THE RELATIONSHIP OF UNDERWRITING, INVESTMENT, LEVERAGE, AND EXPOSURE TO TOTAL RETURN ON OWNERS' EQUITY

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In recent years, insurance literature and research reflect a great deal of attention to investment return in property and liability insurance companies and a number of important considerations have been discussed. Many issues, however, have not necessarily been resolved and there remains a dearth of thoughtful material on property and liability company finance. There has been so little analysis of investment matters from an actuarial point of view that there is still a need for further development of and agreement on fundamental principles. Accordingly, this paper is written for the purpose of formulating some simple but basic relationships which depict the manner in which investment return, financial leverage, underwriting results, and the utilization of underwriting capacity (or the so-called insurance exposure) all combine to determine the return to stockholders of an insurance company.

The Choice of the Investment Base

In the Arthur D. Little study of insurance company profits and prices, the issue was raised concerning the choice between total assets (investable funds) or net worth (capital and surplus) as the appropriate investment base for computing rates of return. The study concentrated primarily on return on total investable funds to "overcome the difficulties caused by seasonal variations in assets and differences in debt/equity ratios."[2] It was argued further that from society's point of view the critical measure of return is on total assets since society is the ultimate winner or loser regardless of how the resources in a business venture are financed. While the Little study did present computations of return to net worth, it was admitted that the "study does not present a framework for making a risk/return comparison for returns on net worth."[3] These aspects of the choice of an appropriate in-

[1] The author acknowledges the assistance of Dr. Anthony J. Curley, Assistant Professor of Finance at the University of Pennsylvania, who first introduced the author to certain leverage relationships in non-insurance enterprises and by so doing unintionally stimulated this paper.

[2] *Prices and Profits in the Property and Liability Insurance Industry* (A Report to the American Insurance Association by Arthur D. Little, Inc.), 1968, p. 28.

[3] *Ibid.*, p. 40.

vestment base are subject to debate but an analysis of the objectives and methodology of the Little study is not the purpose of this article. What will be shown, however, is the exact relationship between return on assets and return on equity via the well-known concept of financial leverage.

Total Return on Equity — The Basic Equation

It can be argued sensibly that an insurance company operates with a levered capital structure. The leverage, however, does not result from the use of debt capital,[4] but, instead, is an "insurance leverage" resulting from the deferred nature of insurance liabilities. This concept of insurance leverage can be used to explain in simple terms the relationship between return on assets and return on equity.

For convenience let us establish the following notation:

T — Total after-tax return to the insurer
I — Investment gain or loss (after appropriate tax charges)
U — Underwriting profit or loss (after appropriate tax charges)
P — Premium income
A — Total assets
R — Reserves and other liabilities (excluding equity in unearned premium reserves)
S — Stockholders' equity (capital, surplus, and equity in unearned premium reserve)

Using this notation:

$$\frac{T}{S} = \text{Total return on equity}$$

$$T = I + U \text{ and } S = A - R$$

Therefore: $$\frac{T}{S} = \frac{I+U}{S}$$

or: $$\frac{T}{S} = \frac{A}{A} \cdot \frac{I+U}{S} = \frac{A\,(I+U)}{AS}$$

[4] Recently it has been recommended that property-liability insurance companies be permitted to issue debt obligations to obtain capital. See New York State Insurance Department, *Report of the Special Commitee on Insurance Holding Companies*, 1968, p. 8. It should be recognized that the introduction of true debt into the capital structure may be possible only at interest rates well above an insurer's present cost of capital.

