A STRATEGY FOR PROPERTY-LIABILITY INSURERS IN INFLATIONARY TIMES

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Abstract

The primary business of the insurance industry is insurance underwriting. The insurance business is also engaged in the investment of funds generated by its underwriting activity as well as the capital and surplus. Thus, the operating results of insurers are affected by two components: underwriting results and investment returns. Historically, both of these components have been negatively correlated with the rate of inflation. Since insurers have considerable (but not complete) discretion in determining their investment mix, they are free to structure their investment portfolios to balance the adverse effects of inflation on underwriting profit margins. Thus, an investment strategy that correlates investment returns positively with the inflation rate is desirable during inflationary times. The purpose of this paper is to develop a method of inflation immunization for the property-liability insurance industry. The inflation immunized investment portfolio, based on experience during the period 1951 through 1981, involves a significant investment in Treasury bills. The strategy for reducing the effect of inflation on operating results presented in this analysis is one means by which insurers may cope with an inflationry environment.

Analysis of economic data indicates that inflation has both increased and become more variable over the past 15 years. Inflation has a considerable effect on insurance profitability by impacting both components of insurance operations, underwriting and investments. Since the elimination of inflation in the near future is unlikely despite progress in reducing the rate of inflation, the insurance industry must decide whether to continue to accept the risk of uncertain inflation or whether to protect itself against inflation. This paper presents a strategy for inflation immunization for the property-liability insurance industry and measures the cost of this strategy.

First the history of inflation in this country since 1926 is discussed. Then the correlation of each of the components of insurance operations with inflation is analyzed. Next the correlation of insurance investment returns with inflation is investigated by examining returns on long term bonds, common stocks, and Treasury bills. Following this discussion, an inflation immunization strategy for the insurance industry is developed. Portfolio theory is then introduced to develop an investment strategy that minimizes the effect of inflation on total insurance operations without diminishing the expected profitability. Next the inflation immmunization determination is updated using data through the end of 1981. Finally the results are summarized and some conclusions are offered. The method of determining the data and the sources are discussed in Appendix I. Summary statistics of the data are shown in Appendix II.

SECTION 1—INFLATION

Recent economic conditions have made the current rate of inflation a subject of common knowledge. A greater perception of the inflation issue can be obtained by viewing the inflation rate over an extended period of time. Figure 1 illustrates the yearly percentage change in Consumer Price Index measured from December to December for the period 1926 to 1981. This graph indicates that wide swings in the rate of inflation are not uncommon and that the relative price stability of the 1950s is more unusual than the extreme fluctuations of the 1970s.

The deficiencies of the Consumer Price Index (CPI) as an accurate measure of the true inflation rate are widely recognized, but no superior all-purpose inflation index is available.[1] The CPI is a monthly statistical measure of a market

[1] For a description of some of the problems with the CPI, see [8] and [9].

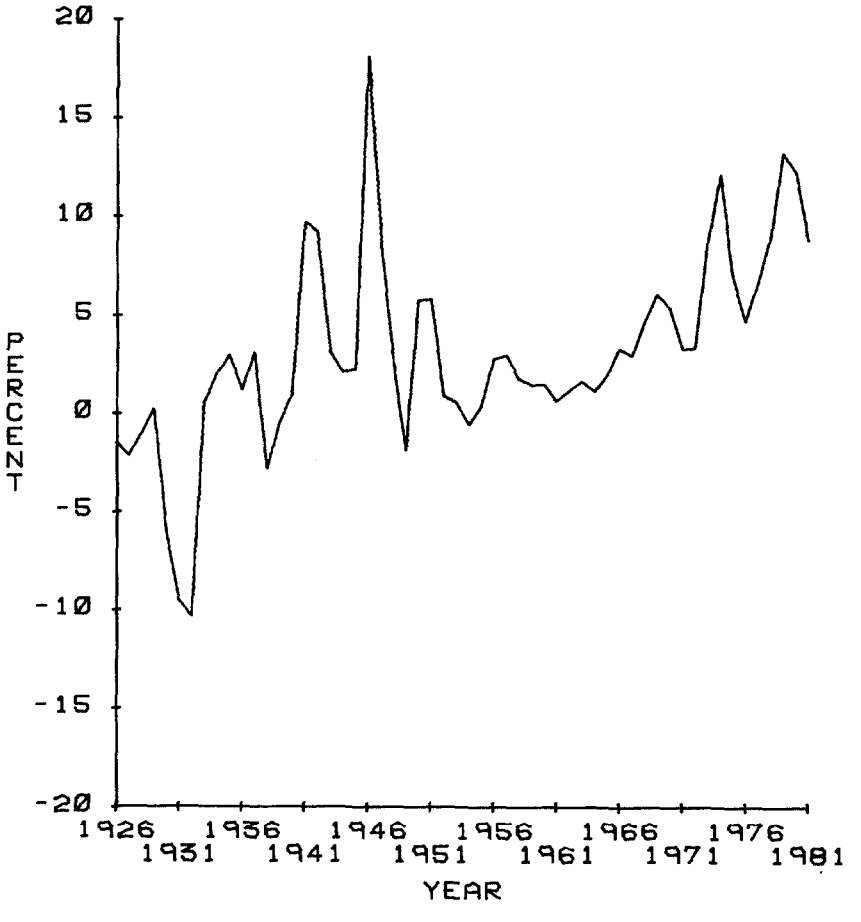

FIGURE 1

YEARLY PERCENTAGE CHANGE IN CPI (DEC.-DEC.)

1926-1981

basket of items commonly purchased by urban workers. Measurement of certain items is lagged due to data collection procedures. The validity of the composite market basket for other segments of society, such as the retired or rural residents, is suspect. Norton Masterson [7] compiled a Claim Cost Index for property-liability insurers that more closely reflects inflation for insurers than the CPI. The CPI is used in this paper for lack of a better index to correlate not only with insurance underwriting, but also with investment returns.

