased below the initial level. In our tests, we see there is sufficient call protection so that the decrease in interest rates does not cause any problems and, in fact, we could survive further decreases. If we had gone ahead and increased reserves a year earlier to survive 20 percent, then it is likely that we can still survive increases to 20 percent. Without the increase in reserves a year earlier, we might be able to survive 16 percent. In either case, the question now is whether or not we should release reserves so as to be able to survive plus 500 basis points from the current level. Or, should we continue to aim for 16 percent or 20 percent? After all, one year earlier, we thought either 16 percent or 20 percent was the rate interest rates could conceivably rise to and that perhaps reserves should make provision for. But last year, 20 percent was 500 basis points away; now it is 1,000 basis points away. Holding reserves for a plus 1,000 basis point change in interest rates just does not seem right.

So a question is, what are we aiming for? Or, what level of conservatism are we supposed to be building into the statutory reserves? And, how do we reserve for this mismatch risk over time, where interest rates will indeed fluctuate up and down?

Another problem along the same line is whether we should use the current rate at the time of the certification or some sort of average annual rate. The problem with using the current spot rate is that it is much more volatile than an

average annual rate. Thus, if we have the misfortune of having interest rates at 16 percent on December 31, even though interest rates have averaged only 12 percent for the year, we may overreact and set up a large reserve. On the other hand, if interest rates were at 12 percent from January through November, and then rose to 16 percent in December, it is pretty hard to ignore that fact when doing the certification.

Some good valuation practices for reserving for mismatch suggest themselves. Reserves should be

- o at least adequate at current spot rates.
- o conservative at average rates (for example, a two-year or three-year average).
- o based on margins for plus/minus 500 basis points (such margins could be phased in over some time frame).

If the plus/minus 500 basis point objective is stated in terms of the average rate, and an appropriate averaging basis is used, we can largely avoid the problem of overreacting to interest rate changes. If spot rates increase substantially and remain there, the average rate will ultimately increase, and we will ultimately have margins to survive the plus or minus 500 basis point tests.

I would like to close by summarizing the valuation principles I have postulated. Perhaps these are not true principles; perhaps "valuation standards of practices," or "guidelines," would be more appropriate terms. In any case, I believe the profession needs to address these issues and resolve differences of opinion before the valuation actuary concept can become a reality.

First, reserve adequacy requires that the present value of statutory gains/losses to each future year equals or exceeds zero. Procedures used in testing this relationship must presume that blocks of similar policies are used, nonguaranteed elements are consistent with the scenario, cash flows are consistent with the scenario, and reasonably adverse scenarios are incorporated.

Next, mechanisms are required to prevent large fluctuations in annual earnings/reserves. However, at minimum, adequacy is required under the continuation of current conditions. Margins for adverse deviations should increase with the level of uncertainty.

As mentioned earlier, there is nothing particularly difficult or mysterious about cash flow analysis. Cash flow analysis, duration and CFS are tools the actuary needs to use and understand to assess earnings patterns under different economic scenarios. They are natural extentions of other tools we have long used.