Using simple algebra:

$$\frac{T}{S} = \frac{AI + AU + IR - IR}{AS}$$

$$= \frac{I(A-R)}{AS} + \frac{IR}{AS} + \frac{AU}{AS}$$

$$= \frac{IS}{AS} + \frac{IR}{AS} + \frac{U}{S} \tag{1}$$

$$= \frac{I}{A} + \frac{IR}{AS} + \frac{U}{S} \cdot \frac{P}{P}$$

finally yields: $$\frac{T}{S} = \frac{I}{A}\left(1 + \frac{R}{S}\right) + \frac{U}{P} \cdot \frac{P}{S} \tag{2}$$

Hence, we see that the total return to stockholders is equal to the sum of investment return on assets (I/A) multiplied by an insurance leverage factor $(1 + R/S)$ dependent on the size of reserves relative to surplus — plus — the underwriting profit[5] (or minus the underwriting loss) on premiums (U/P) multiplied by an insurance exposure term (P/S) relating premiums to surplus. The formula does not require a mutually exclusive choice between equity or total assets as an investment base but rather clearly points out their interdependence. In fact, the formula contains a third rate of return measure in the form of the U/P ratio, a familiar and traditional benchmark for measuring underwriting results. Thus, in one simple equation we see the relationship among return on equity (the investors' viewpoint), return on assets (society's viewpoint), and return on sales (the regulators' and actuaries' viewpoint).

Formula (2) contains the P/S ratio which is sometimes referred to as the insurance exposure and has been advocated on occasion as a rule-of-thumb indicator of insolvency risk.[6] In the basic formula, however, it can be seen that the P/S ratio and the U/P ratio contribute to the return on equity

[5] Since the primary objective of the formula is to measure return for investors and not regulators, underwriting profit or loss on an adjusted basis would be preferable to statutory results since the former would show more correctly the true incidence of expenses. Whatever adjustment is used, it should reflect the fact that it is the cash flow from underwriting that directly affects the investable assets.

[6] For example, see J. W. Middendorf, II, *Investment Policies of Fire and Casualty Insurance Companies* (New York: Wood, Struthers and Co., 1954), pp. 26–30; and Roger Kenney, *Fundamentals of Fire and Casualty Insurance Strength* (Dedham, Mass.: Kenney Insurance Studies, 1967), pp. 97–102.

in much the same manner as do sales margins multiplied by turnover rates in the analysis of return for manufacturing or merchandising concerns.

Reserves Viewed as Non-Equity Capital

Another interesting aspect of this formulation is revealed by placing it in a different form as follows:

$$\text{from (1)} \quad \frac{T}{S} = \frac{I}{A} + \frac{IR}{AS} + \frac{U}{S} \cdot \frac{R}{R}$$

$$\text{therefore} \quad \frac{T}{S} = \frac{I}{A} + \frac{R}{S} \left(\frac{I}{A} + \frac{U}{R} \right) \tag{3}$$

An interpretation of formula (3) requires that R be viewed as "reserve capital," that is, the amount of total investable assets that has been supplied by other than the owners. In this form the leverage factor R/S is applied separately to interest income on total assets and underwriting profit or loss related to the reserve capital contributed by policyholders. In the case of underwriting losses, formula (3) is plainly analogous to the use of debt capital for financial leverage.[7] With this viewpoint, underwriting losses can be considered as the "interest" that the insurer has paid for the use of R dollars of reserve capital.[8] Naturally, reserve capital differs from the usual debt capital in that with the former the cost of "borrowing" is a variable rather than a fixed interest rate.[9] Formula (3) indicates that it is to the benefit of the owners to continue to write insurance in the event of underwriting losses as long as ratio I/A exceeds the absolute value of a negative ratio U/R. This does not mean that underwriting losses are a desirable objective, but it merely indicates the advantage of continuing to write insurance (ignoring other constraints on cutbacks) during periods of unprofitability. Only when losses make the absolute value of negative U/R larger than I/A does the leverage from the insurance portfolio become unfavorable and detract from the return to stockholders.

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[7] The development of a counterpart of this formula for analysis of leverage through debt financing appears in C. A. Westwick, "A Graphical Treatment of Gearing," *Journal of Accounting Research,* Vol. 4, No. 2, Autumn, 1966.