Returning to Figure 1, it can be seen that prices declined significantly during the years 1930 to 1932, the onset of the Great Depression. Price changes then fluctuated in the range of plus to minus 3.0 percent until the beginning of World War II, and then increased significantly. Price controls instituted in 1942 restrained the rate of inflation until 1946 when their removal allowed the inflation rate to hit an as yet unsurpassed 18.2 percent. The ensuing period of relative price stability lasted until the late 1960s. Price controls during the period 1971 to 1973 again restrained the inflation rate until controls were lifted.

The change in prices in a price control period are not indicative of the true rate of inflation, according to Eugene Fama [3]. Fama contends that price controls substitute nonmonetary costs, such as waiting in line, shortages, and inconvenience, for monetary costs. Removal of controls then allows monetary costs, which are measured by the CPI and other price indexes, to catch up with the true cost of goods and services. This reasoning explains much of the variation in the rate of inflation just before, during, and immediately following price control periods. Nevertheless, the CPI still represents a measure of the cost of items to insurers for claims and, indirectly, wages, and for investors in determining interest rates and required rates of return. The prior inflation spikes of 1946 and 1974 can be explained by the lifting of price controls. The inflation rate of 1979 has the distinction of being the first time in 54 years that double digit inflation occurred other than as a result of ending price controls.

SECTION 2—COMPONENTS OF INSURANCE RISK

Insurance profitability is derived from the combination of two separate components, underwriting and investments. Underwriting profitability depends upon factors such as the adequacy of rate levels, competition, and catastrophe experience. Inflation affects underwriting profitability since, for those lines in which the price is not a function of the amount of coverage provided, rate level adjustments must continually be made to maintain adequate rates. Use of past data and delays, both internal and regulatory induced, produce inadequate rate

levels under inflation. Automobile insurance provides a prime example. For coverages in which the insurance premium increases in line with inflation, the rate lag is less of a problem. Examples are inflation-adjusted Homeowners policies and business policies rated on the value of wages or sales.

Unanticipated inflation also affects loss reserve development. Loss reserves include a factor representing the expected rate of increase in claim costs. This factor can either be explicitly indicated and incorporated in the loss reserve determination or, more likely, it may simply be included implicitly in the loss reserving methodology. Loss reserves established based on paid or incurred loss development, for example, include as the expectation of future inflation a weighted average of past inflation rates. Unexpected changes in the inflation rate for claims will cause loss reserves to be deficient or redundant. This development will affect the calendar year combined ratio, commonly used to evaluate profitability and used in this paper. A higher than expected inflation rate will cause profitability to decrease, whereas a lower than expected inflation rate will increase profitability.

The statutory underwriting profit margin for stock property-liability insurers during the period 1926 to 1981 is shown in Figure 2, along with the change in the CPI each year. A pronounced negative relationship between the inflation rate and the underwriting profit margin is apparent by observing the extreme values. High underwriting profitability occurs in 1938, when price levels dropped. Underwriting profitability first reduced in 1942 after inflation increased, and then increased as inflation reduced in 1943. Underwriting profitability was high in 1948 and 1949 as inflation reduced. The pattern continued through the 1960s and 1970s with underwriting losses slightly lagging the inflation spurt in 1974 and reduction in 1976.

The pre-1933 period does not conform with the negative relationship outlined above. Underwriting profitability declined in 1930, 1931, and 1932 as price levels dropped substantially. One possible explanation for this atypical correspondence is the pervasive effect of the Depression. Despite price level reductions, economic conditions were so poor that insurance premium receipts declined, causing expense ratios to climb. Loss ratios jumped for Fire Insurance, Accident and Health, Workers' Compensation, and most substantially for Fidelity and Surety [2]. Depressed economic conditions led to increased losses in part from moral hazard, and likely would do so again under similar circumstances. However, because the concern here is for a strategy to deal with inflation, the deflationary period up through 1932 is not considered in developing the statistical relationships used in this model. Therefore, the usefulness of this

