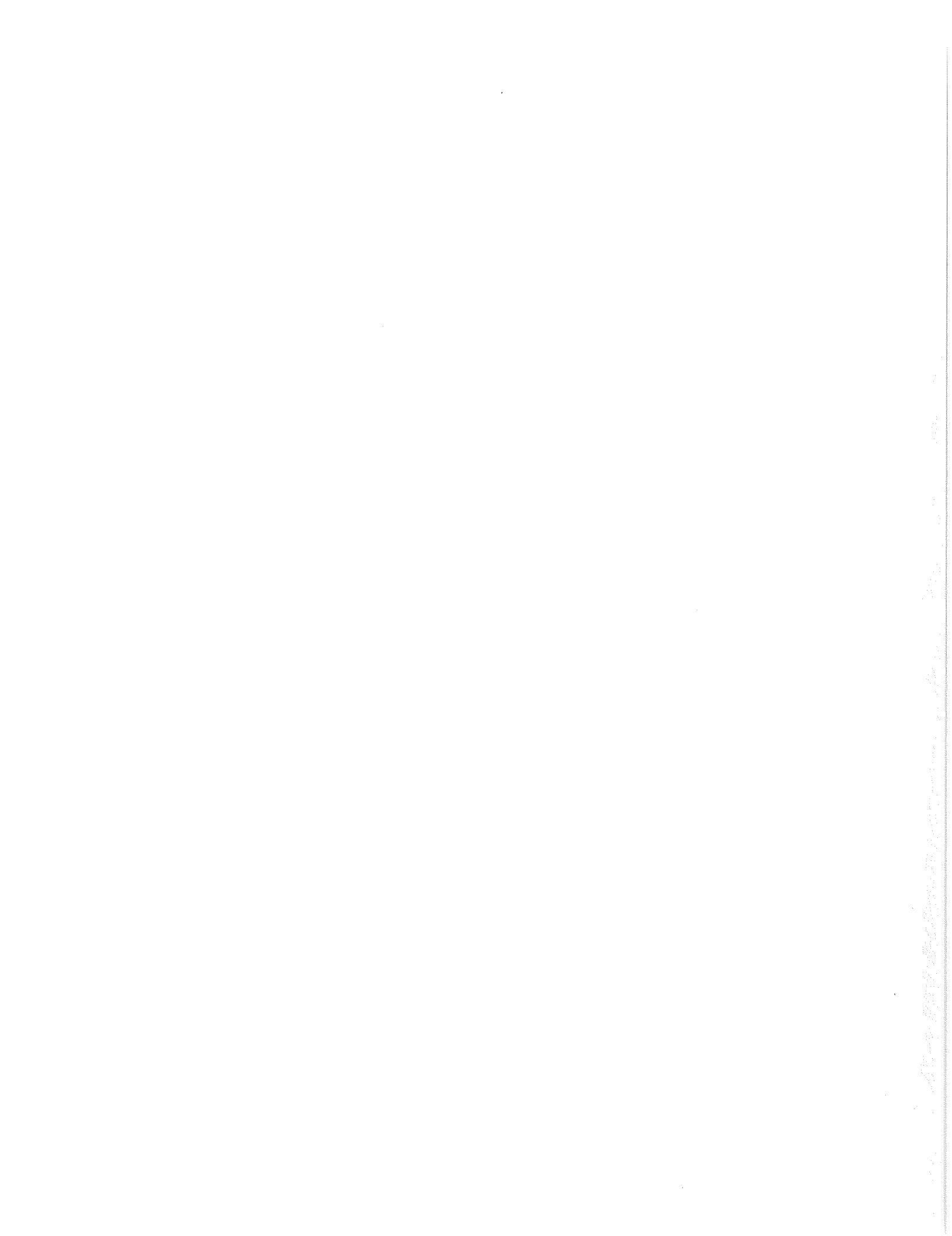


# **CAS Exam 9 Study Kit**

## **“Asset/Liability Management Strategies for Property and Casualty Companies”**

by P.D. Noris

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**Asset/Liability  
Management Strategies  
for Property & Casualty Companies**

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Product Manager  
May 1985

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## **INTRODUCTION**

In addition to being an "insurance" risk intermediary, a Property and Casualty (P&C) insurance company has become a "financial" risk intermediary. Gone are the days when an insurer could be paid *solely* for the function of reducing the disutility of the risk of each insured's loss. The high rates of return that may be earned on insurance premiums while the insurer is waiting for losses to occur, and then be paid, have caused insurers to be dragged, perhaps unknowingly, into the role of financial intermediary. The additional investment risks inherent in this role have long been known to other financial intermediaries, such as commercial banks (and more recently to life insurance companies<sup>1</sup>), but P&C companies are relatively new to this game. It is true that the P&C business is a unique bundle of risks, but many of the techniques developed for other financial intermediaries can be adapted to help P&C insurers manage these varied risks more profitably.

The purpose of this paper is to illustrate a typical P&C insurance company and to suggest how some asset/liability management techniques may be used in order that company management may better control its own destiny. Section I of this paper develops a computer model of the entire P&C insurance industry that is used to illustrate the dynamics of insurance underwriting and investment profitability. The nature of the industry's liabilities, the time profile of their insurance claims, is then explored in Section II. Once the nature of the assets and liabilities is understood, a methodology is developed in Section III which allows us to place a market value on any P&C insurance company. The ability to manage the market value of an insurance company is achieved in Section IV by computing the firm's sensitivity to changes in interest rates. By raising or lowering the firm's sensitivity to interest rates, company management can partake in structured risk taking, choosing when to emphasize investment risk or when to emphasize insurance underwriting risk.

Sections V and VI show the process that would be involved in developing and implementing an investment strategy for a P&C insurer. An investment strategy is illustrated by hypothesizing a number of possible goals of company management and then developing a simple strategy to achieve those goals. The computer model developed previously is then used, in Section VII, to test the historical effectiveness of the strategy, which is shown to be very effective.

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<sup>1</sup> See Toevs and Haney (1984), and Tilley and Jacob (1984).

**SECTION I****THE TYPICAL P&C INSURANCE COMPANY: AN ILLUSTRATION**

This paper develops a model insurance company. The word "model" does not imply that it is an ideal company, rather it refers to the fact that the company is a computer model created using industry-wide data from "Best's Aggregates & Averages." This methodology could certainly be applied to any individual company (and this will be a major thrust of Morgan Stanley's analytical effort in the P&C industry), but the aggregates are meant to be relevant to most companies in the industry today. While the illustrations are developed from industry data, some liberties have been taken for the sake of clarity.

XYZ Casualty, as we will refer to the model company, is constructed to be a primary writer of five lines of business. Sales have been indexed to equal the industry's total sales for each line (percentage of total 1972 premiums shown in parentheses): Auto Liability (39%), Auto Physical Damage (22%), Multiple Peril (17%), Workers' Compensation (13%) and General Liability, including Medical Malpractice (9%). For purposes of our study the company came into "existence" in 1972 and has written business through year-end 1983. By choosing the five largest lines of P&C insurance sales (accounting for over 70% of total industry premiums) XYZ has experienced the same trends in premium growth and underwriting profitability ratios as the aggregate P&C industry, as shown in Figures 1 and 1A.

**XYZ Investment Policy**

XYZ had an investment policy that changed over time but was relatively stable from any one year to the next. In 1972 the first step in implementing this policy was to determine the amount of the Company's Statutory Policyholder's Surplus.<sup>2</sup> The amount of surplus dictated the amount of the firm's holdings in common and preferred equities. While XYZ desired a high percentage of its assets to be invested in stocks (possibly its management felt that equities would achieve a long-term real rate of return), the company could not risk an accounting reduction in its surplus account that would restrict the amount of premiums that could be written (insurance regulators typically limit a company's premium writings to no more than 3 or 4 times surplus). Because common stocks and non-sinking fund preferreds are the only assets that XYZ is required to mark-to-market at the end of each accounting period, it was felt that the insurer should somewhat limit its policyholders' (and shareholders', if it is a stock company) risk of any sharp decline in stock prices. Investment policy in 1972 was to invest no more than 100% of policyholder's surplus in equities, an amount thought to be conservative at the time. We will see that this policy changed radically later in the decade. The annual return on the equity portion of XYZ's investment portfolio is represented by the annual total-return<sup>3</sup> on the S&P 500 Index.

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2. Many definitions are contained in the Appendix.

3. Includes both capital appreciation and dividend income.

Figure 1  
Net Premiums Written

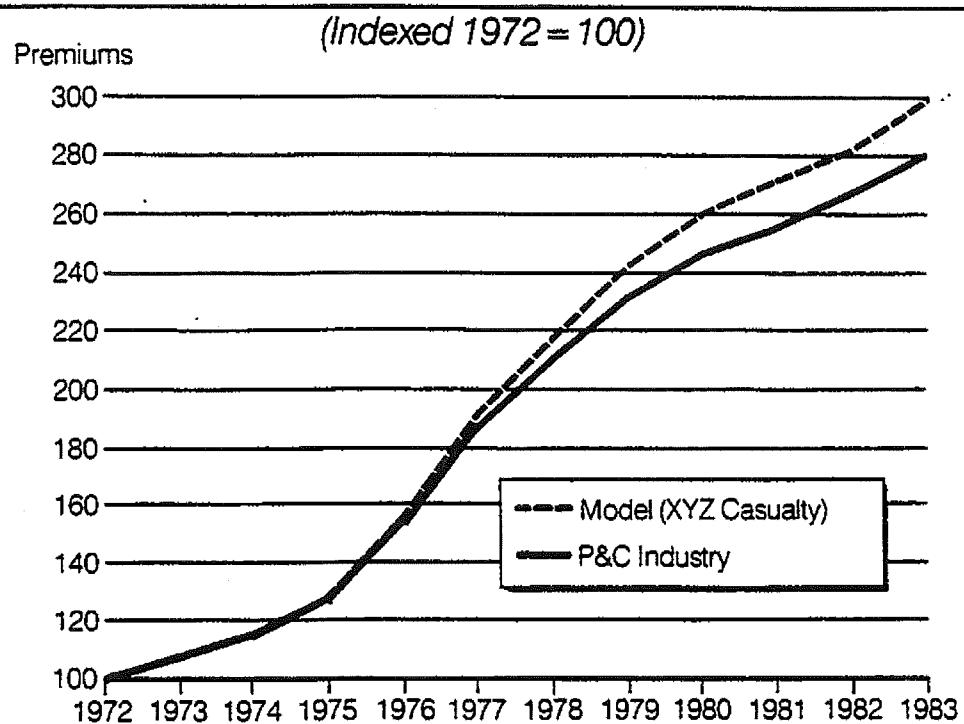
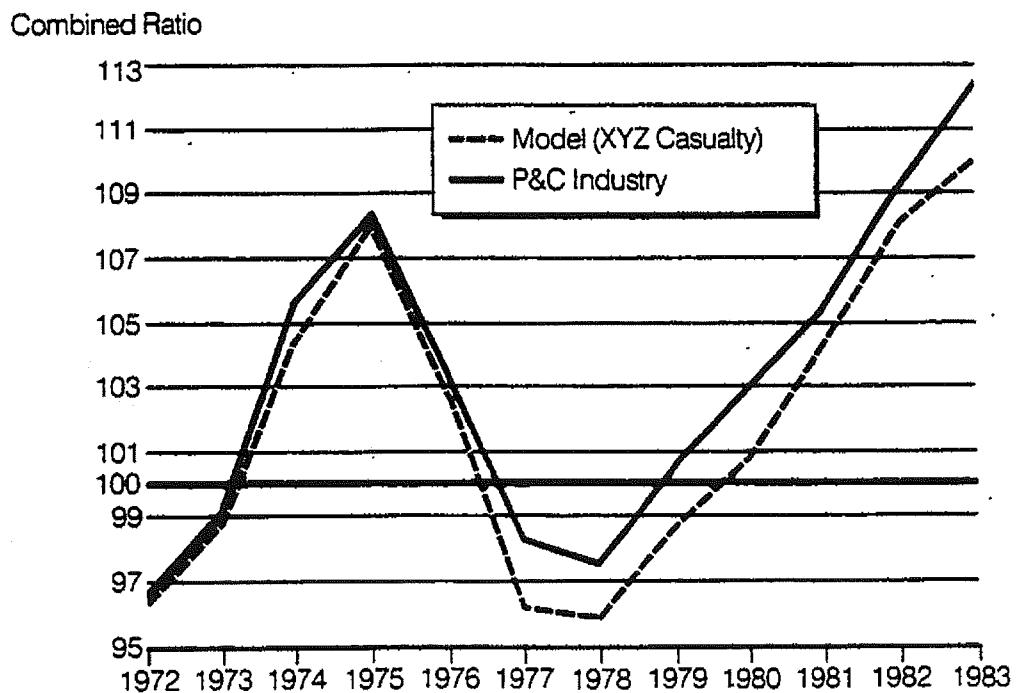


Figure 1A  
Combined Ratio



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The balance of the investment portfolio was placed in instruments that could be held at amortized cost. These instruments included taxable and tax-exempt bonds and taxable money-market instruments. Because of the high effective tax rate of the industry, caused by the profitability of insurance underwriting, and the expectation that this high rate would continue, XYZ decided to place the majority of its remaining assets in tax-exempt Municipal bonds, thus sheltering any investment earnings from income tax. The final portion of assets was invested in taxable bonds, divided between long-term bonds and money-markets, the latter serving as a liquidity reserve.

The decision as to sector and maturity of the fixed-income holdings came not so much from the perspective of what types of insurance liabilities the company was writing, but more from "market" decisions based upon the Investment Committee's analysis of what sectors looked cheap and what part of the yield curve offered value. XYZ felt that so long as the company was looked at from a "going concern" perspective, asset/liability matching need not play a major role in the investment allocation decision. While it was true that most policies' premiums would be available for investment for just a few years, XYZ would be renewing these insurance policies (or ones similar to them) and this would create a stable core of funds that could be invested to any desired part of the maturity spectrum, no matter how long or short. Day-to-day cash needs and any catastrophic losses could be handled by the approximately 5% of assets that were held in money-market instruments. So went the conventional wisdom of the day.

This rationale of largely ignoring liability considerations led to the practice of purchasing predominately long-term (at least 20 years to maturity) bonds, particularly in the Municipal sector where there has traditionally been a very steep positively-sloped yield curve. In our model, which allows for investment at only year-ends, XYZ's practice was to buy 20-year Municipal bonds with yields equal to Moody's Bond-Buyer Index, 20-year taxable bonds with yields equal to Moody's Corporate Bond Composite Index and one-year money-market instruments with yields equal to the annual return on one-year Treasury-Bills. The percentage of assets invested in each asset, as well as the various year-end yields (for bonds) or yearly book rates of return (for stocks and money-markets), are shown in Table I.

As can be seen in Table I, the only major shift that XYZ made in investment policy occurred in 1974 when the percentage of assets devoted to equities was dramatically reduced (from 32% of assets to 19%). One inadvertent reason for this reduction was the disastrous stock market performance in 1974, the S&P fell over 25%, which translated into a reduced equity, and surplus, position. But XYZ also consciously decided to reduce its exposure to equities in addition to that deterioration; 1973 had also been a poor year for equities, declining 15%, and 1974 was shaping up to be a poor year on the underwriting side, with the company's combined ratio coming in at over 104%. Because prospects for 1975 underwriting results did not look any rosier, XYZ decided to reduce its exposure to, and limit the balance sheet impact of, any potential further deterioration in the stock markets. While this timing was unfortunate because the S&P actually rose 25% in 1975, the reduction in risk was necessary from the standpoint of prudence. The reduction in equities as a percent of policyholder's surplus to the 60% range remained in effect through 1983.

Table I  
XYZ Casualty

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
<b>Balance Sheet (percent)</b>												
Assets												
Money Market	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Taxable	10	23	36	38	41	40	38	34	36	35	34	34
Tax-Exempt	40	40	40	40	40	40	40	40	40	40	40	40
Common & Pfd	45	32	19	17	14	15	17	21	19	20	21	21
Total Assets	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Liabilities + Surplus												
Loss Reserves	50%	64%	76%	76%	76%	74%	72%	68%	69%	67%	65%	65%
Surplus	50	36	24	24	24	24	26	28	32	31	33	35
Total Liab. + Surplus	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Stock to Surplus Ratio	91%	91%	78%	72%	68%	58%	57%	61%	65%	61%	59%	60%
<b>Annual Rate of Return</b>												
Common & Pfd: Div.	N/A	3.46%	5.25%	4.08%	3.77%	4.91%	5.28%	5.23%	4.54%	5.41%	4.88%	4.30%
Cap.	N/A	-16.32	-30.50	30.07	18.30	-12.11	1.20	13.25	28.84	-10.99	15.91	17.87
Money Market	N/A	5.80	7.40	7.30	6.30	4.90	7.10	12.90	12.20	14.20	14.40	8.80
<b>Year-End Yields</b>												
Taxable Bonds	7.47%	8.05%	9.63%	9.57%	8.47%	8.54%	9.49%	11.35%	14.04%	15.38%	13.02%	13.01%
Tax-Exempt Bonds	5.11	5.16	7.08	7.29	5.83	5.66	6.61	7.23	9.76	13.30	9.56	9.76

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## Results of XYZ's Investment and Underwriting Practice

Table II shows yearly Income Statements and Balance Sheets for our model insurance company for the eleven-year period between 12/31/72 and 12/31/83. Other relevant statistics, such as average investment yield, stock to surplus ratio and bond portfolio book-to-market ratio are also shown in this table. The tax rate used in calculating the annual tax expense is the effective corporate tax rate for any taxable income (48% tax rate through 1979 and 46% thereafter).

One can see from Table II the extremely poor underwriting results of 1974-1975 and the recent years of 1982 and 1983. In these years our model company actually generated tax benefits from having underwriting losses which exceeded taxable investment income. These benefits helped the company to show positive net operating income in 1974, 1982, and 1983, and to almost break even in 1975. It is likely that our model would have shown positive net operating income in 1975 also, had our analysis gone back far enough to include tax benefits from underwriting losses in the late 1960s.