[8] Similarly, underwriting profits can be viewed as a negative cost of reserve capital.

[9] The bulk of the reserve liabilities obviously are not obligations that extend over durations comparable to long-term debt instruments. They do, however, resemble short- and intermediate-term debt and it can be argued that all forms of indebtedness, regardless of term, should be included in the measurement of leverage. See Ivan R. Woods "Financial 'Leverage' and 'Gearing' in Perspective," reprinted in Edward J. Mock (editor) *Financial Decision Making* (Scranton, Pennsylvania: International Textbook Co., 1967), pp. 533–534.

The Impact of Insurance Leverage

The significant impact of leverage in insurance operations can be illustrated by applying formula (3) to the four hypothetical examples of operating results shown in Table 1.[10] The percentage return on equity as calculated by formula (3) for each company and for each insurance situation is shown in Table 2. While these results can be calculated directly, formula (3) is useful for visualizing in each instance the contribution to or subtraction from the total return on equity resulting from the effect of leverage in the insurance companies. The figures in Table 2 show the increased absolute and relative variability of operating returns that result from increased leverage, and this variability would have been even more significant had the investment rate of return been allowed to vary. Hence, the leverage ratio or the reserve-surplus ratio serves as an indicator or a partial determinant of the riskiness of the owner's investment in the firm.

Actuarial Determination of the Optimum Capital Structure

The preceding view of reserves as leverage-inducing, non-equity capital, if it is accepted, has significant implications for the scope of actuarial analysis. With this view, the actuary, dealing primarily with premiums and reserves, cannot, and indeed should not, ignore one of the fundamental problems in the theory and practice of financial management — the problem of determining the optimal capital structure of the firm.

The problem of finding the optimal composition of liabilities and owners' equity at which the value of a firm will be maximized appears on the surface to be as relevant to a stock insurance company as to any other business enterprise. The two crucial variables that are generally accepted as the determinants of the value of a firm are the expected earning stream and the rate at which that stream is capitalized by the market. It is intuitively obvious and it has been shown in formula (3) that non-equity financing from reserves will add to the income stream as long as the costs of financing the reserves are less than the returns from invested assets. The central issue of the optimal capital structure is the effect of non-equity financing such as reserves on the quality (variance) of the insurer's earnings

[10] The figures in Table 1 are in no sense assumed to be realistic or representative of any one company. They are used only to point out the direction of the impact of the leverage variable and many other considerations have been ignored. For example, nothing has been said about the fact that insurance companies with such diverse leverage ratios are not likely to have identical investment or underwriting results. Also, no attempt is made to discuss the implications of the varied blends of income and gains and losses that can underlie the return on invested assets.

Table 1

Hypothetical Operating Results

Company A: An unlevered investment trust
Invested assets: $20,000,000
Owners' equity: $20,000,000
Investment return: 5%
Leverage ratio[3]: 0

Company B: Insurance company — "low" leverage
Invested assets: $20,000,000
Reserve liabilities[1]: $6,666,667
Owners' equity[2]: $13,333,333
Investment return: 5%
Leverage ratio[3]: ½

Company C: Insurance company — "medium" leverage
Invested assets: $20,000,000
Reserve liabilities[1]: $10,000,000
Owners' equity[2]: $10,000,000
Investment return: 5%
Leverage ratio[3]: 1

Company D: Insurance company — "high" leverage
Invested assets: $20,000,000
Reserve liabilities[1]: $13,333,333
Owners' equity[2]: $6,666,667
Investment return: 5%
Leverage ratio[3]: 2

Insurance operating results[4]: Situation 1 — +6% (profit)
Situation 2 — 0% (breakeven)
Situation 3 — −6% (loss)

[1] Excluding equity in unearned premium reserve.
[2] Including equity in unearned premium reserve.
[3] Reserve liabilities divided by owners' equity.
[4] Underwriting profit or loss as a percentage of reserve liabilities.