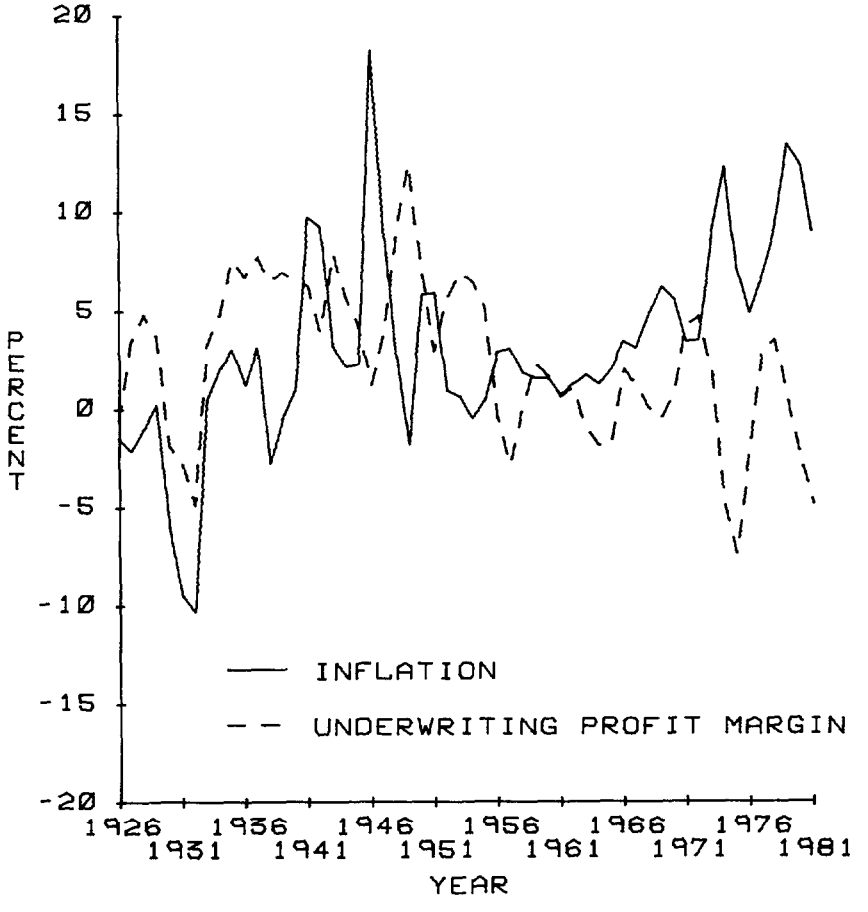

FIGURE 2

STATUTORY UNDERWRITING PROFIT MARGIN AND YEARLY PERCENTAGE CHANGE IN CPI (DEC.-DEC.) 1926-1981

model is restricted to inflationary conditions and does not necessarily apply to periods of deflation.

For the period 1933 to 1981, the relationship between underwriting profit margin and inflation, based on ordinary least squares regression,[2] can be expressed as:

$$UPM_t = 4.36 - .389\ INF_t + e_t$$
$$T = -3.079 \text{ (significant at the 1.0\% level)}$$
$$R^2 = .168$$

where UPM = underwriting profit margin (statutory)
INF = inflation rate (percent change in the CPI)
e = error term

Later other variables will be introduced and incorporated in this analysis. Data for some of these variables are either not valid or not available prior to 1951 or after 1976. To simplify the presentation the same time period, 1951 through 1976, is used initially for all segments of the analysis to illustrate the methodology. The portion of this analysis for the variables where data are available through 1981 is updated later. For the common period 1951 through 1976, the relationship between underwriting profit margin and inflation was:

$$UPM_t = 2.96 - .617\ INF_t + e_t$$
$$T = -3.029 \text{ (significant at the 1.0\% level)}$$
$$R^2 = .277$$

The significant negative relationship confirms the expected and observed negative correlation between underwriting profitability and inflation. The amount

[2] The use of regression methodology to analyze time series data depends on the consistency of the data base and the absence of nonrandom changes. Shifts in the line of business mix of property-liability insurers, the introduction of trend factors and loss development factors in ratemaking, and societal changes create the possibility of inappropriate results for the regression of underwriting profit margins against the inflation rate. However, analysis of the residuals of this relationship indicates no unusual patterns in recent years. The actual values do not consistently fall either above or below the fitted values. Thus, although this problem should be kept in mind while applying the techniques described in this paper, it does not appear to create serious problems for the data used here.

of variation in underwriting profitability that is explained by inflation (R^2 = .168 and .277) is not high, as many other factors impact insurance underwriting profitability. However, inflation does significantly affect underwriting profit margins.

Investment profit or loss, the other component of profitability for property-liability insurers, is the total of investment income (dividends or interest), realized capital gains or losses for bonds and real estate, and realized and unrealized capital gains and losses for stocks. Unrealized capital gains or losses on bonds that qualify for amortization valuation are not a factor in statutory investment profit or loss for insurers. Inflation tends to cause interest rates on bonds to increase, thus increasing investment returns. The loss in value on outstanding bonds that accompanies the increase in interest rates on new issues as inflation increases, although a consideration in overall financial planning for insurers, does not affect statutory accounting results if the loss is not realized. Variations in market values of stocks flow directly into overall insurance profitability.

When the realized losses on bonds and real estate plus the realized and unrealized losses on stocks exceed the investment income from dividends and interest, as occurred most recently in 1973 and 1974, the total investment return is negative. The investment income in this case is offset by the loss of principal producing negative total returns.

The insurance investment return may be calculated by dividing the investment profit or loss including investment income for each year by the mean investable assets of insurers for that year.[3] Some admitted assets for the insurance industry, such as premium balances, do not produce investment income. Investable assets for the industry have been approximated by multiplying total admitted assets by .90.[4] Insurance investment return for stock property-liability insurers during the period 1926 to 1981 is shown in Figure 3, again including the percent change in the CPI. Substantial variation in insurance investment return is evident, but the tendency of the rate of return to peak at inflation lows and hit a bottom at inflation peaks can be observed.

[3] All references to returns in this paper are to nominal rates of return.

[4] Data in *Best's Aggregates and Averages* [2] supports this approximation.