Likewise, Table II also shows the stellar years of 1977, 1978 and 1979, when strong underwriting gains combined with growing investment income to produce annual book returns-on-surplus<sup>4</sup> of 20% or more. But in some ways it was these halcyon days of the late 1970s that were hiding the sores that would begin to fester in the 1980s. As we will see in Section III, the accounting reports that were showing record profitability belied the chronic asset/liability mismatch of the industry.

A relevant exercise at this point is to see if the results of our model company behave like a typical P&C insurance company. Figures 2, 3 and 4 show how the annual performance of the model company, XYZ Casualty, compares to industry aggregates from Best's. Figure 2 shows the percent change in the model's and the industry's Statutory Surplus each year. Figure 3 shows annual return-on-surplus results. Figure 4 develops investment income as a percent of mean assets. It is readily apparent that our model insurance company looks very much like the insurance industry aggregates. Even though the model company exhibits slightly more volatile performance figures, which would be expected since we began with a clean balance sheet on 12/31/72 and are writing only five lines of business, the model results are generally in the right direction and of the same magnitude as the industry aggregates. The model's slight underperformance, as measured by return-on-surplus, can be explained by its higher effective tax rate compared to the industry (our model company does not have any tax loss carry-forwards from pre-1972 underwriting periods). The "fresh start" we gave our company would also explain the model's slightly higher average investment yields than those of the industry, which include investments from business that was written in much lower yield environments of years before 1972.

It is interesting to see that an industry as large and complicated as the Property and Casualty Industry can be very nearly replicated by a fairly simplified model that assumes only five lines of insurance, four available investments and allows inflow or outflow of funds only at year end. This is a fortunate circumstance, since it significantly simplifies Section IV of our analysis which looks at the impact of changing the firm's investment policy to account for the nature of the industry's liabilities.

4. ROS = Net Operating Income - Beginning Surplus.

Figure 2

*Change in Surplus*

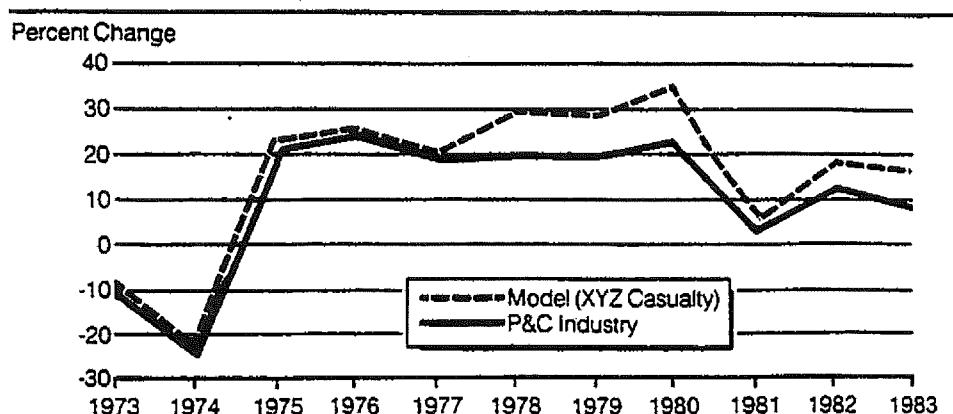


Figure 3

*Return on Surplus*

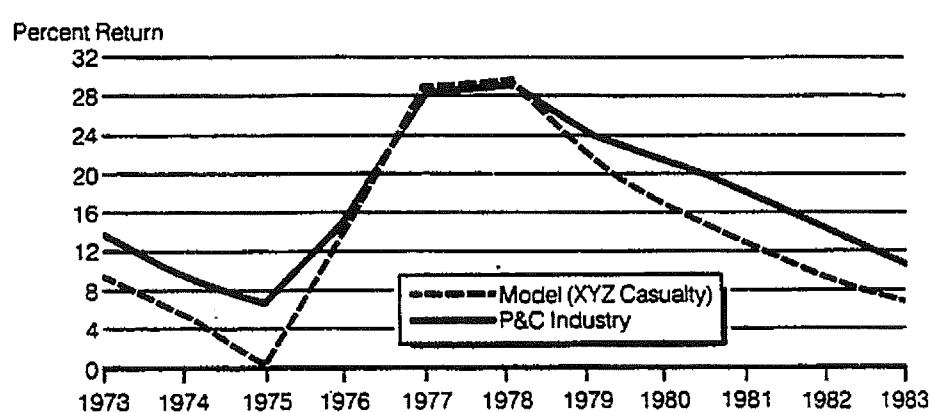
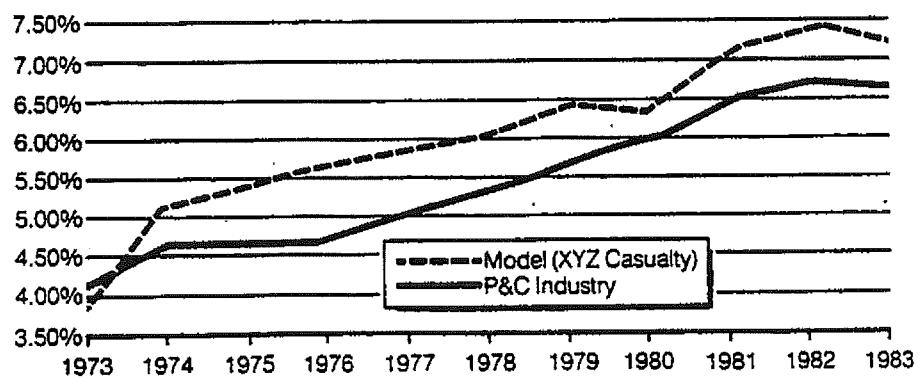


Figure 4

*Investment Income as % of Mean Assets*



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Table II  
XYZ Casualty

Income Statement	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Net Premium Earned												
Auto Liab	\$11,383	\$11,744	\$11,889	\$12,807	\$15,122	\$18,159	\$20,073	\$21,682	\$22,934	\$24,011	\$25,610	\$27,528
Auto Phys	6,408	6,864	7,106	7,399	8,962	10,961	12,484	13,969	15,466	16,469	17,579	19,178
Workers Comp	4,010	4,676	5,332	5,965	7,274	9,072	10,771	12,653	13,895	14,407	13,918	14,097
Multi Peril	5,083	5,941	6,815	7,751	9,382	11,309	13,162	15,082	16,544	17,562	18,828	20,014
General Liab	2,564	2,734	2,921	3,644	5,038	6,571	7,380	7,726	7,797	7,370	7,077	7,240
Total Premium	\$29,448	\$31,959	\$34,063	\$37,566	\$45,724	\$56,072	\$63,870	\$71,112	\$76,636	\$79,819	\$83,012	\$88,057
Expenses												
Losses Incurred	20,519	22,974	26,201	30,712	35,610	40,415	45,489	52,542	57,794	62,401	67,338	72,846
Underwriting Exp	7,842	8,613	9,339	9,862	11,355	13,546	15,763	17,696	19,430	20,915	22,412	24,069
Net Underwriting Income	\$ 1,087	\$ 372	(\$ 1,477)	(\$ 3,008)	(\$ 1,240)	\$ 2,111	\$ 2,618	\$ 874	(\$ 588)	(\$ 3,498)	(\$ 6,736)	(\$ 8,856)
Investment Income												
Money Mkt	0	66	111	126	136	131	227	494	556	769	847	.580
Taxable	0	164	529	1,084	1,462	1,807	2,289	2,724	3,132	3,590	4,309	4,902
Tax-Exempt	0	469	612	741	996	1,233	1,475	1,807	2,226	2,896	3,400	3,938
Dividend	0	360	510	263	275	433	478	595	715	1,221	1,099	1,105
Investment Exp	0	(76)	(99)	(114)	(143)	(176)	(21)	(253)	(301)	(357)	(388)	(435)
Pre-tax Investment Income	\$ 0	\$ 984	\$ 1,663	\$ 2,100	\$ 2,728	\$ 3,428	\$ 4,257	\$ 5,367	\$ 6,328	\$ 8,029	\$ 9,266	\$ 10,091
Pre-tax Operating Income	\$ 1,087	\$ 1,356	\$ 186	(\$ 908)	\$ 1,487	\$ 5,539	\$ 6,875	\$ 6,242	\$ 5,739	\$ 4,532	\$ 2,528	\$ 1,233
Income Taxes	522	279	(413)	(899)	123	1,890	2,397	1,886	1,337	275	(831)	(1,677)
Net Operating Income	\$ 565	\$ 1,077	\$ 599	(\$ 9)	\$ 1,364	\$ 3,649	\$ 4,478	\$ 4,356	\$ 4,403	\$ 4,257	\$ 3,358	\$ 2,910

Table II  
XYZ Casualty  
(continued)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
<b>Balance Sheet</b>												
<b>Assets</b>												
Money Market	\$ 1,146	\$ 1,495	\$ 1,722	\$ 2,159	\$ 2,667	\$ 3,200	\$ 3,829	\$ 4,553	\$ 5,412	\$ 5,885	\$ 6,589	\$ 7,353
Taxable	2,197	6,731	12,492	16,448	20,521	26,155	30,748	34,341	36,962	42,218	46,778	50,350
Tax-Exempt	9,172	11,958	13,773	17,274	21,339	25,603	30,633	36,426	43,298	47,080	52,715	59,822
Common & Pfd	<u>10,414</u>	<u>9,711</u>	<u>6,446</u>	<u>7,304</u>	<u>8,820</u>	<u>9,050</u>	<u>11,373</u>	<u>15,746</u>	<u>22,572</u>	<u>25,705</u>	<u>30,529</u>	
Total Assets	<u>\$22,929</u>	<u>\$29,896</u>	<u>\$44,433</u>	<u>\$63,186</u>	<u>\$53,348</u>	<u>\$64,009</u>	<u>\$76,583</u>	<u>\$91,066</u>	<u>\$108,244</u>	<u>\$117,700</u>	<u>\$131,787</u>	<u>\$147,054</u>
<b>Liabilities &amp; Surplus</b>												
Loss Reserves	\$11,465	\$19,262	\$26,162	\$32,986	\$40,447	\$48,527	\$56,515	\$65,135	\$73,370	\$81,049	\$88,196	\$95,960
Surplus	<u>11,465</u>	<u>10,634</u>	<u>8,271</u>	<u>10,200</u>	<u>12,901</u>	<u>15,482</u>	<u>20,068</u>	<u>25,931</u>	<u>34,874</u>	<u>36,651</u>	<u>43,592</u>	<u>51,095</u>
Total Liab. & Surplus	<u>\$22,929</u>	<u>\$29,896</u>	<u>\$43,433</u>	<u>\$43,186</u>	<u>\$53,348</u>	<u>\$64,009</u>	<u>\$76,583</u>	<u>\$91,066</u>	<u>\$108,244</u>	<u>\$117,700</u>	<u>\$131,787</u>	<u>\$147,054</u>
Stock to Surplus Ratio	91%	91%	78%	72%	68%	58%	57%	61%	65%	61%	59%	60%
Inv. Inc. % of Assets	N/A	3.73%	5.17%	5.41%	5.65%	5.84%	6.06%	6.40%	6.75%	7.11%	7.43%	7.24%
Ratio of Market Value to Book:												
Taxable Bonds	100%	98%	92%	95%	104%	102%	95%	84%	71%	71%	86%	87%
Tax-Exempt Bonds	100%	100%	84%	87%	102%	104%	95%	92%	78%	63%	88%	88%

**SECTION II****THE NATURE OF P&C LIABILITIES**

P&C liabilities have a characteristic time profile—a premium that is received today will be paid out in the form of a claim some time in the future. The timing and size of this claim payment depends upon the nature of the line of business—automobile damage claims settle rather quickly and cannot exceed the value of the automobile while medical malpractice claims may take years to litigate and their ultimate size is somewhat at the whim of a jury. Any individual claim may settle sooner or later than expected (no one knows when a particular ship will sink), but reasonably stable payment patterns may be determined in the *aggregate*. This is one of the principles on which insurance practice is based.

Once the payment pattern for a line of business has been determined, various *immunization* techniques may be used to increase the probability that investment results are sufficient to achieve a profitable return for that line of business. As mentioned in Section I, traditional investment practice has largely ignored the nature of liability payment patterns, relying instead upon a hoped-for stability in investment markets so that a previously purchased long-term investment could be used to back the new year's written coverages (after the new year's premiums were, in effect, used to pay off claims on previous years' coverages). This practice also relied upon a stability in insurance pricing from one policy year to the next, in that the income from last year's investments will be adequate only if this year's pricing does not assume any extra income from higher market rates of interest. We are all too much aware of the recent instability of the investment and insurance markets. In such an environment, investment strategies that do not account for the nature of the liability side of the balance sheet are likely to cause great financial distress.

**Typical Liability Payment Patterns**

The five insurance lines of XYZ Casualty each have a characteristic payment pattern, known as their "loss development."<sup>5</sup> For purposes of this exposition, we have assumed that loss reserve data published for the P&C industry are a reasonable basis for projections and illustrations. These patterns were gleaned from two "Best's Insurance Management Reports" articles dealing with 1983 casualty loss reserves.<sup>6</sup> In general, loss payment patterns for any individual company are developed in Schedules O and P of a company's Statutory Annual Statement. In addition, company actuaries are routinely involved in developing their best estimates as to future loss payments resulting from each year's coverages.

**Automobile Physical Damage**

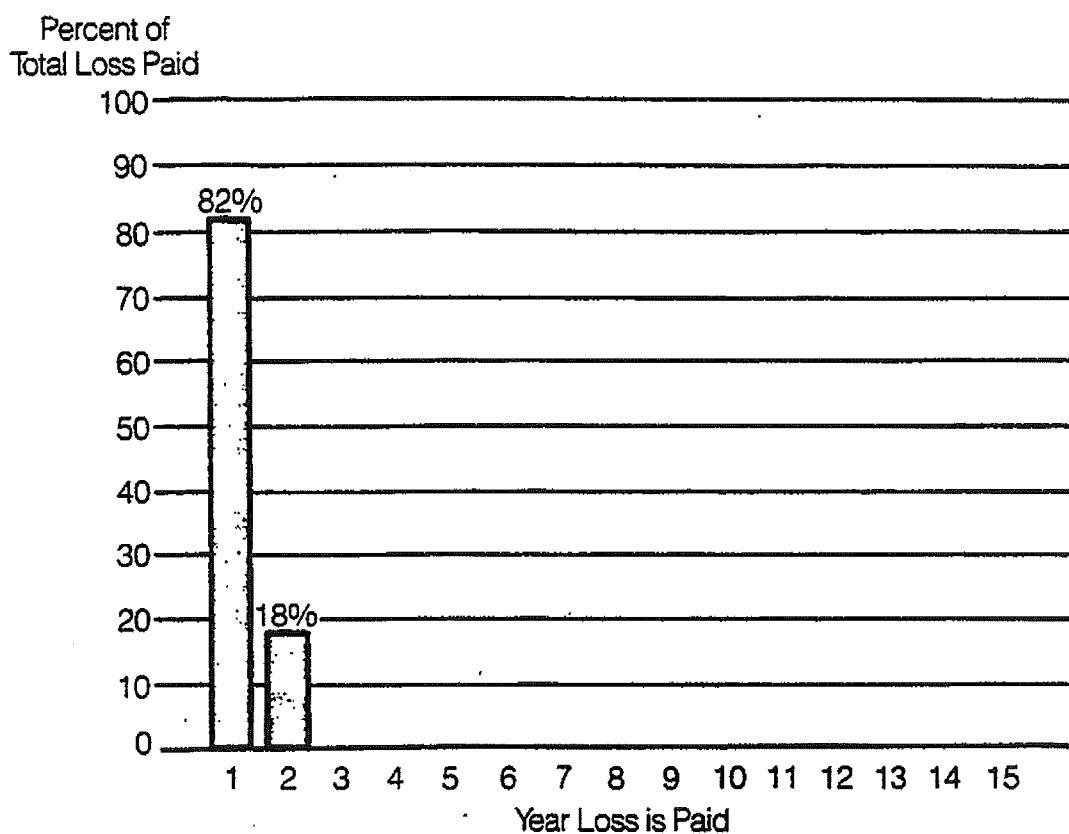
Coverage for Automobile Physical Damage is a classic example of what is known as a "short-tailed" line of business. The "tail" refers to the length of time it takes to settle or pay off a claim once it has occurred. Typical industry data shows that, 82% of the time, an insured automobile accident will be paid off within one year.<sup>7</sup> In fact, the tail on Auto Physical Damage

5. The amount by which actual losses vary from original projections is also sometimes referred to as "loss development."

6. "1983 Casualty Loss Reserves," *Best's Insurance Management Reports*, November 12, 1984 and December 24, 1984.

7. Loss patterns for Auto Physical Damage were not included in the Best's articles and have been developed from individual company Annual Statements.