Table 2

Return on Owners' Equity Based on Data in Table 1

	Company A	Company B	Company C	Company D
Situation 1	5.0%	10.5%	16%	27%
Situation 2	5.0	7.5	10	15
Situation 3	5.0	4.5	4	3

and, hence, on the rate at which the earnings are capitalized by the market for valuation purposes. It is in the determination of the impact of insurance obligations (as reflected in reserves) on the magnitude and variance of future earnings that the talents of the actuary are required. What this suggests is that the actuarial determination of the probability of ruin or insolvency should be extended to include the determination of the probabilities of unfavorable returns to owners and the attendant lowering of market valuation of the company or at the extreme a departure of equity capital from the business.

The analysis of reserve capital (or insurance leverage) is undoubtedly more complicated than the analysis of debt capital. As was stated previously, the cost of the latter is fixed while the former has an expected cost with a variance. Additionally, an increase in the relative amount of debt capital generally entails demands by the creditors for a progressively higher interest rate to reflect the increased risk of larger fixed commitments, but the relative profitability of expanding an insurance portfolio is not as predictable. The ability to reduce the relative variance of underwriting results by sheer volume and logical diversification may offset the costs of taking additional and possibly poorer risks.

The actuarial analysis of the optimal capital structure (or optimum reserve-surplus ratio) of the insurer must also include an analysis of the quality and earning capacity of the assets. One of the major determinants of the amount of non-equity capital that may safely be undertaken by the firm is the degree of variability in the investment earning stream. The traditional position is that the greater the variability of earnings the lower the prescribed debt-equity ratio. Thus, the optimum reserve position for an insurer is not independent of the investment policy that is followed.

Of what practical application is an analysis of the optimal capital structure of a property and liability insurer? If the industry does have a capacity problem from the insuring public's viewpoint, it may be explained by a capital structure that from an investor's viewpoint is optimal at a relatively low reserve/surplus ratio. Furthermore, one can inquire whether a capacity problem is attributable only in part to rating formulas and/or regulation and is affected also by overly aggressive investment portfolios that set the optimal capital structure at a relatively low reserve/surplus ratio. Alternatively, and in the author's opinion more realistically, if the optimal capital structure is at a higher reserve/surplus ratio than is maintained currently in the typical company, then one might conclude that the industry is over-

capitalized with investor capital. This situation would explain the financial motivation behind the recent emphasis on holding-company formations to absorb insurance company capital. Interestingly, the fact that investor capital might be in excess appears to have been overlooked or ignored as a possible logical explanation of the general unprofitability alleged by the Arthur D. Little study of prices and profits.

Conclusions

If present regulatory and financial trends continue, the actuary is going to be forced to narrow the analytical gap between the insurance and investment sides of the business.[11] The arguments presented here reinforce the position that investment return can no longer be ignored by the actuary, but they do not prescribe the manner in which investment should be included in the current ratemaking process. It is suggested that somehow simply plugging a rate of return into current ratemaking formulas is too narrow an approach. Once the actuary introduces investment returns into his analysis, he must logically be concerned with the rather broad financial management objectives affecting total performance of the firm. The basic formulas derived in this paper show the role that the insurance operations play in the over-all determination of total return to stockholders. According to financial theory, it is this return that management should be attempting to maximize. It appears, however, that management in general, and actuaries in particular, have been over-zealous in addressing themselves to regulators rather than the shareholders. In order to remedy this imbalance, current techniques of ratemaking and rate regulation may have to undergo traumatic procedural and philosophical changes to properly accommodate the introduction of investment considerations into the ratemaking process. Perhaps the only solution with enough flexibility is a system of open competition.

[11] The existence of this separation was described to this Society in S. Davidson Herron, Jr., "Insurance Company Investment," *Proceedings of the Casualty Actuarial Society*, 1966, pp. 238–239.