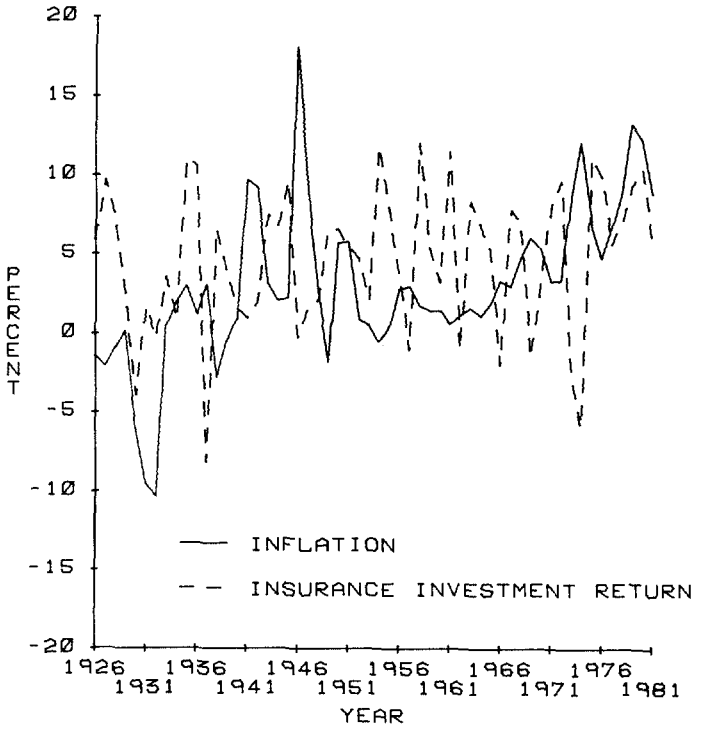

FIGURE 3

INSURANCE INVESTMENT RETURNS ON INVESTABLE ASSETS AND YEARLY PERCENTAGE CHANGE IN CPI (DEC.-DEC.) 1926-1981

Regressing insurance investment returns against inflation using the same procedure applied for underwriting profit margins shows the following results:

1933–1981

$IIR_t = 6.00 - .239\ INF_t + e_t$
$T = -1.513$ (not significant)
$R^2 = .046$

1951–1976

$IIR_t = 7.81 - .817\ INF_t + e_t$
$T = -2.646$ (significant at the 5.0% level)
$R^2 = .226$
where IIR = insurance investment return on mean investable assets.

Thus, inflation is negatively correlated with both insurance underwriting and insurance investment return. With both components of insurance operating results impacted adversely by inflation, inflation presents a severe threat to insurers. However, insurers are not forced to accept this fate. In the next section the investment returns of several investment alternatives are analyzed to give further consideration to the relationship between insurance investment returns and inflation.

SECTION 3—INVESTMENT RETURNS ON ALTERNATIVE INVESTMENTS

The insurance investment return determined previously is the average return of various investments. Insurers' assets consist of government and municipal bonds, corporate bonds, common and preferred stock, real estate, and other investments, as well as some non-income earning assets. The composition of stock insurers' investment portfolios has changed over time. The objective here is to isolate the effect of inflation on the investment returns of four different types of investments: long term government bonds, long term corporate bonds, common stocks, and Treasury bills. The returns include both interest income and changes in market value for the year. In insurance accounting, changes in market value for long term bonds are not included unless the bonds are sold. Thus, the returns on the long term bonds are not comparable to the statutory accounting conventions of the insurance industry, but do reflect the financial effects of long term bond investment. The method used in determining the rates of return and the sources of these data are specified in Appendix I.

Figure 4 illustrates the investment return on long term government bonds during the period 1926 through 1976. Figure 5 illustrates the return on long term corporate bonds. Figure 6 shows the return on common stocks during the period 1926 through 1981. Figure 7 indicates the return on U. S. Treasury bills during that same period. The inflation rate is included on each figure. The regression equations for each relationship are shown in Table 1.

TABLE 1

REGRESSION COEFFICIENTS
1951–1976

$LTG_t = 2.63 + .095\ INF_t + e_t$
$T = .205$ (not significant)
$R^2 = .002$
$LTC_t = 3.93 - .084\ INF_t + e_t$
$T = -.171$ (not significant)
$R^2 = .001$
$CS_t = 22.73 - 3.114\ INF_t + e_t$
$T = -2.675$ (significant at the 5.0% level)
$R^2 = .230$
$TB_t = 1.87 + .556\ INF_t + e_t$
$T = 7.594$ (significant at the 1.0% level)
$R^2 = .706$

where LTG = long term government bond returns
LTC = long term corporate bond returns
CS = common stock returns
TB = Treasury bill returns

Investment returns on long term government bonds and long term corporate bonds are not significantly correlated with inflation. However, common stock returns are significantly negatively correlated with inflation to the point that a 1 percent higher inflation rate reduces common stock returns by more than 3 percent.[5] The amount of variation explained by inflation is low ($R^2 = .230$) as many other factors affect stock prices.

[5] For an explanation of the basis of this relationship, as well as a review of the literature on this topic, see Feldstein [4].