Figure 5  
*Auto Physical Damage  
Loss Development*



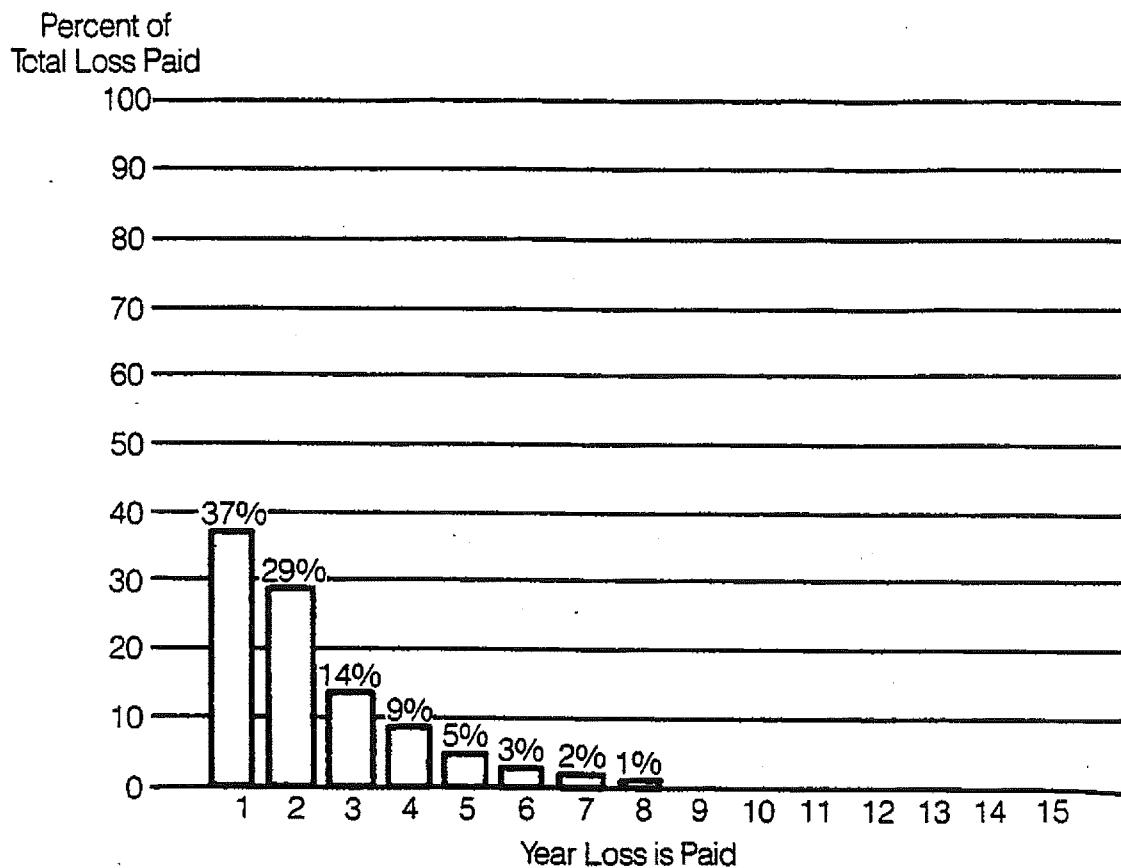
rarely extends beyond the second accident loss year and, for the sake of our analysis, we will assume that all losses are paid in years one and two.

As a visual tool in comparing various lines of insurance business, we will graph the loss payment patterns for each line, placing the percent of total to be paid on the "Y-axis" and number of years since occurrence of the loss on the "X-axis." We can quickly see the short-tailed nature of Automobile Physical Damage (Figure 5).

#### **Automobile Liability**

Automobile Liability coverage has a longer tail than Physical Damage coverage. Liability claims are susceptible to negotiation and litigation and an insurance company may find that it has use of premium funds for many years until a claim eventually has to be paid. In many ways it was the industry's realization that long-tailed claims could result in substantial amounts of investment income that fostered the practice of "cash flow underwriting," which is explained in more detail in a later section. Best's data indicates that only 37% of Auto Liability claims will be paid within the first year and less than two-thirds of the claims by the end of the second year. Typical data from individual companies indicate that the tail extends about 8 years.

Figure 6  
*Auto Liability  
Loss Development*



An added risk of any long-tailed line is that eventual payments on claims may differ significantly from original projections. Many unknowns impact the ultimate size of a claim, not the least of which is the future rate of inflation. Actuaries must account for some amount of inflation of future claims in their loss development analyses, but the recent violent swings in inflation (particularly inflation of medical costs) have shown these assumptions to be suspect. There is also the additional impact of "social" inflation, as court awards rise higher and higher each day, that must somehow be accounted for. The topic of immunizing against an inflation rate is discussed later in this paper and, for the present, we will assume that the company actuary has accurately projected the future loss development pattern for each line of business.

#### **Multiple Peril**

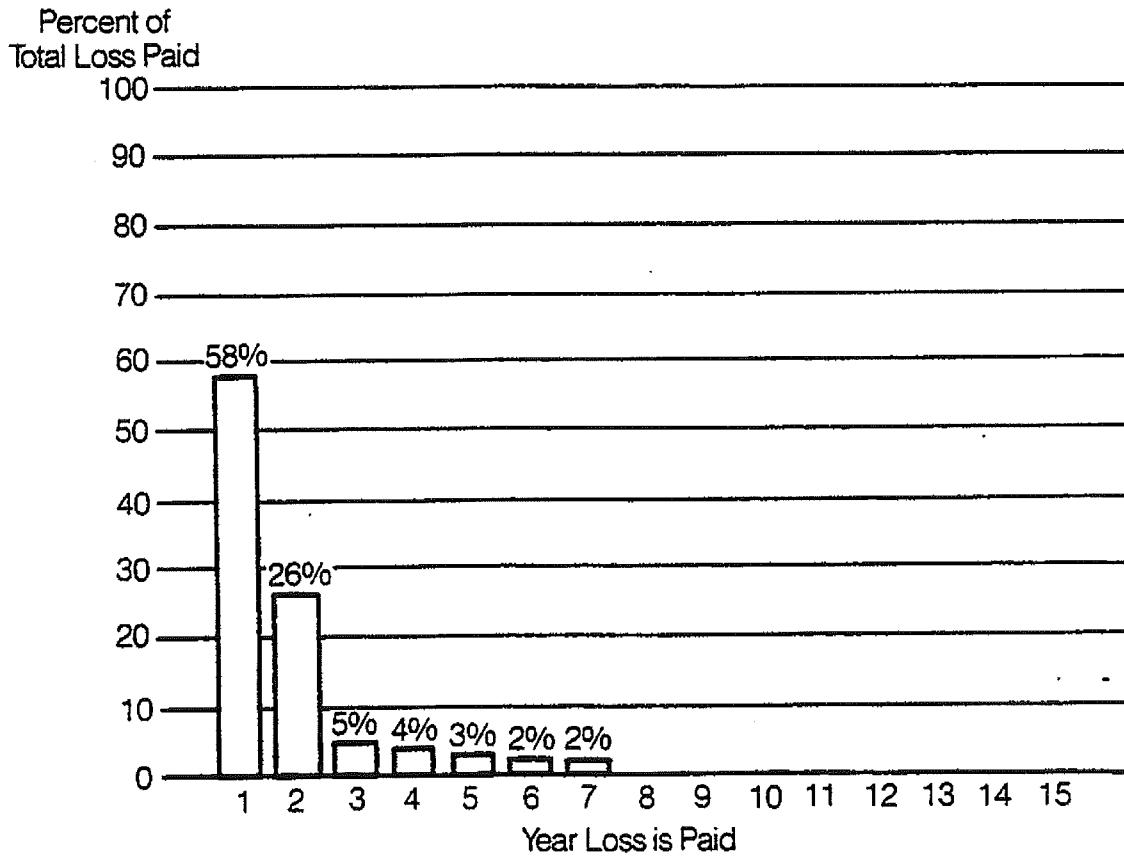
Multiple Peril insurance is a combination of both property (damage) and liability insurance. Perils that are covered include such things as fire, lightning, hail, windstorms, and explosions, and the insurance policy covers both the repair of physical damage as well as coverage for any liability claims that arise from the catastrophic events. The lines of business that are

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included in this category are farmowners, homeowners and commercial multiple peril in addition to ocean marine, aircraft, and boiler and machinery. Because Multiple Peril consists predominantly of property coverage, it has a shorter tail than pure liability coverage, with almost 96% of incurred losses being paid within 5 years. The shorter tail also means that there is little time for unanticipated occurrences to impact the size of the eventual claims, thus the line exhibits relatively stable loss development statistics over the years as losses develop in accordance with the original projections.

Another statistic which adds to the degree of confidence one may place on the loss development pattern for Multiple Peril, and most other short-tailed lines, is the low amount of first year reserves that are in the form of IBNR. IBNR, which stands for "Incurred But Not Reported," refers to all the losses that the insurance company has theoretically had on a line of business but have not yet been reported to the company. These claims will eventually be paid, after the loss has been reported, so the insurance company must reserve against them. The smaller the amount of reserves that are in the form of IBNR, the more confidence the company actuaries have that they have accounted for all eventual losses. Generally, only 15% of Multiple Peril losses are not reported before the end of the first year.

Figure 7  
*Multiple Peril  
Loss Development*

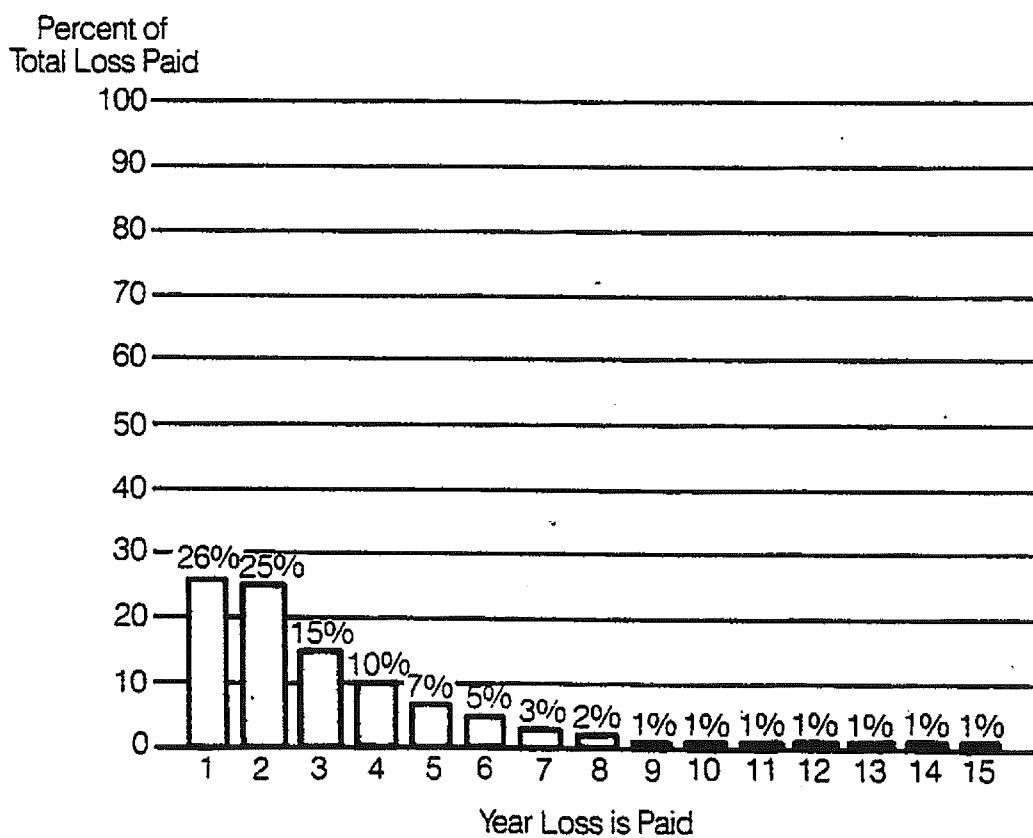


**Workers' Compensation**

Another form of liability insurance is Workers' Compensation, which provides benefits for employees injured on the job, or who incur a job-connected disease. Unlike traditional liability coverages, Workers' Compensation pays benefits without regard to whether the employer is at fault. The worker can be paid without establishing negligence on the part of the employer.

Workers' Compensation is the classic example of a long-tailed line of insurance. This long tail arises from two circumstances: 1) many claims take years to develop, and 2) many loss claims are paid in the form of recurring medical cost payments or income supplements. Occupational diseases, such as asbestosis, can take decades to reach their disabling stage. Even with legal questions aside as to which insurer is responsible for loss coverage (either the company that was the insurer when the disease was contracted or the one when the symptoms appeared), the loss reserves for Workers' Compensation extend well beyond 10 years. The long tail and the high degree of confidence that can be placed on certain portions of Workers' Compensation losses, such as disability income payments, have caused this line to become one of the few lines of P&C insurance for which discounted reserve accounting is used. The topic of discounting reserves is covered in Section VII of this report.

Figure 8

**Workers' Compensation  
Loss Development**

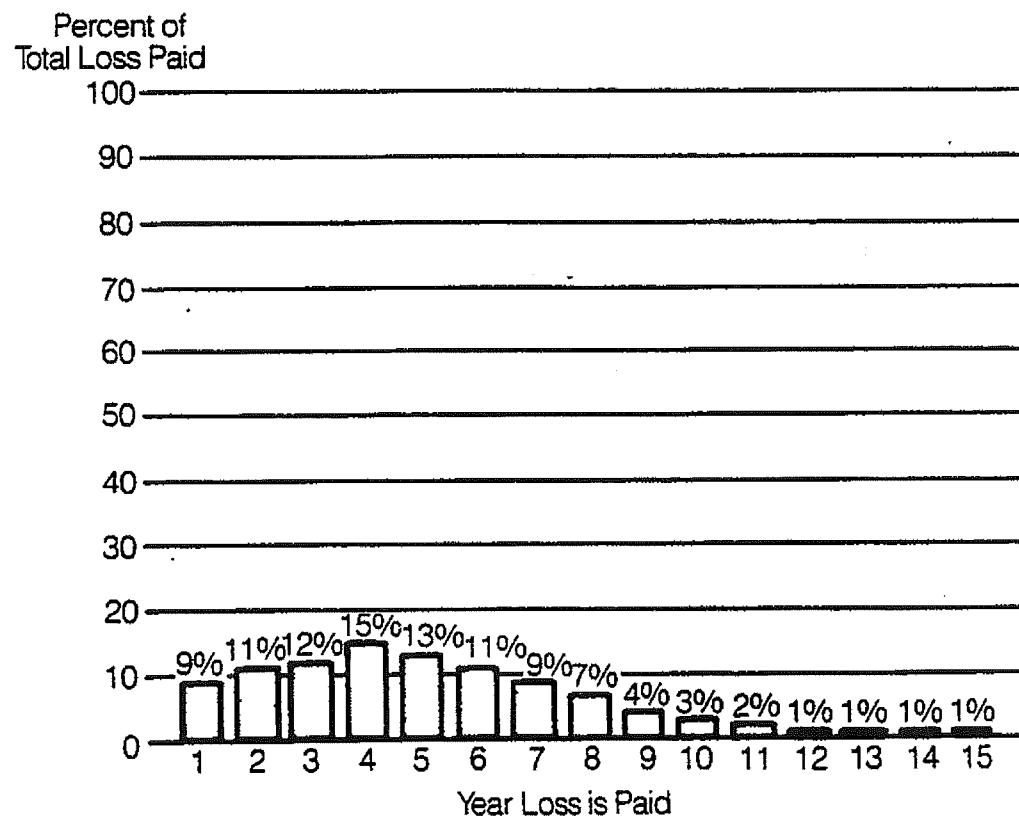
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## General Liability

Of all the lines of insurance, General Liability, which includes Medical Malpractice in our examples, poses the most difficult problem in estimating the loss development pattern and size of loss reserve. Public attitudes toward responsibility on such issues as product and toxic substance liability are evolving toward a definition of strict liability and court awards are increasing at an alarming rate. The actuary who is standing in 1985 and is trying to develop loss reserves for claims that will be paid as a result of a medical malpractice trial in 1990 is, at best, using a cloudy crystal ball. Best's analysts state that General Liability reserves for losses arising in 1978 have had to be increased 25% through year-end 1983, and it is estimated that over 40% of these losses are still yet to be paid!<sup>18</sup>

The loss development pattern used in Figure 9 is meant only to be representative of the patterns that develop for General and Medical Malpractice Liability. This pattern indicates the lag before most cases come to trial which causes an increasing pattern in losses in years one through four. The very long tail can result from years of litigation and, finally, settlement in the form of many years of support payments.

Figure 9  
*General Liability*  
*Loss Development*



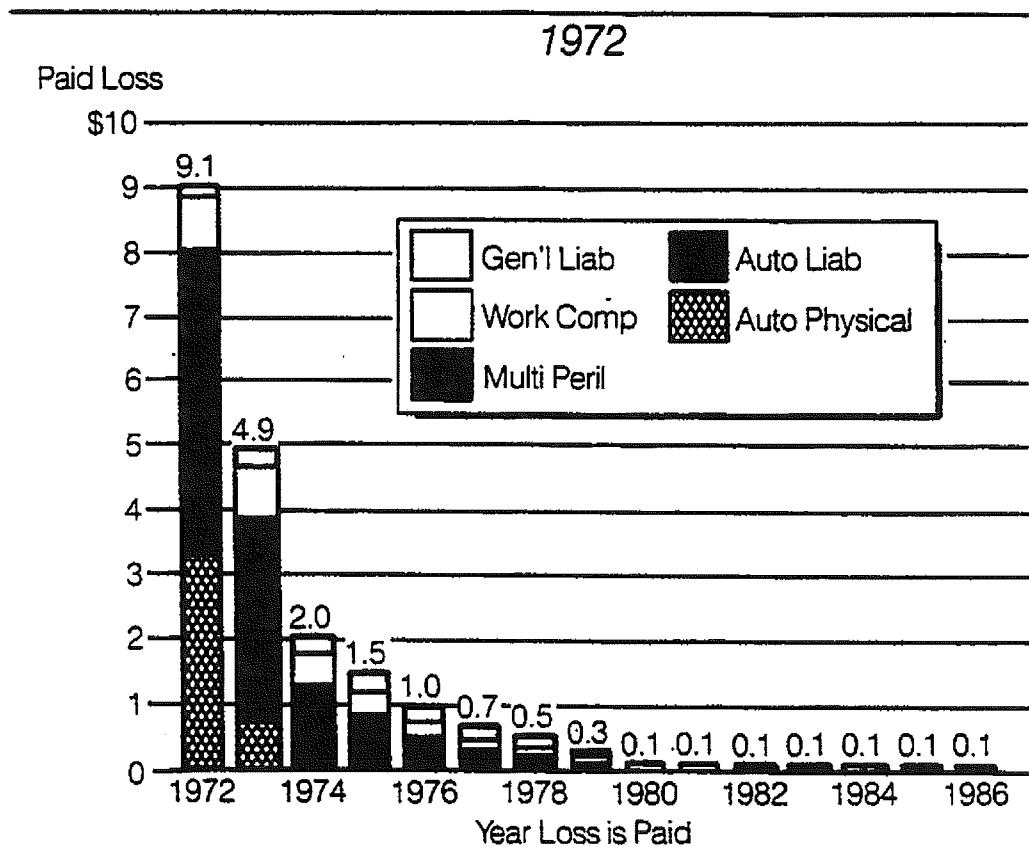
18. "1983 Casualty Loss Reserves," op. cit.