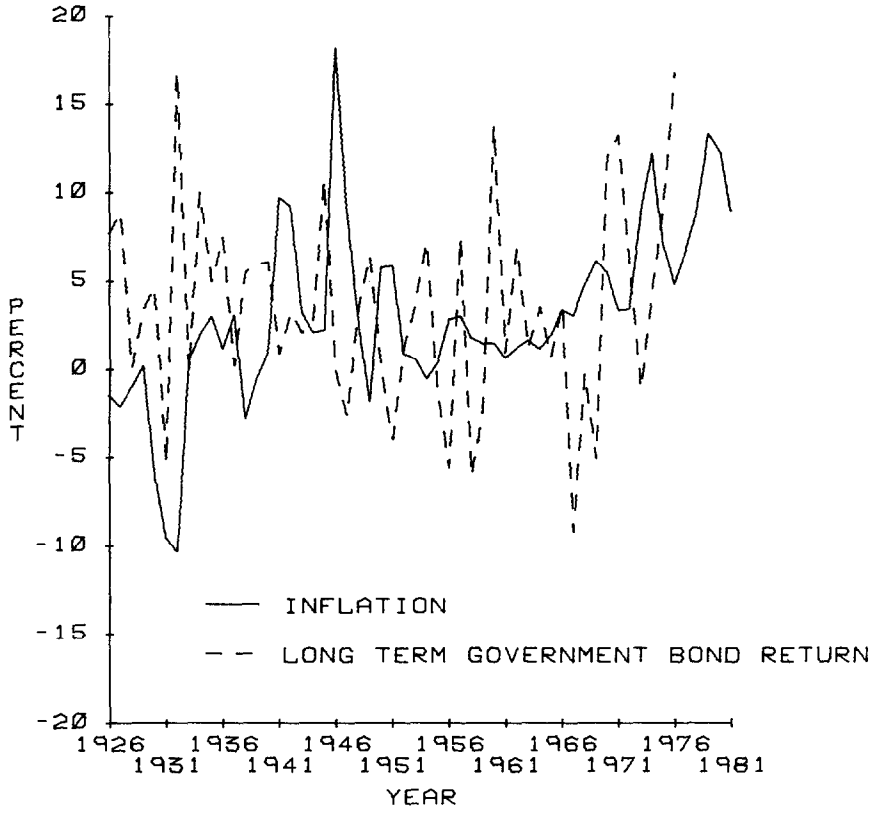

FIGURE 4

LONG TERM GOVERNMENT BOND RETURNS AND YEARLY PERCENTAGE CHANGE IN CPI (DEC.-DEC.) 1926-1976

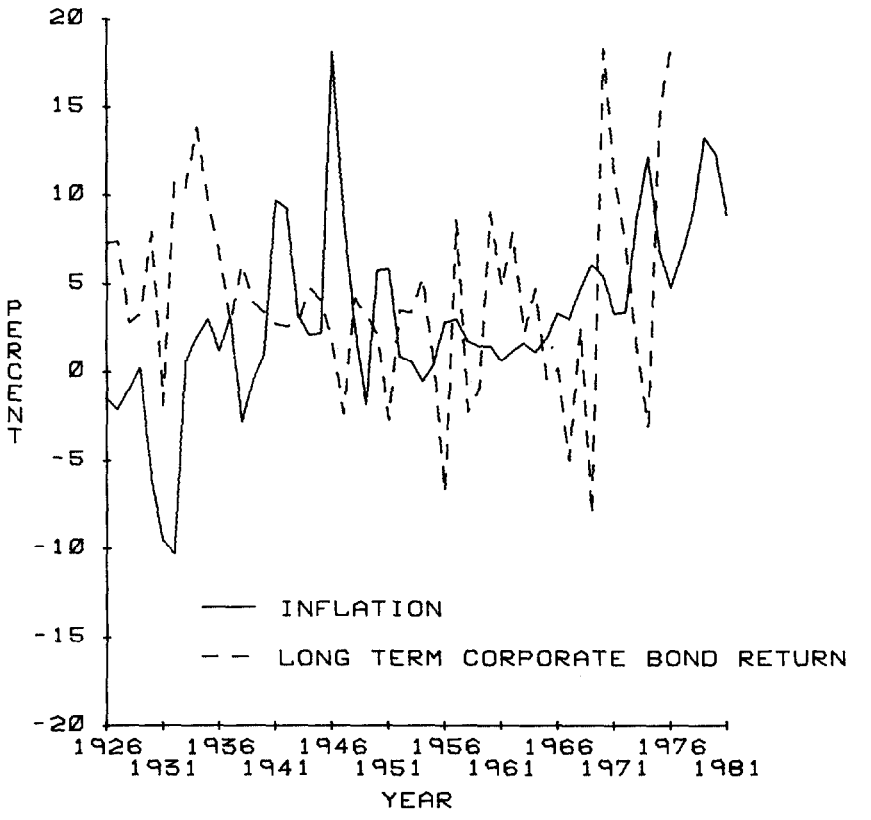

FIGURE 5

LONG TERM CORPORATE BOND RETURNS AND YEARLY PERCENTAGE CHANGE IN CPI (DEC.-DEC.) 1926-1976

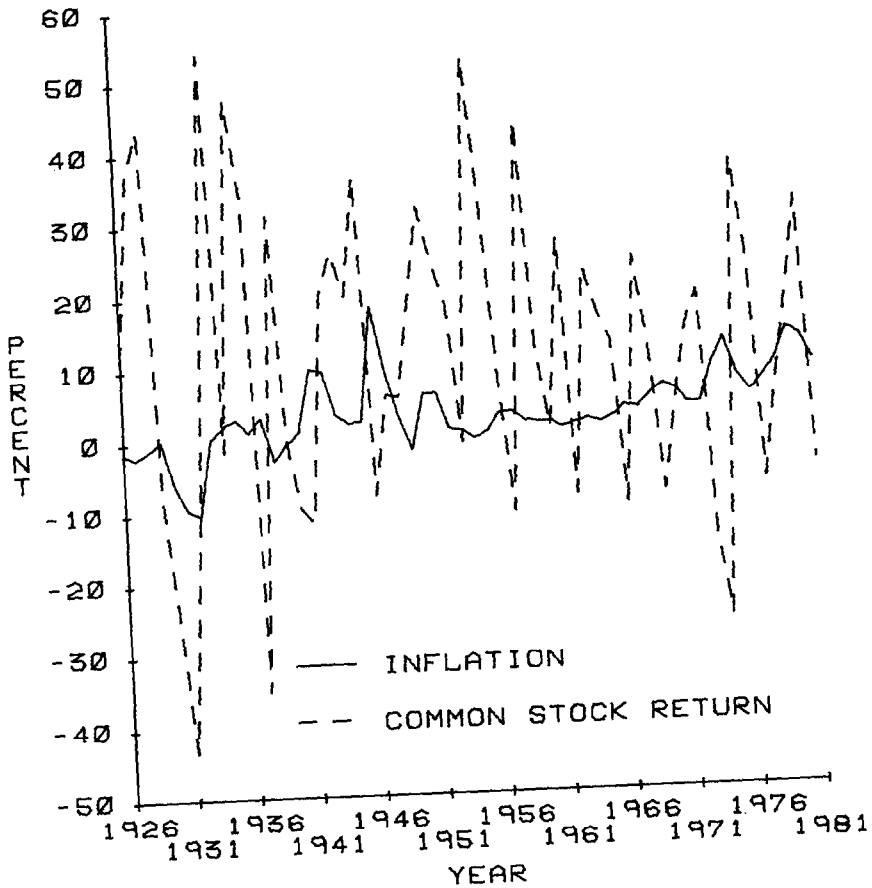

FIGURE 6

COMMON STOCK RETURNS AND

YEARLY PERCENTAGE CHANGE IN CPI (DEC.-DEC.)