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## The Liabilities in Aggregate

Once the individual lines of business have been analyzed, the next step is to aggregate them into a representation of future liabilities of the entire company. Figure 10 shows the projected loss payments for XYZ Casualty for the business written in 1972 (that is, as of year-end 1972). To construct Figure 10, the various loss payment patterns are simply weighted by the dollar amount of loss reserves that are held for each line at year-end. The *loss reserves* themselves are a function of the amount of premiums that were earned and what the expected loss ratio is for that line of insurance. The *loss ratio* for any line of insurance is the amount of premium, stated as a percentage, that is expected to be ultimately paid out in the form of a loss, including the cost of adjusting that loss. There is a counterpart to the loss ratio which is known as the *expense ratio*. The *expense ratio* is the portion of each premium that is used by the insurance company to pay for the costs of writing insurance—overhead, sales compensation, etc. While the expenses may, in theory, also have a development pattern associated with them, we will assume that all expenses are paid in the year that a premium is earned.

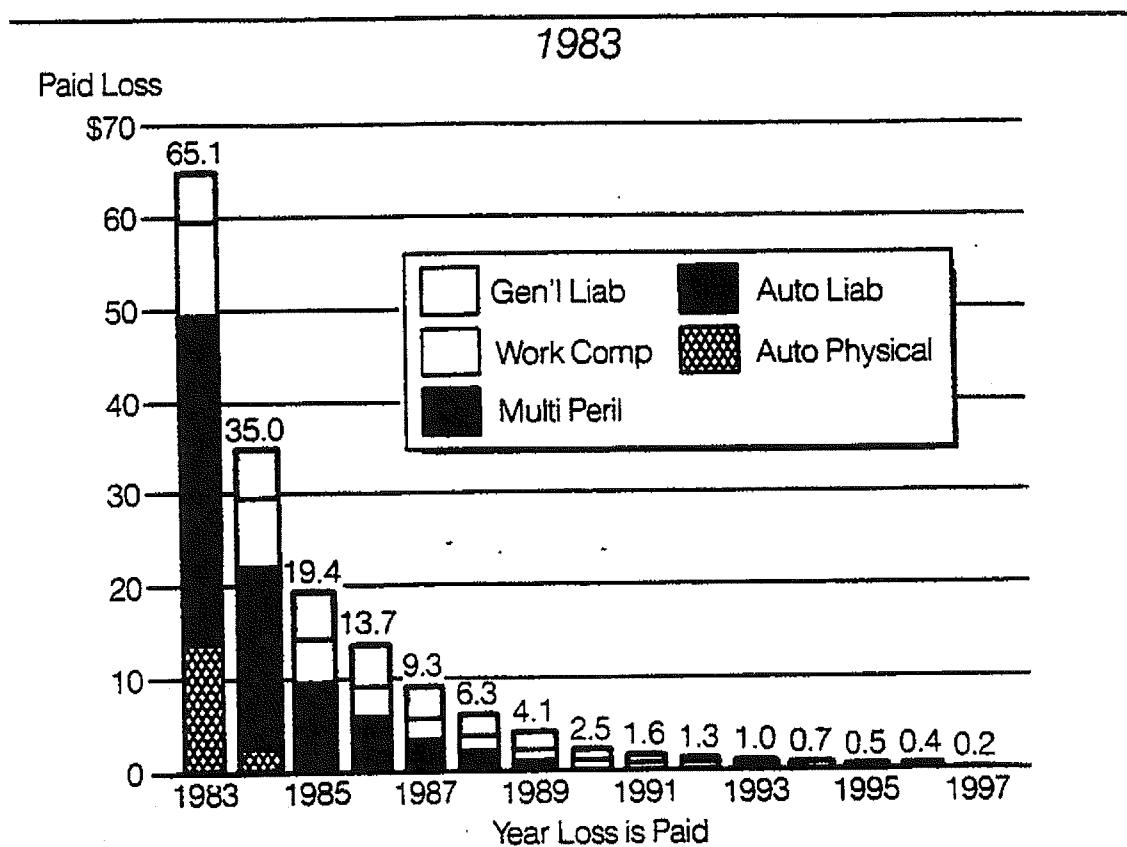
Figure 10  
XYZ Casualty  
Liability Schedule



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Figure 10 represents the paid-loss profile for a company that has been in existence for only one year. As time goes by, the liability profile changes, including a component from business that was written in the most recent year and a component from losses that have not yet been paid on previous years' business. At year-end 1983, XYZ Casualty has 11 years of underwriting experience. This mature company represented in Figure 11 has approached a paid-loss profile that will exhibit very little change from year-to-year, impacted only by changes in the mix of business, pricing of future coverage, and losses developing differently from assumptions as to incidence and claim size. It is against this liability profile that we must construct an investment strategy that will help support and increase the total market value of the company.

Figure 11  
XYZ Casualty  
Mature Liability Schedule



## SECTION III

## MARKET VALUE OF A PROPERTY &amp; CASUALTY INSURANCE COMPANY

The total market value of any firm is derived from two sources: portfolio equity and franchise equity.<sup>9</sup> Portfolio equity equals the value of *currently booked assets less the value of currently booked liabilities*. The value of net income from business *not yet booked* by the insurance company is termed franchise equity and is equivalent to the economically determined value for goodwill. While a proper asset/liability model should consider both forms of equity in the measurement of risk exposure, the practical problems in measuring franchise equity preclude it from most analyses. This paper will continue the traditional emphasis on measuring the interest rate risk exposure of portfolio equity only. Portfolio equity, as proxy for the total value of the firm, does however represent an excellent target account for interest rate risk management.

The size of portfolio equity for a P&C insurance company depends upon the difference between the cash flows from currently booked assets (its investment account) and the amounts needed to pay insurance claims on currently booked coverages (its loss profile). There are a number of useful ways portfolio equity can be analyzed, the simplest being a visual representation of all cash flows in the year they are to be received or paid. Just as we aggregated the liabilities of a P&C insurance company into a profile (Figure 11), we can aggregate its assets. Figure 12 displays this representation of assets for XYZ Casualty as of 12/31/83. Asset flows are shown by layering the coupon and maturity cash flows from each of the investment portfolio's holdings on top of one another. Short-term money-market instruments (T-Bills) are shown as a lump sum in 1984, their maturity year, as are the firm's holdings in common stock. Because XYZ's investment policy of purchasing 20-year bonds has been in effect for only the past 11 years, we can see that the bond maturity ladder does not commence until 1992. The ladder, however, is then continuous from 1992 through 2003. An even more mature P&C company will have this ladder entirely filled in, but the large amount of growth the industry experienced in the 1970s indicates this asset profile is probably not unlike many insurers today.

The liabilities are put in the same context by placing the paid loss profile (developed in Figure 11) over the asset profile. Figure 12 now represents all of XYZ Casualty's tangible accounts: assets, liabilities, and *portfolio equity* (the amount assets exceed liabilities).

How should one value portfolio equity? Even though assets clearly exceed liabilities in every year except 1985 and 1986, the firm's portfolio equity may or may not be positive. Should we "borrow" some excess assets from later years to plug the gap and then simply sum up the excess assets? Or should we give some weight to the fact that the shortfalls occur sooner than most of the excesses and derive some "present value" concept of portfolio equity by allowing for the time value of money? The latter is clearly the preferred method, but even this answer is somewhat ambiguous because there are many ways to discount cash flows.

<sup>9</sup> The concepts concerning the market value of equity described in this section are covered more fully for other financial institutions by Tress and Hanes in "Measuring and Managing Interest Rate Risk: A Guide to Asset/Liability Models Used in Banks and Thrifts," Morgan Stanley, October 1984.

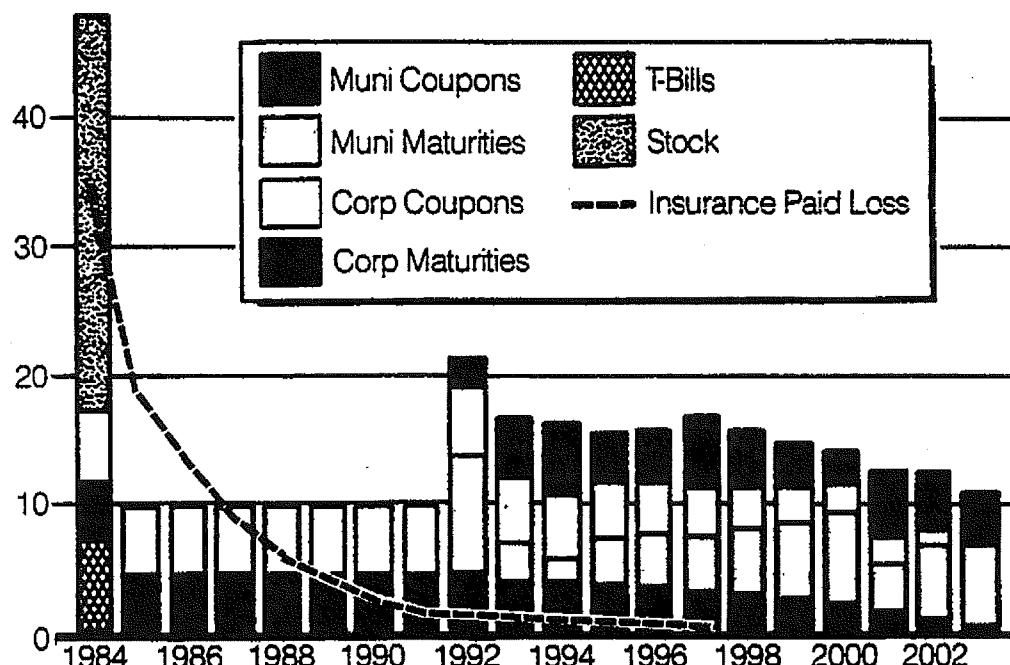
Figure 12

*XYZ Casualty  
Assets and Liabilities*

12/31/83

Amount of Cash Flow

\$50



**Book Value Accounting: Statutory Surplus**

Book value accounting would have us discount most asset cash flows at the yields at which they were *originally* purchased. Stocks would be shown at their current market value (as would any assets in default). On the other hand, because the P&C industry does not utilize discounting of reserves, the firm's liabilities as represented by the paid loss profile are, in effect, discounted at 0% interest (that is, the losses are simply summed).<sup>10</sup> The portfolio equity value that results from this calculation (Table III) is known as Statutory Surplus and is the same as shown previously in Table I.

**Current Value Accounting: Current Value Surplus**

Some have argued that book value accounting is inappropriate for companies that must compete in a market value world. Since 1981 the Progressive Corporation (an Ohio P&C insurance company) has included in its annual report to shareholders financial statements on both a GAAP<sup>11</sup> basis and a basis they term "Current Value/Total Return" accounting; "current value" referring to values on the balance sheet and "total return" referring to values on the income statement.

10. Some discounting of P&C reserves is becoming more prevalent, particularly in Workers' Compensation, but this practice has been ignored for the illustrative purposes of this paper.

11. Generally Accepted Accounting Principles (GAAP) for P&C companies is similar to Statutory Accounting in its treatment of the valuation of financial assets. GAAP, however, is on an accrual basis for some expenses and some reserves.

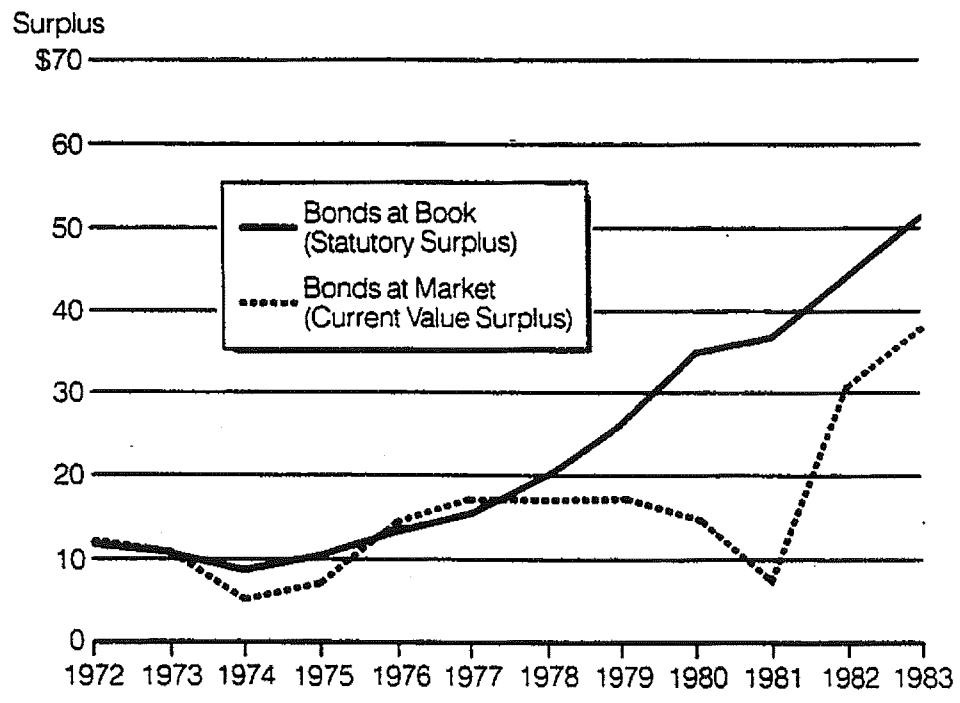
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Progressive Corp.'s methodology is to value all assets at current market values and to include any unrealized capital gains or losses (reduced by the long-term capital gains tax rate) in both the balance sheet and the income statement. Neither statutory nor GAAP accounting practice recognizes unrealized gains or losses on book value assets, and unrealized gains or losses on stocks are shown only on the balance sheet (as an adjustment to surplus or shareholders' equity). Progressive states that "total return" accounting "most accurately reflects real economic results."<sup>12</sup> The Current Value Surplus (CVS) for XYZ Casualty is also developed in Table III.

Progressive's current value/total return accounting system certainly would have highlighted the plight of the P&C industry as interest rates rose during 1974-75 and then again beginning in 1979. Figure 13 shows the surplus of XYZ Casualty on both a statutory basis (with bonds held at book value) and a current value basis (with bonds at market) for the period from 1972 to 1983. While statutory surplus exhibits a somewhat constant rate of positive growth, with absolute declines in only 1973 and 1974 caused by the bear market in stocks, the CVS displays quite an erratic path. Current value accounting would have shown the industry to have dangerously low amounts of surplus in 1974 and 1981, amounts that were only 61% and 20%, respectively, of reported statutory surplus. Even with the bond rally of 1982-83, the CVS of XYZ Casualty is only 74% of statutory surplus at year-end 1983.

Figure 13

### XYZ Casualty Statutory Surplus vs. Current Value Surplus



12. Progressive Corp., 1981 Annual Report: page 3.

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**Table III-A**  
**Statutory Surplus (12/31/83)**

	Description	Discounting Used?	Rate	Value
Assets:				
	Money Market	Yes	Cost	\$ 7,353
	Taxable Bonds	Yes	Cost	50,350
	Tax-exempt Bonds	Yes	Cost	58,822
	Stock	N/A	Market	30,529
	Total Assets			<u>\$147,054</u>
Liabilities:				
	Loss Reserves	No	N/A	\$ 95,960
Statutory Surplus:				<u>\$ 51,094</u>

**Table III-B**  
**Current Value Surplus (12/31/83)**

	Description	Discounting Used?	Rate	Value
Assets:				
	Money Market	Yes	Market	\$ 7,353
	Taxable Bonds	Yes	Market	43,765
	Tax-exempt Bonds	Yes	Market	52,056
	Stock	N/A	Market	30,529
	Total Assets			<u>\$133,703</u>
Liabilities:				
	Loss Reserves	No	N/A	\$ 95,960
Current Value Surplus:				<u>\$ 37,743</u>

**Table III-C**  
**Market Value Surplus (12/31/83)**

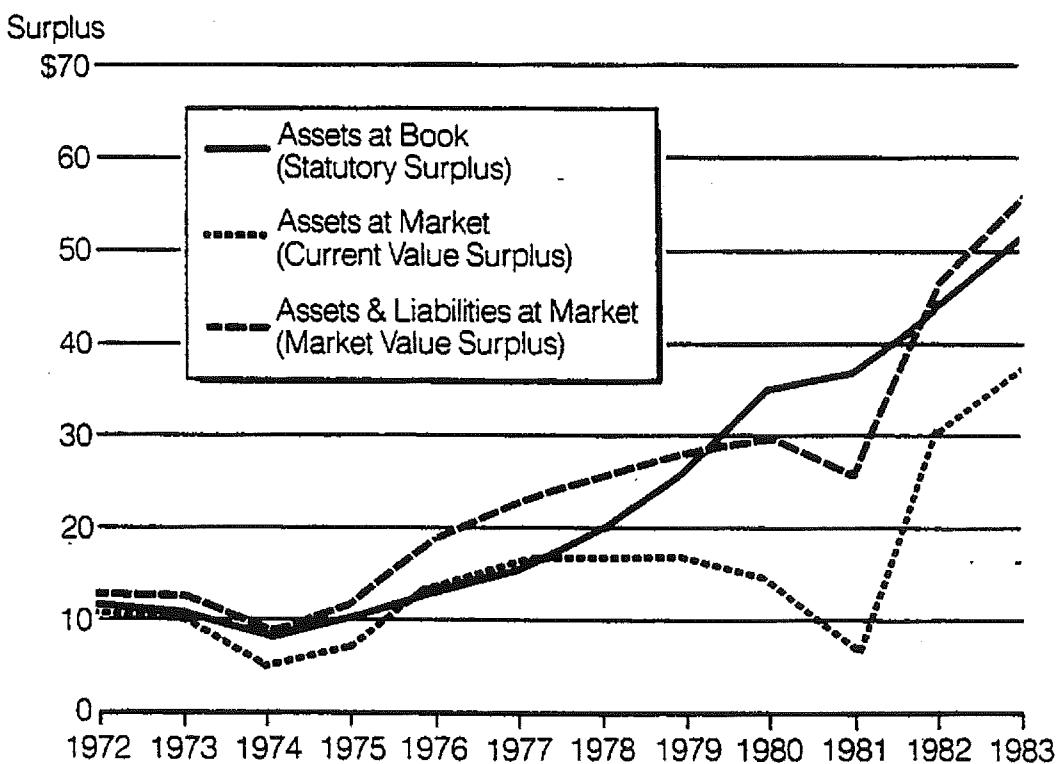
	Description	Discounting Used?	Rate	Value
Assets:				
	Money Market	Yes	Market	\$ 7,353
	Taxable Bonds	Yes	Market	43,765
	Tax-exempt Bonds	Yes	Market	52,056
	Stock	N/A	Market	30,529
	Total Assets			<u>\$133,703</u>
Liabilities:				
	Loss Reserves	Yes	After-Tax	\$ 78,631
Market Value Surplus:				<u>\$ 55,072</u>

**Economic Accounting: Market Value Surplus**

In reality, current value accounting goes too far in one direction in placing a market value on the firm's surplus account. While we have put a market value on all of the firm's financial assets, we have still ignored the time value of money in valuing the firm's liabilities. In a true economic sense, any losses that are to be paid in the future should be discounted in a manner similar to the way we discounted future cash flows on assets. Any positive rate of interest used in discounting these reserves would, of course, lower the present value of the loss reserve and, thus, increase the reported amount of surplus. Questions arise as to what rate of interest should be used in discounting P&C reserves. Possibilities are: the firm's historical yield on its asset portfolio (a recommendation of the U.S. General Accounting Office); the yields for bonds in the current investment market; a conservative rate of interest, such as 4%, to account for the potential variation in loss experience; or no discounting at all (statutory accounting). For purposes of this paper, we will use the spot yields for municipal bonds in the current investment market as a proxy for the after-tax investment yield available on current investments. The result of placing a market value on both assets and liabilities, Market Value Surplus (MVS) for XYZ Casualty at year-end 1983, is also shown in Table III.

The first thing that strikes us about XYZ's year-end 1983 MVS is that it is *higher* than the reported statutory surplus (\$55,072 versus \$51,094). Does this mean that XYZ is healthier

Figure 14

**XYZ Casualty  
Surplus Values**

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than the reported statements indicate? It is possible. If XYZ has accurately projected its loss payment pattern (a big "if" in today's environment), and we have used the appropriate after-tax rates of discount, then we can truly say that the insurer has a current MVS which is higher than the reported statutory surplus. But, as shown below in Figure 14, the MVS of XYZ has also been volatile, almost as volatile as CVS. In addition, even though the application of a discount rate to an insurer's liabilities will always cause MVS to be higher than CVS, and often higher than statutory surplus, there have been periods (1980 and 1981) when MVS has been lower than statutory surplus. If the industry continues its traditional investment practice of investing in long-term bonds, MVS will continue to be highly volatile. There exists, however, an alternative. Company management can choose to *manage* the volatility of MVS and help insure the profitable growth of the firm.

SECTION IV

MANAGING MARKET VALUE SURPLUS

Why should an insurance company manage its MVS, as opposed to managing statutory surplus or no management at all? One obvious reason is that a firm's MVS is a leading indicator of the future book value of the firm, since book value converges to market value as asset and liability items mature. Managing the MVS will thus enable company management to better serve the goals of the company's owners—that is, higher future stock prices for stockholders or higher future dividends for policyholders as the case may be.

Another reason for managing market value surplus may come from insurance regulators who, from time to time, have become concerned with the capital adequacy of the industry. A 1979 report commissioned by the National Association of Insurance Commissioners (NAIC) had the actuarial consulting firm of Tillinghast, Nelson & Warren (TNW) review the appropriateness of using various forms of market value accounting, including the consideration of some type of Mandatory Securities Valuation Reserve (MSVR) for P&C company balance sheets.<sup>13</sup> While TNW's ultimate recommendation was that an MSVR is not appropriate for P&C insurers, they did make a number of observations as to the appropriate size and valuation of an insurer's surplus account, concluding that statutory accounting is appropriate only if asset/liability matching is adhered to:

*...Thus, we believe much more attention must be paid to the matching of asset and liability maturities. If liabilities are reasonably stated, and if matching is reasonably carried out, then amortized values will not result in significant surplus distortions.<sup>14</sup>*

*...The required surplus for insurers who keep their asset and liability maturity schedules in balance with each other should be less than for those who choose to invest in longer maturities, thereby accepting the additional risk of market price fluctuations.<sup>15</sup>*

**Interest Rate Sensitivity of Surplus: Duration Gap**

To understand how to manage the value of a firm's MVS, one must first understand what can make that value change. The MVS of an insurer can be viewed as a "net" bond, albeit one with an unusual series of positive and negative cash flows. These flows are represented by the amounts assets differ from liabilities, developed previously in Figure 12 and shown below in Figure 15. Like any bond, the MVS will have a price sensitivity to changes in interest rates—the "longer" the bond is, the more sensitive its price will be to a given change in interest rates. The particular measure of "length" that accurately communicates the interest rate sensitivity of the "net bond" is known as *duration*.<sup>16</sup>

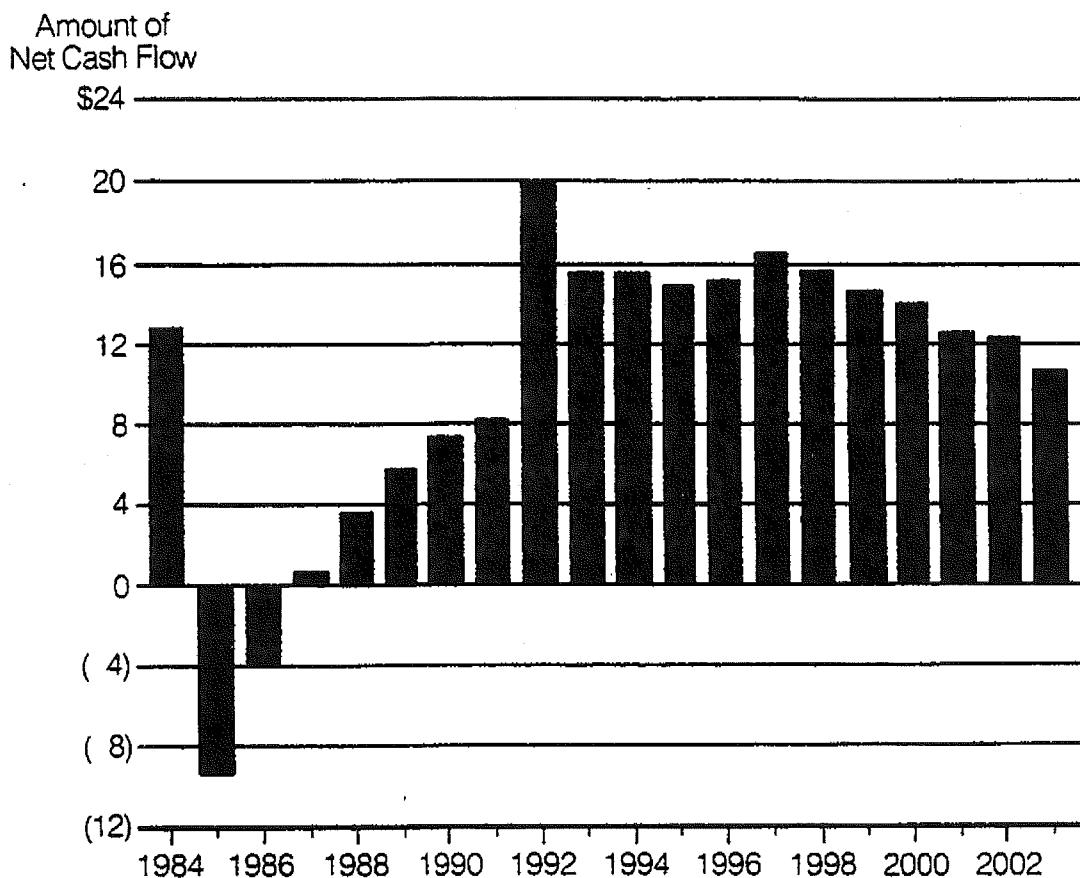
13. "Appropriateness of a Mandatory Securities Valuation Reserve Concept for Property and Casualty Insurers": Parts I & II; Tillinghast, Nelson & Warren; February 1978 and March 1979.

14. TNW report; part I; page 68.

15. TNW report; part I; page 101.

16. This paper presupposes a familiarity with the concept of duration. For a more fully developed explanation of duration, see Toevs (Jan., 1984) and, for the particular context of P&C insurers, "Duration," an article by Ronald Ferguson in the Proceedings of the Casualty Actuarial Society, volume 70 (1983).

Figure 15  
XYZ Casualty  
Cash Flow of Net Surplus



The calculations required to find, and then manage, the duration of the MVS account are based upon the additive property of duration—the duration of a combination of instruments is equal to the sum of the durations of the individual instruments weighted by their appropriate market values. Table III had shown us that the MVS of an insurer is equal to the market value of its assets ( $MV_A$ ) minus the market value of its liabilities ( $MV_L$ ), or:

$$MVS = MV_A - MV_L \quad (1)$$

Using Equation 1, we can weight each component's duration ( $D$ ) by its market value ( $MV$ ):

$$D_{mvs} * MVS = (D_{mvA} * MV_A) - (D_{mvL} * MV_L) \quad (2)$$

Therefore, to find the duration of MVS:

$$D_{mvs} = \frac{(D_{mvA} * MV_A) - (D_{mvL} * MV_L)}{MVS} \quad (3)$$

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The amount that the duration of MVS varies from zero is known as the firm's "duration gap."<sup>17</sup> Insurers with a larger duration gap will have a market value surplus that is more susceptible to changes in interest rates than firms with a gap of zero. A positive duration gap, indicating that assets are longer than liabilities, would mean that any rise in interest rates would lower the absolute value of MVS (since asset market values would decline relatively more than liability market values). A negative duration gap would mean that rising interest rates would actually improve the amount of MVS.

Table IV develops the duration gap for XYZ Casualty as of year-end 1983. The durations for the fixed-income assets (bonds and money-markets) are calculated using the traditional method of weighing their various cash flows' terms-to-maturity by their present values, this method is sometimes referred to as Macaulay's duration. The common stock component of XYZ's asset base presents an interesting duration calculation problem, since common stock does not have a maturity date or maturity value. It can be shown that the duration of a consol bond (a bond which pays coupons into perpetuity) is approximately  $1/i$ , where  $i$  is its yield to maturity. Similarly, the duration of common stock may be approximated by  $1/d$ , where  $d$  is the current dividend rate.<sup>18</sup> In our model, we assume  $d$  to equal the annual dividend yield on the S&P 500. Even though we can calculate a duration for stock, the value of stock is influenced by many other factors in addition to interest rates, indicating that the duration value for stock is, at best, an approximation for its sensitivity to interest rates. Section IV of this paper will show how a company's stock holdings can be modified to make them fit better into an asset/liability management framework.

Table IV  
Market Value Surplus (12/31/83)

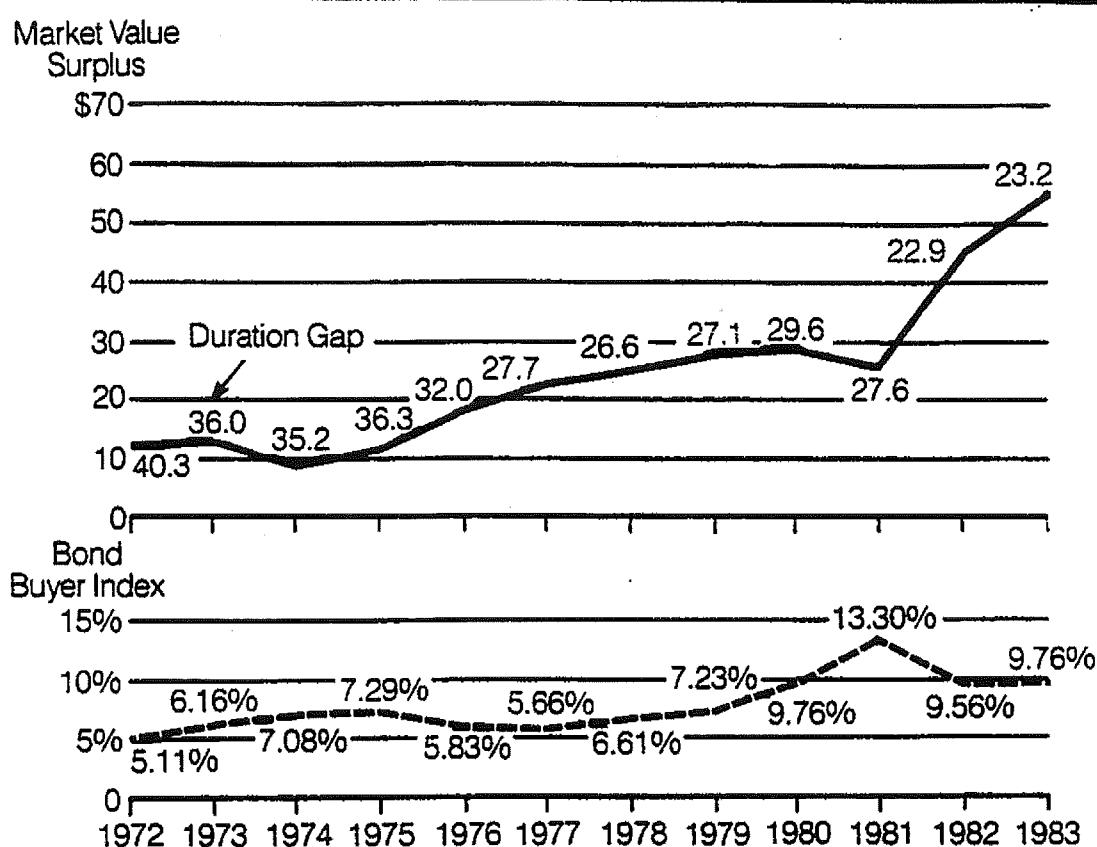
	Description	Discounting Used?	Discounting Rate	Value	Duration
Assets:					
	Money Market	Yes	Market	\$ 7,353	1.00 yrs
	Taxable Bonds	Yes	Market	43,765	7.33
	Tax-exempt Bonds	Yes	Market	52,056	8.41
	Stock	N/A	Market	30,529	23.26
	Total Assets			\$133,703	11.04 yrs
Liabilities:					
	Loss Reserves	Yes	After-Tax	\$ 78,631	2.51 yrs
Market Value Surplus:				\$ 55,072	23.22 yrs

17. The concept of Duration Gap is more fully developed in Toevs and Haney (1984).

18. Attempts have been made to show the duration of equity securities to be a function of the security's Beta. The reader is referred to Bierwag, Kaufman and Toevs (1983) for studies relating to the duration of equity securities.

Figure 16

*XYZ Casualty  
Duration Gap of MVS*



XYZ's positive duration gap of 23.2 years indicates that its MVS will have the interest rate sensitivity equal to that of a 23.2 year zero-coupon bond (which is a very long term bond); that is, a rise in interest rates will cause a large decline in MVS but any decline in interest rates will sharply increase MVS. Figure 16, which takes the line for XYZ's MVS from Figure 14 and shows it in relation to movements in interest rates (the Bond Buyer Index), indicates the effects of carrying a large positive duration gap over a long period of time. We can see that MVS has been quite volatile, falling precipitously in the high interest rate environments of 1974 and 1981, and rebounding dramatically with the drop in interest rates in 1982.

#### Duration Gap of Target Accounts

Rather than just blindly carry a large duration gap, which will leave the value of the firm's MVS greatly dependent upon the level of interest rates (an uncontrollable factor), the insurer should choose to manage this gap. By deciding when, and to what extent, to have a duration gap, company management can position the firm to take advantage of any projected changes in

interest rates, or, in an extreme case, to position the firm to have a MVS that is immune to changes in interest rates. The previous section gave us the tools that are necessary to compute the duration gap, this section will give us a few targets at which a company can shoot.

### Duration Gap of Surplus

The duration gap previously computed in Equation (3) and Table IV can more specifically be called the Duration Gap of Surplus ( $DG_s$ ), in that it tells the interest sensitivity of an insurer's market value surplus account. As explained previously, a large positive  $DG_s$  indicates a potentially volatile surplus account, one that will increase (decrease) in value if interest rates should decline (rise). A natural target for managing  $DG_s$  would be to achieve a  $DG_s$  that is equal to zero, which would mean that the value of MVS will be *immune* to changes in interest rates.

Having a  $DG_s$  of zero would be valuable to most insurers, since insurance regulators typically limit premium volume to a small multiple of reported surplus. If the surplus is managed so that its value never declines from changes in interest rates, then premium volume will not have to be constricted, unless large underwriting losses develop. Setting  $DG_s$  equal to zero would give the MVS account the stable price characteristic of a money-market fund (which also has a duration near zero). However, like a money-market fund, a  $DG_s$ s of zero would result in fluctuations in total earnings, depending upon the interest rate environment.

### Duration Gap of Total Return on Surplus

In reality, it is probably unduly restrictive, and unnecessary, for an insurer to take its duration gap of surplus all the way down to zero. Another valuable feature of duration is that it indicates the holding period over which a rate of return can be immunized. If duration is set equal to the desired holding period, then the initial promised return can be realized independent of changes in the level of interest rates.<sup>19</sup> This would suggest that by setting a firm's  $DG_s$  equal to some holding period, the net yield of MVS can be achieved over that period. Many insurers desire to manage *annual* returns-on-surplus so that they are always positive. Provided the net yield of MVS is positive, this goal can be achieved by setting  $DG_s$  equal to one.

Immunizing a total rate of return over longer planning horizons can be achieved by having a higher  $DG_s$ . Even though a higher  $DG_s$  immunizes MVS over a longer holding period, interim results may be above or below the immunized holding-period return. The insurer must reach some compromise between holding-period return and stability in interim results. In general, the formula for the Duration Gap of Total Return-on-Surplus ( $DG_{trs}$ ) is:

$$DG_{trs} = D_s - H \quad (4)$$

Where  $D_s$  is the duration of surplus and  $H$  is the holding or investment period over which management wishes to lock up the currently available return on surplus. By setting  $DG_{trs} = 0$ , the firm will immunize total return over the holding period.