1926-1981

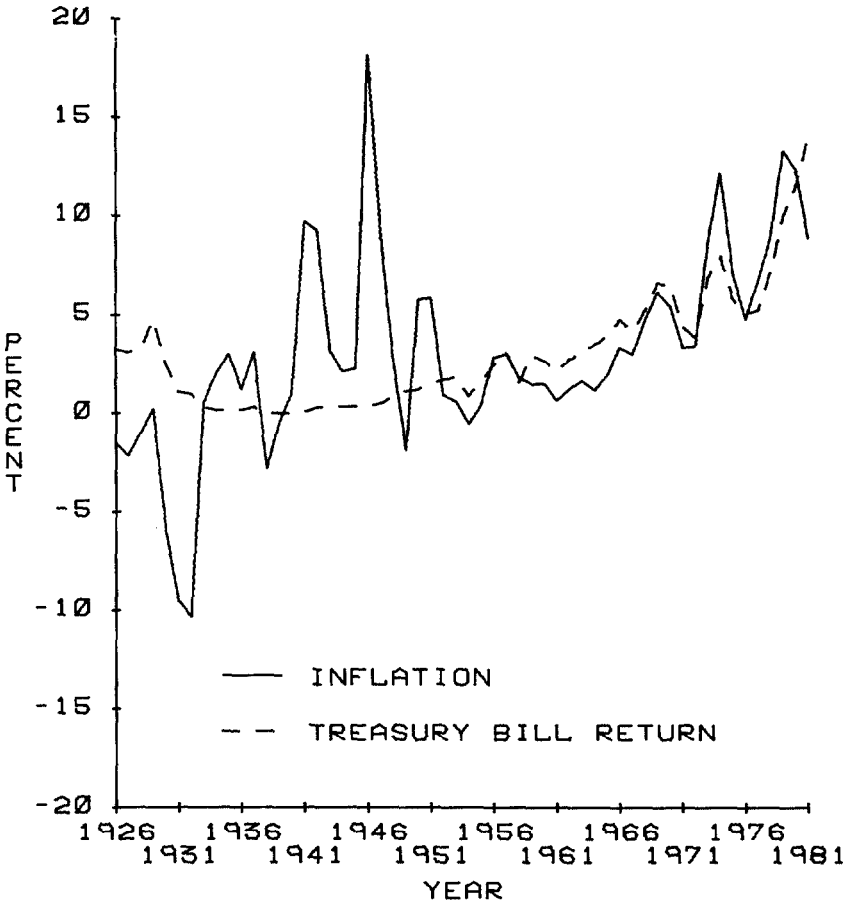

FIGURE 7

TREASURY BILL RETURNS AND

YEARLY PERCENTAGE CHANGE IN CPI (DEC.-DEC.)

1926-1981

Returns on Treasury bills, which are short term (1 to 3 month) investments, have been highly positively correlated with inflation since 1951. This relationship is expected and is explained by Fisher [5], Fama [3] and others. For high inflation rates investors demand a high interest rate to compensate for the loss of spending power. The nominal interest rate, according to the Fisher effect, is approximately equal to the anticipated inflation rate plus the desired real rate of return. This return would be available only on new bond investments, as previously purchased bonds would be locked into prior interest rates until maturity unless sold at the current market price. Short term investments avoid this lag. Prior to 1951, short term interest rates were intentionally held down by the Federal Reserve to accommodate government financing of social programs and the war debt. The Accord of 1951 supposedly ended the artificial suppression of short term interest rates. Experience prior to 1951, as can be seen from Figure 7, does not indicate a relationship between inflation and Treasury bill returns.

SECTION 4—INFLATION IMMUNIZATION

Insurance underwriting profit margins and current investment returns are both negatively correlated with the rate of inflation. Returns on Treasury bills are positively correlated with inflation. These opposite relationships can be utilized to immunize an insurer against the effect of inflation by properly structuring the investment portfolio. The adverse effects of inflation on underwriting and current investment returns can be offset by the beneficial effect of inflation on Treasury bill returns.

Since the assets of an insurer generally exceed the annual earned premium, the effect of a change in investment return has a greater impact on overall operating profitability than a similar change in underwriting profit margin. The leverage of total assets to earned premium varies over time. In 1980 the mean investable asset value for the year was 2.01 times the earned premium for that year for stock insurers [2]. This leverage factor is incorporated in the inflation immunization calculation.

In order to immunize an insurer from the effects of inflation, an investment portfolio must be chosen such that the impact of inflation on investment return offsets the effect of inflation on underwriting profit margin. The calculation involved in this determination is:

$$RUPM + RTB(L)(X) + RIIR(L)(1 - X) = 0.0 \quad (1)$$

where $RUPM$ = regression coefficient for the effect of inflation on underwriting profit margins.
RTB = regression coefficient for the effect of inflation on Treasury bill returns
$RIIR$ = regression coefficient for the effect of inflation on insurance investment returns
L = leverage ratio (investable assets/earned premium)
X = portion of assets to be invested in Treasury bills

Substituting the regression coefficients calculated from the period 1951 through 1976 and the 1980 leverage ratio into equation 1 yields:

$$-.617 + .556(2.01)X - .817(2.01)(1 - X) = 0$$
$$X = .818$$

The inflation immunized investment portfolio for the stock insurance industry as of the end of 1980, based on relationships calculated on 1951 through 1976 data, would have involved investing 81.8 percent of investable assets in Treasury bills and leaving the remaining 18.2 percent of investable assets distributed as currently invested. Insurance operating results would continue to fluctuate, but variations would be independent of the rate of inflation. Insurers would be immunized against the effects of inflation to the extent that the historical relationships between inflation and the components of insurance profitability remain constant. Changes in line of business mix over time and other changes in insurance operations may affect the relationship of underwriting profitability to inflation and should be considered in determining the appropriate time period on which to base this analysis.

Immunization is not costless. To attract investors, risky investments are required to produce a higher expected return than less risky investments. Treasury bills, as a less risky investment than common stocks, produce a lower return in the long run. For the period 1951 through 1976, Treasury bills generated a mean annual return of 3.7 percent, compared with 12.3 percent for common stocks and 5.1 percent for aggregate insurance investment returns. If insurers had maintained 81.8 percent of their investable assets in Treasury bills during this period, the inflation immunized investment return would have been 4.0 percent. Based on the 1980 leverage ratio, this reduction of 1.1 percentage points in insurance investment returns would be equivalent to a 2.2 percentage points reduction in underwriting profit margin.

SECTION 5—PORTFOLIO THEORY

If the cost of inflation immunization is considered too high a price to pay to eliminate the effect of inflation on insurance company profitability, an alternative method is available to minimize the effect of inflation while still achieving the desired target rate of return. Mean-variance analysis is based on the premise that an investor given the option of different investment opportunities with equivalent expected returns will prefer the alternative with the lowest variance. Portfolio theory provides a method for determining the optimal investment mix to produce the lowest variance for a given expected rate of return.[6] The inputs required for this procedure are the expected return and variance for each investment option and the covariance between each pair of investments. Since the variance of total operating profitability is to be minimized, insurance underwriting is treated as an investment alternative, but the amount of premium is constrained.

The following terms will be used in this analysis:

$E(r_i)$ = expected return on investment i
X_i = proportion of the portfolio invested in i
S_i = standard deviation of return on investment i
$Cov(i,j)$ = covariance between returns on investments i and j

The objective of this determination is to minimize the variance of insurance profitability related to inflation. Therefore, the covariances between investments are determined by multiplying each of the regression coefficients for the investment option related to inflation by the variance of the rate of inflation; for example:

$$Cov(TB,CS) = (RTB)(RCS)(S^2_{INF})$$

The investment alternatives used in this example are insurance underwriting, long term government bonds, Treasury bills, long term corporate bonds, and common stocks. The expected returns, variances, and covariances are determined from the period 1951 through 1976. The 1980 leverage ratio is applied. The minimum variance investment mix is determined by solving the following equations:

Minimize:

$$\sum_{i=1}^{5} \sum_{j=1}^{5} X_i X_j Cov(i,j) \tag{2}$$

[6] For an introduction to the mathematics of portfolio theory, see Francis and Archer [6].

Subject to:

$$\sum_{i=1}^{5} X_i E(r_i) = (5.086)(2.01) = 10.22 \tag{3}$$

$$X_1 = 1.0 \tag{4}$$

$$X_2 + X_3 + X_4 + X_5 = 2.01 \tag{5}$$

$$X_2, X_3, X_4, X_5 \geq 0.0 \tag{6}$$

$1 = UPM$, $2 = LTG$, $3 = TB$, $4 = LTC$, $5 = CS$

Equation 2 indicates that the variance of the portfolio is to be minimized. Equation 3 requires the return on the portfolio from investments in long term government bonds, Treasury bills, long term corporate bonds, and common stocks to equal the target rate of return (the mean insurance investment return over the period) times the leverage factor.[7] Equation 4 constrains earned premium to its current proportion. Equation 5 requires the sum of the investments to equal the leverage factor. Equation 6 restricts investment to positive values.

The foregoing series of equations can be solved by quadratic programming. The solution to this system of equations is:

$X_1 = 1.000$
$X_2 = 0.000$
$X_3 = 1.693$
$X_4 = 0.000$
$X_5 = 0.317$

The minimum variance portfolio involves investing 84.2 percent of investable assets in Treasury bills and 15.8 percent of investable assets in common stock. No long term bonds are included in this inflation minimization portfolio.

SECTION 6—UPDATE

The regression coefficients of inflation related to profit margins, insurance investment returns, and common stock returns change considerably when the experience through 1981 is included, as shown in Appendix II. The regression

[7] The effect of taxes on investment income can be included in this determination by expanding Equation 3. The after tax expected returns of each investment alternative would be used rather than the total expected return. The target rate of return would be the historical after tax investment income return for the industry multiplied by the leverage factor. Although historical after tax investment income data are not published for the industry, individual insurers would have this information for their own use.

coefficient of inflation related to Treasury bill returns does not alter significantly for the updated period. Data are not available to extend the long term government and corporate bond returns through 1981.

Substituting into equation 1 the regression coefficients for the period 1951 through 1981 (shown in Appendix II) yields:

$$-.396 + .699(2.01)X - .178(2.01)(1 - X) = 0.0$$
$$X = .428$$

The inflation immunized portfolio based on this more recent experience involves investing 42.8 percent of investable assets in Treasury bills, leaving 57.2 percent as currently allocated. For the period 1951 through 1981, this investment portfolio would have yielded a 5.2 percent return, reduced from the actual 5.5 percent return on insurance investments. This decline of 0.3 percentage points would be equivalent to a 0.6 percentage points reduction in underwriting profit margin, based on the 1980 leverage ratio.