---

19. Provided the duration is rebalanced periodically to counteract duration drift.

**Duration Gap of Leverage**

A final target account is of interest to those who are concerned with capital adequacy. It is the ratio of MVS to MVA. The reciprocal of the MVS to MVA ratio is the MVA to MVS ratio, known as "economic leverage." The economic leverage of a firm will remain unchanged only when both elements either remain unchanged or change proportionately. That is, when interest rates cause the market value of assets to increase by one percent, the market value of surplus must also increase by one percent for the asset-to-surplus ratio to remain unchanged. Since the percentage change for the market value of any security (given a change in interest rates) depends upon its duration, the duration of surplus must equal the duration of the assets to immunize economic leverage against interest rate fluctuations. Therefore, to immunize the economic leverage of a firm, it is necessary to set the Duration Gap for Economic Leverage ( $DG_{el}$ ) equal to zero, where:

$$DG_{el} = D_{mvs} - D_{mva} \quad (5)$$

**SECTION V****DEVELOPING AN INVESTMENT STRATEGY**

The purpose of this section of the paper is to illustrate the development and implementation of an investment strategy. This strategy is developed using the duration gap techniques discussed in Section IV. We then test the strategy, in Section VI, over the same historical period used in our previous examples. The results of the illustrative investment strategy are finally compared to XYZ's results that were achieved using a more traditional investment strategy.

**Management Goals**

Before constructing any investment strategy, it is necessary for company management (usually the Investment Committee of the Board of Directors) to enumerate the various goals and policies that will govern the Investment Department's operations. Once these goals and policies have been outlined, an investment strategy can be created that will optimize the results while staying within policy guidelines. The goals we have listed below are not meant as a recommendation, each company's needs and policies are unique, but these goals are indicative of the types of goals management may voice as well as being reasonable *and achievable*:

- 1) *Achieve consistently a positive growth rate in shareholders' investment.* Alternative ways of stating this goal are growth in: shareholder's equity; book value per share; policyholders' surplus; or market value surplus. The goal of *positive* growth is necessary to insure that available growth in premium sales is never needlessly impaired by a decline in statutory surplus. *Consistent* growth should translate into a higher price/earning multiple for the firm's stock, as the market tends to place a premium on consistency.
- 2) *Risk should not be taken with policyholder funds—investment of insurance reserves should be as "risk neutral" as possible.* Insurance regulators are concerned with the adequacy of both the insurer's reserves for insurance claims and the assets that back those reserves. Changes in the investment environment should not impact the insurer's ability to pay claims as they come due. Since shareholders' ownership interest, which is protected by goal #1, is equal to the portion of the company that is not needed for insurance reserves, goals #1 and #2 are complimentary.
- 3) *Maximum flexibility should be maintained in shifting between income from taxable or tax-exempt investment sources.* Sudden changes in insurance tax laws or the profitability of insurance underwriting may make investment income from taxable, rather than tax-exempt, sources more desirable. Another way of stating this goal is to maximize after-tax income on a year by year basis.
- 4) *Consistent with the foregoing goals, maximize the firm's investment exposure to equity securities.* To illustrate other types of goals that may be achieved, we will make the assumption that XYZ's management believes that the equity markets will outperform fixed-income securities over a long time horizon. This extra performance may be needed to achieve the real rates of return that are necessary to cover insurance claims that may grow through the ravages of unexpected inflation.

## Implications of Goals on Investment Strategy

*Achieve consistently a positive growth rate in shareholders' investment.* This goal implies that the Market Value Surplus (MVS) of the firm should never decline on an absolute basis. If the relevant time horizon for the firm is the next annual report to shareholders (although that may not be the most optimal time horizon), then "never decline" can be restated to mean "MVS at year-end will at least be equal to the previous year's MVS."

There are basically two ways to insure that MVS never declines: 1) manage MVS as if it were a one-year, or shorter, bond; or 2) purchase a "put" option on MVS that has a strike price equal to the previous year's MVS. Section IV showed that by managing the Duration Gap of Surplus ( $DG_s$ ) or the Duration Gap of Total Return on Surplus ( $DG_{trs}$ ) to a value of zero, the MVS will act either like a money-market account ( $DG_s = 0$ ) or will have a rate of return that is immunized over the one-year time horizon (if  $DG_{trs} = 0$  for  $H = 1$ ). Provided the net yield of MVS is positive, managing the  $DG_s$  or  $DG_{trs}$  to a value of zero will maintain a positive growth in MVS. Because a  $DG_{trs}$  of zero is equivalent to a  $DG_s$  of one<sup>20</sup>, and immunizing any holding period shorter than one year will also achieve a positive yearly growth in MVS, we can relax the constraint that  $DG_s$  equal zero to  $DG_s$  can be between zero and one, inclusive, or:

$$0 \leq DG_s \leq 1 \quad (6)$$

While it is not possible to purchase directly a put on the MVS account, it is possible to purchase puts on many of the components of MVS. If the  $DG_s$  is managed so that it is less than the one-year time horizon, then put protection is theoretically unnecessary, since downside risk of MVS return has already been eliminated by immunizing its holding period return. But, as mentioned in Section III, the common stock component of MVS cannot be managed entirely in a duration framework. Stocks do sometimes fall in value when we expect them to rise! However, by utilizing a "protective put" strategy, stocks can be used in an investment strategy that is consistent with the goal of never having a decline in MVS. The "protective put" strategy will be explained later in this section.

*Risk should not be taken with policyholder funds—investment of insurance reserves should be as "risk neutral" as possible.* The funds that are set aside to pay future insurance claims must be sufficient no matter what economic environment develops. The simplest way to achieve sufficiency is to make sure that there is enough cash flow from bond maturities and coupon income to cover the paid loss profile developed in Section II. The assets that are needed to generate the necessary cash flow would be earmarked for "expense and insurance reserves" and would not be available for any investment practice that deviates from an asset/liability match. This method is known as "cash flow matching" or "bond dedication" in investment management terminology. Cash flow matching works because there is never a possibility of taking a loss on an asset if assets never have to be sold.

An alternative method of achieving the "risk neutral" position is to make sure that there is always sufficient *market value* of assets available to pay any insurance claims. This implies that it is also necessary that if the present value of the assumed claims should vary, then the market value of the assets must vary to the same degree. Assuming that a change in interest rates is the only factor that can change the value of the firm's assets, the assets' *duration* will

20. Since  $DG_{in} = D_s - H$ , where  $H$  is a one-year holding period, and  $DG_s = D_s$ , then  $DG_s = 1$  if  $DG_{in} = 0$ .

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convey the amount of that value change. Initially, a sufficient market value of assets is earmarked for expense and insurance reserves. If the duration of the assets is equal to the duration of the insurance claims and expenses, then there will always be a sufficient market value of assets to cover claims. This investment management technique is known as "duration matching" and it generates results that are close to those of cash flow matching.<sup>21</sup> The primary cause of any difference in results between the two techniques would be due to yield curve twists — cash flow matching is fully immune to twists, but duration matching techniques may have results that vary. However, duration matching is often more cost-effective than cash flow matching, since duration-matched portfolios can utilize the entire universe of available investments while cash-matched portfolios can select from only the investments that have the appropriate cash flow characteristics.

*Maximum flexibility should be maintained in shifting between income from taxable or tax-exempt investment sources.* Insurance companies always have the option of switching their investment portfolio between taxable and tax-exempt investments, but it is seldom viable if the switch would require the realization of a capital loss (and, thus, a decline in statutory surplus). To achieve this goal of flexibility the insurer must either have investments that never decline in value, or a sufficient cash flow from asset maturities to effect the desired rebalancing through new purchases. Investments that never decline in value are few and far between, but the previously mentioned strategy of holding a stock portfolio with "protective puts" would fit the bill. The alternative of sufficient maturity cash flow could be achieved by simply holding an asset portfolio with a relatively short average life, but this might be in conflict with goals #1 and #2, which call for duration matching the longer liabilities.

*Consistent with the foregoing goals, maximize the firm's investment exposure to equity securities.* Since simply holding a large portfolio of equities would subject the firm's surplus account to potential losses, should stock prices decline, this method would be inconsistent with the first goal of constant positive growth in surplus. The "protective put" strategy is an answer to this potential problem. While a protective put truncates any downside risk in holding equities, it still allows the company to participate in much of the upside potential of the equity market.

### **A Strategy**

While one might suspect that the four goals of company management could be somewhat mutually exclusive (i.e., "you can't have your cake and eat it too"), there exists a relatively simple investment strategy that more than adequately achieves the targets in the framework of our model environment. The following three steps are all that are required:

- 1) Duration-match the paid loss profile.
- 2) Invest 100% of statutory surplus in common stocks with protective puts.
- 3) Invest the balance of assets, if any, in short term instruments.

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21. In fact, cash flow matching is merely a polar case of duration matching in which not only durations have been matched, but cash flows as well

**Duration-Match the Paid Loss Profile**

By setting aside enough assets to cover the paid loss profile, we not only protect the policy-holder, but we give ourselves a "free hand" to do whatever we want with the balance of the assets. Since the duration of XYZ Casualty's paid loss profile is only 2.51 years as of 12/31/83 (Table VI), and the market value of the loss reserves is approximately 60% of total asset market value, it is quickly apparent that this strategy requires purchasing many more short and intermediate term assets than the typical P&C insurer is accustomed to buying (a duration of 2.51 years is equivalent to a maturity average life of approximately 3 years). While some investment managers might perceive that shortening the bond portfolio so dramatically could result in a reduction in investment income (particularly in tax-exempt bonds, where there is typically a steep, positively sloped yield curve), this should not be a major concern. Once we have taken care of the protection of policyholders, we are free to more aggressively posture the remainder of the asset portfolio to go after higher rates of return (with commensurately higher degrees of risk). It is possible that the incremental return gained on the balance of the portfolio may more than offset the perceived income give-up of the shortened bond portfolio.

**Stocks with Protective Puts**

The idea of purchasing common stocks and simultaneously purchasing a put option on that stock has been given many labels. Some choose to call the strategy "portfolio insurance" to connote that the put option provides "stop loss" protection against a decline in stock prices.<sup>22</sup> Many portfolio managers may already be familiar with related strategies, sometimes called "90-10" or "money-market/options" portfolios.<sup>23</sup>

This relation comes about through the operation of "put/call parity" which says that owning a put on a stock is the same as owning a package of securities composed of:

- 1) A long position in a call option.
- 2) A short position in the underlying stock.
- 3) A sufficient amount of cash that will mature to the exercise price of the option if invested at the risk free rate of interest.

Intuitively, one can see that this package is equivalent to a put option since:

—if stock prices fall, the call expires worthless and, after the shorted stock is delivered, we are left with the difference between the exercise price (the cash portfolio) and the stock price (which is less than the cash portfolio).

—if stock prices rise, we must deliver the shorted stock which has appreciated. Since we are holding cash whose value is the exercise price, and the call option will pay off any appreciation above the exercise price, we have a net return of zero.

Since a protective put is purchased against an existing stock position, a put-protected portfolio is equal to:

$$\text{Put protected portfolio} = \text{Put} + \text{Stock} \quad (7)$$

22. See Platt and Lataunet (1984), and Rubenstein and Leland (1981).

23. For example, Friedman and Moore, "The Money Market/Options Portfolio: A Prudent Strategy," *Best's Review*, 9/82.

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And we have shown that a put is equivalent to a portfolio of a call, cash and shorted stock:

$$\text{Put} = \text{Call} + \text{Cash} - \text{Stock} \quad (8)$$

Then a put-protected portfolio also equals a position in cash plus a call option:

$$\begin{aligned}\text{Put protected portfolio} &= \text{Call} + \text{Cash} - \text{Stock} + \text{Stock} \\ &= \text{Call} + \text{Cash}\end{aligned} \quad (9)$$

This equivalency of a protective put being equal to holding a cash portfolio plus a call option has given rise to the terminology of "90/10" (that is, invest 90% in cash and 10% in call options) or "money-market/options" portfolio, even though the latter strategies are only crude approximations to a correctly executed protective put strategy.

Many insurance companies are restricted from outright purchases of put options, but the preceding paragraphs show that this does not encumber the company in executing a protective put strategy, since the company can replicate the position by holding money-market instruments and purchasing call options. In addition, it is also possible to replicate the *call options*, through dynamically rebalancing a portfolio composed of money-market instruments and the underlying stock. The proof of this equivalency is rather involved, and the interested reader is referred to other work on the subject<sup>24</sup>, but the beauty of this second equivalency is that it means that the insurance company can hold protective puts against *any* security in its portfolio, not just securities that have options that are traded on listed or over-the-counter exchanges. Indeed, these arguments can be expanded to include replication of options for entire *portfolios* of securities, especially applicable to an institutional investor such as an insurance company.

## Remainder in Short Term Instruments

This part of the strategy is rather self explanatory, since most insurance companies are already accustomed to holding large pools of liquid, short term, securities. But these short term instruments do not necessarily have to be the traditional money-market investments used by most insurers (e.g., T-Bills, bank CDs and BAs, commercial paper, repurchase agreements, institutional money-market funds). The short term component of the portfolio can be composed of any instrument that is liquid (readily marketable) and has the duration characteristics of short term securities (stable principal value). Other, less traditional, investments include: municipal commercial paper (if the insurer needs tax-exempt income); preferred stocks (which are often an attractive alternative to tax-exempt commercial paper); option conversions (a technique consisting of long positions in a put option and stock and a short position in a call option, that yields a risk free rate of return); and interest rate swaps (which can be used to shorten an asset's duration). Even the money-market position taken in the process of replicating the protective put strategy, explained previously, can use these alternative short term investments.

Another interesting way to view the portfolio's short term component is described in a product Morgan Stanley calls "cash management".<sup>25</sup> This product measures the tradeoff between added risk and added return from any investment strategy. These tradeoffs help inform cash

24. See Rubenstein and Leland, op. cit.

25. See Haney, "A Risk Controlled Approach to Managing Corporate Cash Pools," Morgan Stanley & Co. Incorporated, forthcoming.

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managers of their probable investment performance. For any large cash pool that is likely to remain intact for many years (as is the case for a healthy percentage of an insurer's "liquidity pool"), a strategy of simply rolling-over short term investments will not have much principal risk, but there will be a substantial amount of reinvestment risk. The cash management product gives the portfolio manager a measure of the risk involved in deviating from the shortest investment strategy and may allow some incremental return to be prudently captured by extending the portfolio's duration.

## Are the Goals Achieved?

How well does the illustrated investment strategy perform in achieving company management's four goals? Goal #2 (risk neutral investment of insurance reserves) is achieved through a duration matched portfolio. This portfolio's assets will always be sufficient to cover any projected paid losses.<sup>26</sup> The short average life of the assets invested behind the loss reserves, together with the large component of assets held in short term investments, makes goal #3 (maximum tax flexibility) very achievable. By utilizing a protective put strategy in conjunction with holding common stocks, the percentage of assets devoted to stocks can be prudently increased and goal #4 (maximum exposure to equity securities) can be attained. The final, and most important goal, #1 (positive growth in shareholders' investment), should be achieved by the very short duration gap of surplus the foregoing strategy implies (if the downside risk of holding equities has been truncated, and the balance of the surplus funds are invested in instruments with short durations, then the duration gap of surplus will be short).

It appears that the suggested investment strategy should perform well, but "seeing is believing" and an example helps to illuminate the points. Section VI tests the suggested strategy on our model company—XYZ Casualty.

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26. The potential problem of paid losses being different from projections is covered in Section VII of this report.

SECTION VI

TESTING THE INVESTMENT STRATEGY

The method used to test the illustrated investment strategy is to use the model company constructed in Section I (XYZ Casualty) and replace its "traditional" investment strategy with our developed one. By using the same economic time period (1972-1983) and not tampering with the basic sales and liabilities of XYZ (i.e., the amount and mix of premiums and the loss profiles for claims paid are identical to Section I), we can see in isolation what effect changing the investment strategy will have on the reported, as well as market value, surplus accounts.

**Assumptions**

A few simplifying assumptions are made to facilitate the handling of: 1) XYZ's changing tax position, 2) any problems associated with modelling actual sales of investments and 3) any dynamic strategy of asset allocation (such as would occur in a protective put strategy). These assumptions are:

- 1) The percent of assets invested in Municipal securities is held constant at 40%.
- 2) Each year's loss profile is immunized through *cash flow matching*. Since we are assuming that losses develop as projected, cash flow matching will eliminate the need to sell any assets. Both taxable and tax-exempt investments required for the cash flow matching strategy are developed from historical yield curves and are indexed so that the 20-year part of the curve is equal to either the Bond Buyer Index or Moody's Corporate Bond Composite Index.
- 3) The annual return for the equity portion of the portfolio is derived from studies that Morgan Stanley has done regarding equity portfolios with protective puts. In particular, the protective put strategy that is used insures a floor return of zero in conjunction with investing in the S&P 500. All returns from the portfolio insurance strategy are given net of the transactions costs involved in rebalancing the strategy's money-market and equity portfolios. Since insurance companies have a wide range of flexibility in deciding when to actually *realize* any appreciation in their stock holdings, the model assumes that any appreciation that is in excess of the annually available return on the risk-free asset (T-Bills) is kept unrealized. This has the effect of deferring payment of taxes to later periods but also lowers *reported* investment income in years where stocks greatly appreciate (Statutory and GAAP accounting do not show unrealized gains or losses on the income statement). Furthermore, it is assumed that *all* income derived from the stocks with protective puts is taxed at *ordinary* income rates. In actual practice some of the return will be derived from dividends and, possibly, long term capital gains, both of which are tax preference items. We felt it is the most conservative approach to evaluate the suggested investment strategy using the worst possible tax rates.

Table V shows the yields that were historically available for duration matched portfolios versus the longer, 20-year, investments in which XYZ had been investing. The table also shows the annual returns that could be achieved in an equity portfolio with protective puts versus the returns available on the non-protected S&P 500.

*New Investment Strategy*

Table V

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
<b>Bond Portfolio</b>												
Duration of Purchases	2.51	2.61	2.57	2.58	2.66	2.69	2.66	2.63	2.54	2.42	2.54	2.51
Yields												
Taxable Purchases (vs 20-Yr Yield)	7.43%	7.66%	9.01%	8.21%	6.33%	7.70%	10.59%	12.66%	15.61%	14.83%	11.39%	11.59%
BP Pick-up (Give-up)	7.47	8.05	9.63	9.57	8.47	8.54	9.49	11.35	14.04	15.38	13.02	13.01
Municipal Purchases (vs 20-Yr Yield)	3.53%	4.21%	5.30%	4.89%	3.47%	4.09%	5.81%	6.48%	8.17%	9.29%	6.45%	6.95%
BP Pickup (Give-up)	5.11	5.16	7.08	7.29	5.83	5.66	6.61	7.23	9.76	13.30	9.56	9.76
<b>Stocks with Protective Puts</b>												
Total Annual Return (assumed realized) (assumed unrealized)	N/A	-0.01%	-0.01%	23.74%	15.59%	0.13%	2.87%	16.39%	27.90%	0.04%	12.74%	18.94%
S&P 500 Total Return	N/A	-14.86%	-25.25%	34.15%	22.07%	-7.20%	6.48%	18.48%	33.38%	-5.58%	20.79%	22.17%

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## Results

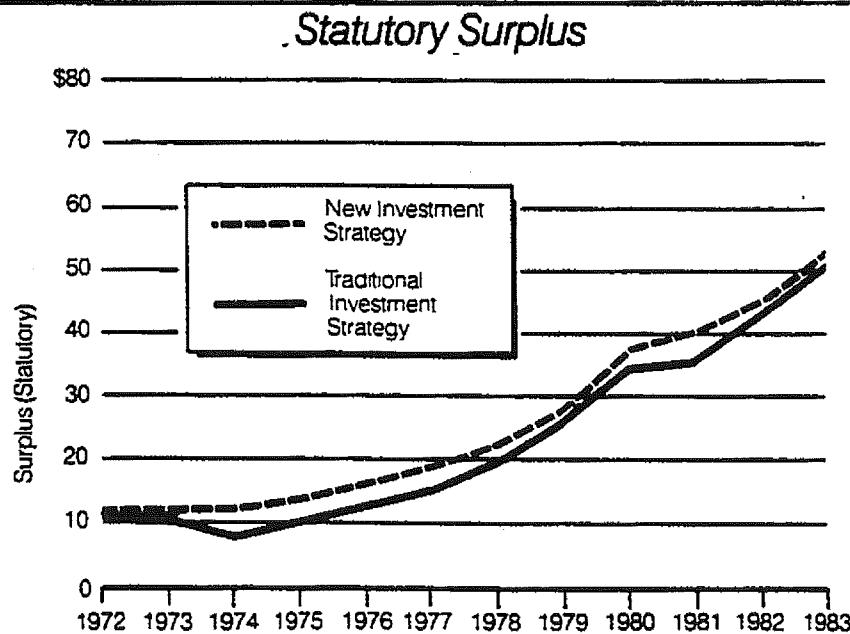
The new investment strategy would have performed quite admirably over the previous 11 years. The annual income statements and balance sheets that emerge under the new strategy are reproduced in Table VI so that the reader can make any comparison to XYZ's previous results (Table II) of greatest interest. We have chosen to highlight two comparisons between the new strategy and the old: 1) the growth and stability of the various surplus accounts (statutory, current value and market value), and 2) the amount of annual investable cash flow (which would enable flexibility in tax management).

Figure 17 shows the development of Statutory, Current Value and Market Value Surplus for both our new investment strategy and for XYZ's historical results (which are taken as a proxy for actual industry results). Statutory surplus develops on a very similar path to the old investment strategy; however, because of the protective put strategy used in the new investment strategy's stock portfolio, statutory surplus did not decline noticeably in either 1973 or 1974 (as opposed to the large declines under the old investment policy). The new strategy results in a very stable growth in statutory surplus.

The current value surplus also exhibits very stable growth under the new investment strategy. With the relatively short average life of the bond investment portfolio, together with the protective put on the stock portfolio, the run-up in interest rates in 1975 and 1979-81 did not cause any substantial market depreciation in the new strategy's assets. This can be contrasted to the horrendous current value surplus results achieved under the old investment strategy.

Figure 17

### New Investment Results Compared to Traditional

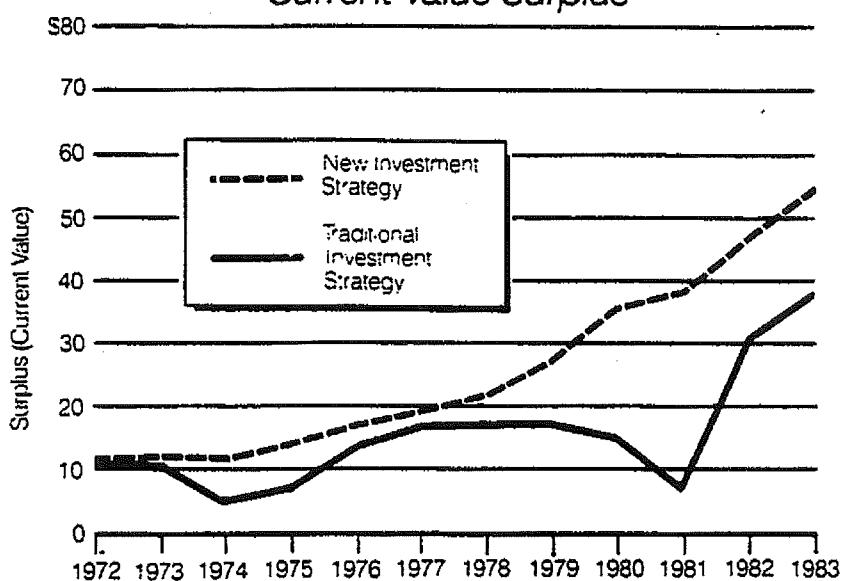


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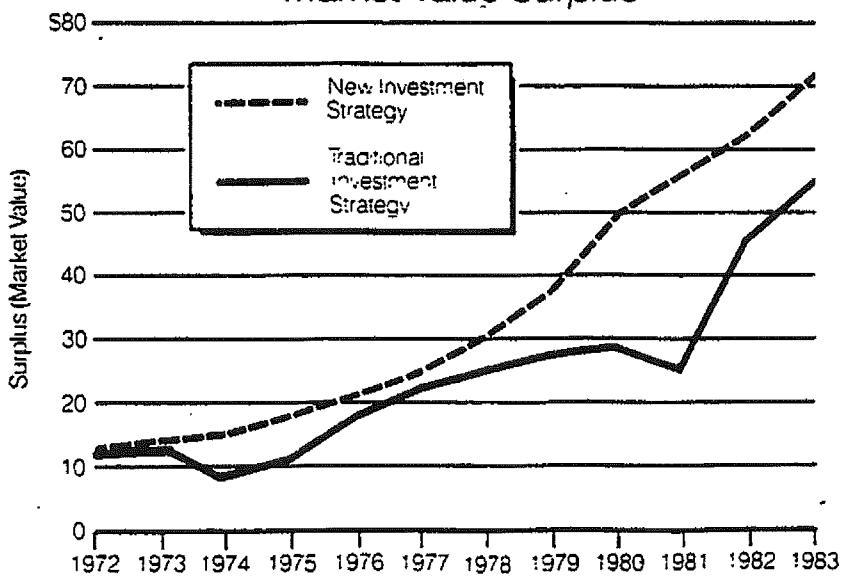
Finally, market value surplus shows a dramatic improvement over XYZ's results (which were, as we pointed out in Section III, already above statutory results). The new investment strategy outperforms the old strategy on *both a reported and an economic basis*. Furthermore, the new results could be expected to outperform the old strategy even under different economic environments because we have chosen to partake in *structured* risk taking, not *market* risk taking. Because of the large, positive, duration gap of surplus maintained in the old strategy, the old strategy would outperform the new strategy only if the markets behaved in our favor (i.e., interest rates declined and then stayed low, or were stable for a long period of time). The new strategy should perform well in all economic environments.

Figure 17 (continued)

### Current Value Surplus



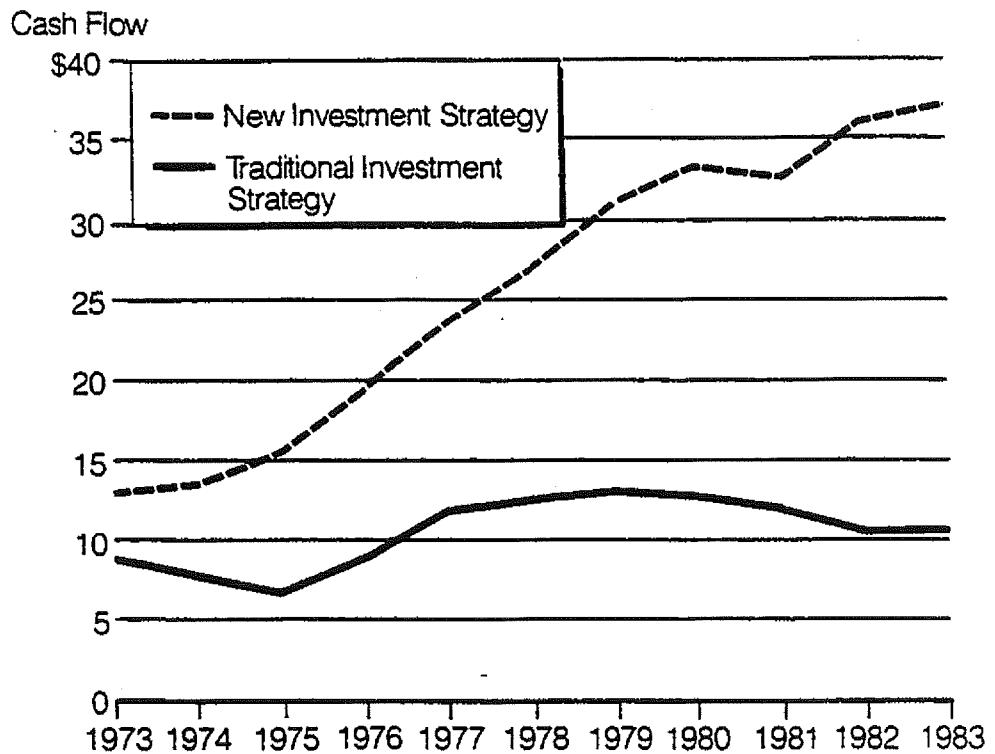
### Market Value Surplus



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As for the real-life world where a company has to worry about such things as taxes, Figure 18 shows that the new investment strategy presents the added flexibility of a large amount of annual cash flow. High cash flow is sometimes thought of as a negative by bond portfolio managers, since there exists the risk that the cash must be reinvested in a lower interest rate environment, but our "risk neutral" investment strategy has eliminated that concern. High cash flow now means high flexibility.

Figure 18  
*Investable Cash Flow*



**XYZ Casualty  
With New Investment Strategy**

Table VI

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
<b>Income Statement</b>												
Net Premium Earned												
Auto Liab	\$11,383	\$11,744	\$11,889	\$12,807	\$15,122	\$18,159	\$20,073	\$21,682	\$22,934	\$24,011	\$25,610	\$27,528
Auto Phys	6,408	6,864	7,106	7,399	8,962	10,961	12,484	13,969	15,466	16,469	17,579	19,178
Workers Comp	4,010	4,676	5,332	5,965	7,274	9,072	10,771	12,653	13,895	14,407	13,918	14,097
Multi Peril	5,083	5,941	6,815	7,751	9,328	11,309	13,162	15,082	16,544	17,562	18,828	20,014
General Liab	2,564	2,734	2,921	3,644	5,038	6,571	7,380	7,726	7,797	7,370	7,077	7,240
Total Premium	\$29,448	\$31,959	\$34,063	\$37,566	\$45,724	\$56,072	\$63,870	\$71,112	\$76,636	\$79,819	\$83,012	\$88,057
Expenses												
Losses Incurred	20,519	22,974	26,201	30,712	35,610	40,416	45,489	52,542	57,794	62,401	67,338	72,846
Underwriting Exp	7,842	8,613	9,339	9,862	11,355	13,546	15,763	17,696	19,430	20,915	22,412	24,069
Net Underwriting Income	\$ 1,087	\$ 372	(\$ 1,477)	(\$ 3,005)	(\$ 1,240)	\$ 2,111	\$ 2,618	\$ 874	(\$ 508)	(\$ 3,498)	(\$ 6,738)	(\$ 8,858)
<b>Investment Income</b>												
Money Market	0	69	177	279	315	282	502	1,174	1,386	2,004	2,481	1,593
Taxable	0	82	334	600	764	877	1,116	1,433	1,708	1,727	1,888	1,963
Tax-Exempt	0	324	505	716	902	966	1,173	1,623	2,153	3,068	3,826	3,916
Stocks (Realized)	0	(1)	(1)	874	878	21	545	2,209	3,434	15	5,193	4,039
Investment Exp	0	(76)	(103)	(126)	(155)	(188)	(223)	(261)	(308)	(367)	(402)	(442)
Pretax Investment Income	\$ 0	\$ 398	\$ 912	\$ 2,343	\$ 2,705	\$ 1,959	\$ 3,114	\$ 6,878	\$ 8,373	\$ 6,447	\$ 12,986	\$ 11,068
Pretax Operating Income	\$ 1,087	\$ 770	\$ (565)	\$ 665	\$ 1,464	\$ 4,070	\$ 5,732	\$ 7,752	\$ 7,785	\$ 2,950	\$ 6,248	\$ 2,210
Income Taxes	522	214	(514)	(663)	270	1,490	2,188	2,947	2,590	(54)	1,114	(785)
Net Operating Income	\$ 565	\$ 556	(\$ 51)	(\$ 2)	\$ 1,194	\$ 2,580	\$ 3,544	\$ 4,810	\$ 5,194	\$ 3,004	\$ 5,134	\$ 2,995

Table VI  
*XYZ Casualty*  
*With New Investment Strategy*  
*(continued)*

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
<b>Balance Sheet</b>												
<b>Assets</b>												
Money Market	\$ 1,185	\$ 2,397	\$ 3,827	\$ 5,001	\$ 5,754	\$ 7,064	\$ 9,104	\$ 11,358	\$ 14,115	\$ 17,231	\$ 18,102	\$ 19,634
Taxable	1,108	4,352	7,083	9,216	11,945	14,451	15,786	16,465	14,805	15,094	16,458	16,525
Tax-Exempt	9,172	12,513	15,252	18,768	22,748	27,012	31,626	37,311	44,450	48,724	53,636	59,801
Common & Pfd	11,465	12,020	11,969	13,934	16,423	19,003	22,547	28,144	37,756	40,760	45,894	53,543
<b>Total Assets</b>	<b>\$22,929</b>	<b>\$31,282</b>	<b>\$38,131</b>	<b>\$46,920</b>	<b>\$56,871</b>	<b>\$67,530</b>	<b>\$79,062</b>	<b>\$93,279</b>	<b>\$111,126</b>	<b>\$121,810</b>	<b>\$134,090</b>	<b>\$149,502</b>
<b>Liabilities &amp; Surplus</b>												
Loss Reserves	\$11,465	\$19,262	\$26,162	\$32,986	\$40,447	\$48,527	\$56,515	\$65,135	\$73,370	\$81,049	\$88,196	\$95,960
Surplus	11,465	12,020	11,969	13,934	16,423	19,003	22,547	28,144	37,756	40,760	45,894	53,543
<b>Total Liab. &amp; Surplus</b>	<b>\$22,929</b>	<b>\$31,282</b>	<b>\$38,131</b>	<b>\$46,920</b>	<b>\$56,871</b>	<b>\$67,530</b>	<b>\$79,062</b>	<b>\$93,279</b>	<b>\$111,126</b>	<b>\$121,810</b>	<b>\$134,090</b>	<b>\$149,502</b>
<b>Ratio of Market Value to Book:</b>												
Taxable Bonds	100%	100%	99%	100%	102%	100%	97%	96%	92%	95%	101%	100%
Tax-Exempt Bonds	100%	100%	98%	100%	102%	101%	99%	98%	97%	96%	102%	101%

**SECTION VII****MISCELLANEOUS ISSUES**

This final section touches upon a few other issues that P&C insurance companies are dealing with today. Future Morgan Stanley publications will expand upon many of these issues from both an analytical and an applications viewpoint, but their existence must at least be noted for this publication to be complete.

**Unexpected Loss Development**

The problem of losses ultimately being paid either in a different amount or at a different time than original expectations is a very real one. If losses are larger or sooner than expected, the amount of assets set aside for Market Value Reserves will not grow (with investment income) to a sufficient amount to cover the losses. Since the illustrated investment strategy recommends that any assets not needed for reserves be invested in higher risk instruments, it is very important that the reserves allow for any contingencies.

Large pools of losses developing sooner than expected, while significantly lowering the amount of investment income that can be earned on reserves, is probably not a major cause of underreserving. While there should be a tendency for insureds to attempt to expedite filing for claims when interest rates are high, it is unlikely that insurers feel much pressure to speed their already fast processing of claims. An acceleration of individual, highly uncertain, claims may be a factor at some insurers, but it is probably not an industry-wide phenomenon. The more likely cause of any underreserving is growth in the *ultimate size* of the losses. Many property claims are specifically indexed to inflation, such as replacement cost coverages, and liability claims are susceptible to increase through their own rate of inflation. This paper's reserving and investing strategies have not yet overtly accounted for any unexpected inflation rate, but that does not mean they cannot be adapted to account for one.