SECTION 7—SUMMARY AND CONCLUSIONS

Since historically both underwriting profit margins and investment returns have been negatively correlated with inflation, total insurance operating results have fluctuated significantly as the rate of inflation has changed. Returns on Treasury bills, however, are positively correlated with inflation. By structuring an insurer's investment portfolio to offset the effect of inflation on underwriting profitability, the effect of inflation on operating results can be eliminated. Depending on the period from which the data are based, the inflation immunized investment portfolio requires the insurer to allocate between 42.8 percent and 81.8 percent of investable assets to Treasury bills. This investment strategy would reduce investment returns by between 0.3 and 1.1 percentage points.

Alternatively, insurers can minimize the impact of inflation on operating results by restructuring the investment portfolio to achieve a target rate of return with minimum inflation induced variation. Based on the data from the period 1951 through 1976, this inflation minimization portfolio would involve investment in only Treasury bills (84.2 percent) and common stocks (15.8 percent).

A very serious problem would develop if insurers were to attempt to shift rapidly to the optimal portfolios presented in this paper. Old long term bonds have a market value well below the statutory amortized value used for convention valuation as a result of a general increase in interest rates. Surplus would be reduced or, for some insurers, eliminated if all currently held long term

bonds were sold. Widespread sales would also greatly depress prices of long term securities, further eroding surplus. The only practical way for the insurance industry to achieve the desired investment mix would be to shift to the inflation immunized portfolio gradually by redirecting new funds and maturing issues. To a certain extent, insurers are locked into past investment policies, although such a problem can be avoided in the future.

Additional investment alternatives not considered in this paper could also offset the impact of inflation on underwriting profit margins and common stock returns. Commodity prices, since these reflect the cost of tangible products, and put options (which are the right to sell a stock at a given price), since put option prices increase as stock prices decline, are also likely to be positively correlated with the inflation rate. The financial futures market, operating since 1975, now allows investors the opportunity to hedge interest rate changes and changes in stock market index values.[8] An inflation immunized portfolio may include investment in these and other alternatives to the extent allowed by insurance investment regulation. Insurers have the ability to offset the adverse impact of inflation on underwriting profitability by structuring their investment portfolios so that investment returns are positively related to inflation. This strategy would reduce the variability of insurance operating profitability resulting from inflation. The property-liability insurance industry can cope with inflation.

[8] The author is indebted to Roger C. Wade for suggesting this alternative strategy. An introduction to this market is presented in Bacon and Williams [1].

APPENDIX I
DATA SOURCES

The three reference sources for obtaining or deriving the data used in this paper are:

1. *Best's Aggregates and Averages: Property-Casualty* (Oldwick, N.J.: A. M. Best Company, 1981, 1982)
2. Ibbotson, Roger G. and Rex A. Sinquefield, *Stocks, Bonds, Bills, and Inflation: The Past (1926–1976) and the Future (1977–2000)* (Charlottesville, Va.: Financial Analysts Research Foundation, 1977)
3. Standard and Poor's *Trade and Security Statistics* (Orange, Conn.: Standard and Poor's Corp., 1978, 1982)

The individual values were determined as follows:

1. Inflation: the percentage change in Consumer Price Index from December to December (Source 2 for 1926–1976; Source 3 for 1977–1981).
2. Underwriting profit margin: statutory underwriting profit margin for stock insurers (Source 1).
3. Insurance investment returns: statutory investment profit or loss including investment income for stock insurers as a percent of mean investable assets, with investable assets considered to be 90 percent of admitted assets (Source 1).
4. Long term government bond returns: total returns from interest and capital gains or losses on a 20 year term bond portfolio of U.S. Government bonds (Source 2).
5. Long term corporate bond returns: total returns from interest and capital gains or losses on the Salomon Brothers High Grade Long Term Corporate Bond Index and Standard and Poor's High Grade Corporate Composite yield data for 20 year maturities (Source 2).
6. Common stock returns: total returns from dividends and capital gains or losses based on the Standard and Poor's Composite Index (Source 2 for 1926–1976; Source 3 for 1977–1981).
7. Treasury bills: holding period returns on shortest term bills not less than one month to maturity held for one month (Source 2 for 1926–1976) and average yield on new issues of three month bills (Source 3 for 1977–1981).

APPENDIX II
SUMMARY STATISTICS

Variable	1933–1981 Mean	1933–1981 Standard Deviation	1951–1976 Mean	1951–1976 Standard Deviation	1951–1981 Mean	1951–1981 Standard Deviation
INF	4.19	4.26	3.34	2.92	4.43	3.80
UPM	2.72	4.05	0.90	3.42	0.74	3.40
IIR	5.00	4.72	5.09	5.01	5.52	4.75
LTG	3.27*	5.58*	2.95	6.64	NA	NA
LTC	4.04*	5.83*	3.65	6.98	NA	NA
CS	12.84	20.01	12.34	18.94	11.77	18.33
TB	3.09	3.23	3.73	1.93	4.68	3.09

* 1933–1976

REGRESSION COEFFICIENTS
Variable$_t$ = a + b *INF*$_t$ + e_t

Variable	a	b	T	R^2
1933–1981				
UPM	4.36	−.389	−3.079**	.168
IIR	6.00	−.239	−1.513	.046
CS	18.97	−1.463	−2.237*	.096
1933–1976				
LTG	4.08	−.230	−1.050	.026
LTC	4.89	−.241	−1.054	.026
1951–1976				
UPM	2.96	−.617	−3.029**	.277
IIR	7.81	−.817	−2.646*	.226
LTG	2.63	.095	.205	.002
LTC	3.93	−.084	−.171	.001
CS	22.73	−3.114	−2.675*	.230
TB	1.87	.556	7.594**	.706
1951–1981				
UPM	2.49	−.396	−2.657*	.196
IIR	6.31	−.178	−.777	.020
CS	17.98	−1.404	−1.638	.085
TB	1.58	.699	9.014**	.737

* = significant at the 5.0% level
** = significant at the 1.0% level

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