The duration matching investment strategies, mentioned previously, immunize a *nominal* return over some holding period; that is, targets are based upon an expected dollar payment of claims and an investment portfolio is then constructed that will pay off at least that much in market value. But the process of estimating the amount of these *expected* claims incorporates only an expected rate of inflation. *Unanticipated* inflation may cause these reserves to be insufficient. What the insurer ideally would like to immunize is a *real* rate of return—one that pays off in "units of coverage" or some similar concept. Even if one could determine the correct rate of inflation to which returns should be indexed, there still exists the problem that traditional fixed-income instruments, such as bonds, have flows that are denominated in fixed dollars. Unless there is some mechanism for these flows to increase with inflation, duration matching strategies will not immunize a real rate of return.<sup>27</sup>

One method of having investment returns keep pace with inflation is to purchase investments which have inflation dependent returns. Real assets, such as real estate, and common stocks come to mind when discussing the topic of assets which might keep pace with inflation. While it is beyond the scope of this paper to quantify whether these assets do indeed yield real rates of

27. Indexed bonds, where either the coupons or principal value change with inflation, may be issued at some time in the future and would be a useful instrument in immunizing real rates of return. See Babbel (1984).

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return (there has been much debate on the subject), the previously mentioned problems of these assets' volatility make their use as the core holding for an insurer's reserve position a difficult proposition.

A second method of keeping investment returns current with inflation is to have investments that roll over quite often. If yields for similar investments in the new market environment are related to the inflation rate, then rolling the portfolio into these new investments will achieve the inflated return. The problem with this strategy is that it requires a departure from the duration matching principle, since shorter maturities are required if the portfolio is to be kept current.

A far simpler method of assuring sufficient assets for inflated claims is to intentionally *overestimate* the expected size or rapidity of the losses. The amount of the overestimation could be earmarked as a *contingency reserve* and would be invested in the same manner as the market value of the estimated loss reserve. The American Academy of Actuaries and the Society of Actuaries have recommended this approach in their report on the role of a life insurance company's valuation actuary.<sup>28</sup>

The joint committee's recommendation is to apportion the assets of the insurance company among:

- 1) Valuation Reserves—these reserves would be sufficient under expected circumstances, but there is still some probability that additional reserves are required.
- 2) Contingency Surplus—this is the amount of surplus (assets minus valuation reserves) that is required to bring the probability of ruin down to an acceptably low level.
- 3) Vitality Surplus—this remaining portion of assets is the amount that is available for growth and change. It is the vitality surplus that we would recommend be used for investment strategies with higher degrees of risk.

Table VII gives an idea how large the contingency surplus of a typical P&C insurance company could be, given some assumptions as to ultimate size and timing of claim payments. The *expected* reserve requirement, "valuation reserve" in the preceding categorization, is found at the intersection of "Change in mean life of loss profile" of zero years and "Overall actual-to-expected ratio for claim amounts" of one times (shown by the shaded regions). This amount, \$78,631, is the same amount that was used in Section III to calculate the firm's Market Value Surplus. If the insurer wished to hold assets in reserve that are sufficient to cover claims that are *both* 20% higher than expected and occur, on average, one year sooner than expected. Table VII shows that reserves in the amount of \$100,574 would be required (bold print). This contingency surplus would increase needed reserves to 127.9% of the reserve amount calculated under a straight expectations approach and would be 104.8% of the reserve calculated under statutory accounting methods. The stair-step line in the middle section of the table indicates that the increased reserve would also be sufficient to cover other combinations of claim size and incidence. For example, the new reserve would be sufficient to cover claims that total 1.5 times the expected amount, provided they are paid 3 years later than expected.

28. "Final Report of the Joint Committee on the Role of the Valuation Actuary in the United States." American Academy of Actuaries and Society of Actuaries. February 1985.

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In actual practice, as in our suggested investment strategy, much of the hypothetical contingency surplus is already being held in the form of short-term assets. These short-term assets not only provide for catastrophic claims, but they also should provide for some protection against unanticipated inflation as they are rolled over in differing interest rate environments.

Table VII

## Required Reserves for Unanticipated Loss Development

	Mean Life	Asset Duration Target	Market Value of Required Assets							
			Overall Actual-to-Expected Ratio for Claim Amounts							
			0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Change - 2 yrs	0.93	0.88	\$71.755	\$80.724	\$98,684	\$98.663	\$107.632	\$116.602	\$125.571	\$134.540
In - 1 yrs	1.93	1.74	\$67.049	\$75.431	\$93,812	\$92.193	\$100.574	\$108.955	\$117.336	\$125.718
Mean 0 yrs	2.93	2.51	\$62,905	\$70.784	\$78,631	\$86.494	\$94.357	\$102.220	\$110.084	\$117.947
Life + 1 yrs	3.93	3.22	\$59.222	\$66.625	\$74.027	\$81.430	\$88.833	\$96.235	\$103.638	\$111.041
Of + 2 yrs	4.93	3.88	\$55.923	\$62.913	\$69.903	\$76.893	\$83.884	\$90.874	\$97.864	\$104.855
Loss + 3 yrs	5.93	4.50	\$52.946	\$59.565	\$66.183	\$72.801	\$79.420	\$86.038	\$92.656	\$99.274
Profile + 4 yrs	6.93	5.08	\$50.245	\$56.526	\$62.806	\$69.087	\$75.368	\$81.648	\$87.929	\$94.210

	Mean Life	Asset Duration Target	As A Percent of Market Value Reserves							
			Overall Actual-to-Expected Ratio for Claim Amounts							
			0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Change - 2 yrs	0.93	0.88	91.3%	102.7%	114.1%	125.5%	136.9%	148.3%	159.7%	171.1%
In - 1 yrs	1.93	1.74	85.3%	95.9%	106.6%	117.2%	127.9%	138.6%	149.2%	159.9%
Mean 0 yrs	2.93	2.51	80.0%	90.0%	100.0%	110.0%	120.0%	130.0%	140.0%	150.0%
Life + 1 yrs	3.93	3.22	75.3%	84.7%	94.1%	103.6%	113.0%	122.4%	131.8%	141.2%
Of + 2 yrs	4.93	3.88	71.1%	80.0%	88.9%	97.8%	106.7%	115.6%	124.5%	133.4%
Loss + 3 yrs	5.93	4.50	67.3%	75.8%	84.2%	92.6%	101.0%	109.4%	117.8%	126.3%
Profile + 4 yrs	6.93	5.08	63.9%	71.9%	79.9%	87.9%	95.9%	103.8%	111.8%	119.8%

	Mean Life	Asset Duration Target	As A Percent of Statutory Reserves							
			Overall Actual-to-Expected Ratio for Claim Amounts							
			0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Change - 2 yrs	0.93	0.88	74.8%	84.1%	93.5%	102.8%	112.2%	121.5%	130.9%	140.2%
In - 1 yrs	1.93	1.74	69.9%	78.6%	87.3%	96.1%	104.8%	113.5%	122.3%	131.0%
Mean 0 yrs	2.93	2.51	65.6%	73.7%	81.9%	90.1%	93.3%	106.5%	114.7%	122.9%
Life + 1 yrs	3.93	3.22	61.7%	69.4%	77.1%	84.9%	92.6%	100.3%	108.0%	115.7%
Of + 2 yrs	4.93	3.88	58.3%	65.6%	72.8%	80.1%	87.4%	94.7%	102.0%	109.3%
Loss + 3 yrs	5.93	4.50	55.2%	62.1%	69.0%	75.9%	82.8%	89.7%	96.6%	103.5%
Profile + 4 yrs	6.93	5.08	52.4%	58.9%	65.5%	72.0%	78.5%	85.1%	91.6%	98.2%

## Discounting of Loss Reserves

The subject of discounting reserves, as well as reserve sufficiency, has recently received much attention. The United States General Accounting Office (GAO) and Treasury have both made proposals to utilize some form of discounting in reporting of insurance reserves for tax accounting purposes. If a lower, discounted, reserve is used for reporting purposes, then more income would be reported at the time the insurance is written. Increased reported income would result in increased tax expense, a natural goal of both departments.

Many observers note that the P&C insurance industry is potentially already severely under-served and any discounting that is used will increase their tax liability and only exacerbate a bad situation.<sup>29</sup> While this paper recommends utilizing discounting of reserves in the *management* of assets and liabilities, it does not contemplate any additional tax burden that discounting would impose.

## Cash Flow Underwriting

To most industry followers, "cash flow underwriting" is a term used to indicate that an insurer is involved in the practice of deliberately pricing insurance coverage so that it has a statutory loss (that is, its combined ratio is over 100). The rationale for writing this business is the hope that the claim will not have to be paid until investment income sufficient to cover the loss has been earned. An alternative definition was advanced by Warren Buffet in Berkshire Hathaway's 1980 Annual Report in which he suggested that some companies were going beyond pricing practices that are based upon future investment income. These companies, he says, are pricing based upon the need to generate sufficient premium income to *avoid selling* any book value assets (bonds) at current market values which would generate book losses. He categorizes this type of cash flow underwriting as "asset maintenance" underwriting.<sup>30</sup>

The methods we have suggested in this paper may, to some readers, be a recommendation for some form of cash flow underwriting. While it is true that our methods recognize the cash flow from future investment income, they differ from traditional cash flow underwriting in one very important way—*we take risks on only a structured basis*. It is one thing to simply take risk, as in cash flow underwriting—it is entirely another thing to understand what risk you are taking. The asset/liability methodology described in this paper accommodates even the most risk-averse insurance company management.

## How Do We Get There From Here?

Once the P&C insurer has decided to adopt the methods and strategies suggested in this paper (if it has not already done so), there remains the question of how to restructure the asset portfolio. Because the combination of statutory accounting practice and an environment of historically high interest rates has led to a situation in which most insurers have assets with market values that are substantially below book values, most insurers cannot simply, painlessly, swap their predominately longer assets for the assets we have suggested. It is a

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29. "Discounting the Downrodden," *Forbes*, February 25, 1985.

30. Berkshire Hathaway Corp., 1980 Annual Report.

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shame that this situation exists, since it is statutory accounting which now hinders the economic health of an industry it was designed to protect.

There are, however, many methods of diminishing the reported accounting effects of any asset restructuring. *Interest rate swaps* may be used to alter an asset's duration while, effectively, amortizing the imbedded economic loss over a longer time horizon. Selling bonds or preferred stocks in conjunction with *issuing puts*, which give the purchaser the right to sell the asset back to the insurance company, are being used as a method of delaying the accounting impact of a market loss. In addition, many *swaps* of assets may have such a quick payback period, or such a large economic return for a given amount of reported loss, that the taking of a reported loss is justified.

## CONCLUSION

We hope that this publication has been instructive. By building a simplified model of the P&C insurance industry, we have been able to illustrate the ebbs and flows of insurance underwriting and investment returns. Once the nature of these building blocks of profitability is understood, we are able to construct reserving and investment strategies that increase the ability of an insurer's management to achieve their goals in spite of a volatile, and often hostile, economic environment. The reserving strategy utilizes expected loss payment patterns as well as allowing for unforeseen contingencies, such as unanticipated inflation. The investment strategy is also based upon an understanding of the loss payment patterns of insurance liabilities. After providing for a sufficient market value of assets to cover both expected loss payments and a reasonable contingency reserve, the investment strategy allows the portfolio manager to strive for larger returns by investing "true" surplus funds in riskier investments.

While this paper describes many useful asset/management concepts, by explaining them in terms of industry aggregates it appears to have ignored the situation of any individual company. The concepts, however, apply with equal force to individual company situations. Once an individual analysis is completed, if an asset/liability mismatch is detected and company management desires to redress the mismatch, there are many rebalancing techniques that are available. Many of these techniques are most easily used in an environment of stable or declining interest rates (from an *immediate* GAAP or Statutory accounting viewpoint). Some techniques have the added advantage of favorable accounting treatment in periods of relatively unstable or high interest rates. However, all techniques in any interest rate environment will add to the *long-range* health of the industry, but only if they are used *before* the disease of high interest rates strikes again.

**APPENDIX**

**GLOSSARY OF INSURANCE AND INVESTMENT TERMS**

**Adjustment Expense**

Expenses of investigating and settling claims, these include allocated claim expense and unallocated claim expense. Allocated expenses are comprised of court costs, fees and expenses of independent adjusters, lawyers, witnesses and other expenses which can be charged to specific claims. Unallocated expenses represent salaries and other overhead which cannot be charged to specific claims.

**Annual Statement (Convention Blank)**

Annual filing an insurer must make with its state insurance commissioner. The annual statement is used to monitor the solvency of insurance companies and it contains many sections, known as "schedules," which cover such things as financial position (balance sheet and income statement), amount and type of insurance reserves, organizational structure and a listing of financial assets.

**Automobile Liability Insurance**

Protection for the insured against financial loss because of legal liability for car-related injuries to others or damage to their property.

**Automobile Physical Damage Insurance**

Coverage for damages or loss of automobile of policyholder, resulting from collision, fire, theft and other perils.

**Boiler and Machinery Insurance**

Coverage for loss arising out of the operation of pressure, mechanical and electrical equipment. It may cover loss to the boiler and machinery itself, damage to other property, and business interruption losses.

**Book Value (Statement Value)**

The carrying value of financial assets as prescribed by statutory accounting and the NAIC. Book value is generally historical cost (plus accretion of any discount or minus amortization of any premium) for most fixed income items, including non-defaulted bonds and sinking fund preferred stocks. Common stock is carried at current market value.

**Catastrophe**

In insurance, a term applied to an incident or series of related incidents involving a loss of more than a million dollars.

**Claim (Loss)**

A demand for payment of a policy benefit because of the occurrence of an insured event such as death, injury, destruction or damage.

**Combined Ratio**

A combination of the underwriting expense ratio and the loss and loss expense ratio. A combined ratio under 100 percent indicates an underwriting profit; one over 100 percent generally indicates an underwriting loss.

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## **Commercial Multiple Peril**

A package type of insurance for the commercial establishment that includes a wide range of essential coverage.

## **Comprehensive Personal Liability Insurance**

Protection for an insured against loss arising out of legal liability to pay money for damage or injury to others for which the insured is responsible. Does not include automobile liability or business operations.

## **Discounting**

Recognizing the time value of money in determining claim reserves.

## **Duration**

A more exact measure of the "length" of a financial instrument than traditional measures such as "maturity" or "average life." Duration has two distinct interpretations. First, it is the amount of time that must pass before the accumulated effect of a sudden change in interest rates on cash flow reinvestment will exactly offset the price effect of this change on the present value of the remaining cash flows. This interpretation indicates the time horizon over which a rate of return may be guaranteed, or "immunized." The second interpretation of duration indicates the instantaneous change in the market value of a series of cash flows for a given change in interest rates.

## **Duration Gap**

The differential between a target account's actual duration and its target, desired, duration. The target account is the variable that an asset/liability manager wishes to control. Typical target accounts include capital adequacy (either absolute surplus or a ratio of surplus to total assets) and total return on equity.

## **Earned Premium**

Pro-rata share of premium for coverage that falls within the current accounting period.

## **Expense Ratio**

Ratio of underwriting expenses to total premiums written.

## **Fire Insurance**

Coverage for losses caused by fire and lightning, plus resultant damage caused by smoke and water.

## **GAAP**

Generally Accepted Accounting Principles. GAAP for P&C insurance companies varies from statutory accounting practice by allowing the recognition of some expenses to be deferred to later periods.

## **General Liability**

A form of coverage that pertains, for the most part, to claims arising out of the insured's liability for injuries or damage caused by ownership of property, manufacturing operations, contracting operations, sale or distribution of products, and the operation of elevators and the like, as well as professional services.

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## **IBNR**

**Incurred But Not Reported.** Refers to insured losses that have already occurred but have not yet been reported to the insurer.

## **Loss Expense**

See Adjustment Expense.

## **Loss and Loss Expense Ratio**

Ratio of losses and loss expenses incurred to premiums earned.

## **Loss Reserve (Liability for Unpaid Claims)**

The amount needed to provide for the estimated ultimate cost of claims relating to insured events that have occurred on or before a particular date (ordinarily, the balance sheet date). The reserve includes the amount of money required for payments on claims that have already been reported to the insurer, as well as the amount required for IBNR claims.

## **Malpractice Insurance**

Coverage for a professional practitioner, such as a doctor or a lawyer, against liability claims resulting from alleged malpractice in the performance of the insured's services.

## **MSVR**

**Mandatory Securities Valuation Reserve.** The MSVR is a reserve category that appears on a life insurance company's NAIC Annual Statement. The purpose of the reserve is to allow for the contingency of asset default or capital loss on disposal. The amount of the reserve is determined by a formula which is dependent upon the type of asset and the asset's rating.

## **NAIC**

**National Association of Insurance Commissioners.** An organization of state insurance officials which attempts to provide national guidelines and suggestions for the administrators of the various state insurance departments. This body has no legislative nor direct regulatory authority, but does play a major role in the development of the laws governing the industry.

## **Peril**

The cause of a possible loss. Perils include fire, windstorm, collision, hail, etc., and are sometimes also referred to as "hazards."

## **Put (Protective Put)**

A put is the right to sell a security at a predetermined price (strike). Puts, like calls or any other option, can be either sold (written) or purchased. A Protective Put describes a package of an underlying security and a put that has been purchased to protect against any market deterioration.

## **Schedules O and P**

The Annual Statement filed by an insurance company is divided into schedules. Schedules O and P pertain to the loss development patterns for historical reserves and the adequacy of reserves for insurance losses.

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## **Statutory Accounting Practice**

Accounting practices prescribed or permitted by insurance regulatory authorities. Statutory accounting generally does not allow expenses to be amortized, rather it requires them to be expensed in the year they can be determined. Both statutory and GAAP accounting for P&C companies allow many assets to be carried on a historical cost basis, as opposed to a market value basis (see "Book Value").

## **Statutory Policyholders' Surplus**

The difference between assets and liabilities (that is, "net worth") as defined by statutory accounting practice.

## **Stock to Surplus Ratio**

The ratio of the market value of an insurer's holdings of common stock to the value of its statutory policyholders' surplus. The ratio indicates the vulnerability of surplus to a decline in stock market values.

## **Strict Liability**

Also known as Absolute Liability, the principle of strict liability causes an insurer to be liable for damage caused by certain conditions that are apt to get out of hand or to cause damage, regardless of whether the insurer is at fault.

## **Unearned Premium**

Pro-rata share of premium for coverage that falls within future accounting periods.

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