

Required Rate of Return for Life Insurers

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Summary

This paper outlines some applications of corporate finance theory to setting target rates of return on capital for Life Insurers.

It proposes that the fair charge for capital finance (including financing policies) is the risk-adjusted opportunity cost for that capital.

The relationship between capital structure, cost of capital and target rates is examined, and conditions outlined under which it is reasonable to ignore capital structure in setting target rates.

Some alternative methods of determining the price for risk to capital are examined. Internal specification of the price of risk is argued to be insufficient, because there is no link with the alternatives available in the market. The EPM is considered to be the best financial model of those examined, subject to the availability of suitable market prices for determining hedging costs. The CAPM is preferred over APT, on the ground of practicality.

Résumé

Taux de Rendement Exigé pour les Assureurs sur la Vie

Cet article souligne certaines applications de la théorie financière de l'entreprise concernant la détermination des taux d'objectifs de rendement sur le capital pour les assureurs sur la vie.

Il propose que le prix équitable pour le financement des capitaux (y compris les politiques de financement) soit le coût d'opportunité corrigé par le risque de ce capital.

La relation entre structure des capitaux, coût des capitaux et taux d'objectifs est examinée, les conditions dans lesquelles il est raisonnable d'ignorer la structure des capitaux lors de la détermination des taux d'objectif sont soulignées.

D'autres méthodes destinées à déterminer le prix du risque par rapport au capital sont examinées. Il est démontré que la spécification interne du prix du risque est insuffisante parce qu'il n'y a pas de lien avec les alternatives disponibles sur le marché. L'EPM est considéré comme étant le meilleur modèle financier ainsi ceux étudiés sous réserve de la disponibilité des prix de marchés pour déterminer les frais de couverture. CAPM est préféré à APT, pour des raisons pratiques.

Introduction

An appropriate required rate of return on capital is an important element in providing fair returns to all the participants in a life office (policyholders, shareholders and bondholders). For a return to be fair it should correspond to the return available on alternative investments of equivalent risk.

External markets provide a range of alternative investments with varying prospective return distributions. This information can be incorporated into our assessment and pricing of risk, but to do this will normally require some assumptions about the nature and efficiency of these markets. At one extreme, the exact risks the office wishes to price may be traded in a market believed to be efficient, in which case the office would accept the market prices. Conversely, the office may assume that the market is so inefficient that it provides no useful information, in which case the office would determine its pricing purely on its internal perceptions of risk.

This paper outlines some alternative approaches, mostly based on corporate finance theory (i.e. attempting to include market information), to setting target rates of return for Life Insurers.

Section 1 discusses why it is important to ensure that the return on funds employed is adequate for the risk taken. Section 2 discusses the impact of capital structure on the required rate of return, section 3 discusses some of the main alternative approaches which have been suggested to setting required rates of return and section 4 summarises the discussions.

1 Need for adequate after-tax return on capital committed

A typical life insurance product requires an initial period of commitment of funds by the office to finance expenses and required reserves in excess of the premiums received (as discussed below, the required reserves may include contingency reserves to allow for adverse fluctuations). This investment is repaid by subsequent releases of funds as premiums, earnings on assets and releases from reserves exceed outgoings (expenses, claim payments, policyholder dividends, etc) and required additions to reserves. In some cases there may be more than one change in sign, which would require slight changes in approach, but I have ignored these for simplicity.

Life Insurers are therefore, by the nature of their business, continually making capital investments in the financing of new policies (and will also make investments in other projects). There is a need to ensure that the return is adequate, i.e. that it is at a fair level relative to alternative uses (of similar risk). Such a fair return on capital finance is a necessary, but certainly not sufficient, condition for finding an appropriate balance between the competing interests of the various groups of policyholders and the external capital providers. Accordingly, it should be a matter of

some interest to the actuary that the required return on capital is set in an appropriate manner.

It should, however, be recognized that target rates alone cannot be the only determinant in allocating capital (Kester and Taggart [1989] discuss some of the other key issues involved in establishing a capital allocation strategy).

For most capital budgeting decisions, the test of adequacy of the return on an investment is the alternative use return for equivalent risk, i.e. the risk-adjusted opportunity cost. The return net of all taxes must be the criterion for both proposed and alternative uses, due to the range of different tax regimes which may apply. For life insurance companies, the standard alternative would be to invest the funds in investment assets (e.g. fixed interest, equities, etc). Accordingly, a discount rate based on available investment returns could be appropriate. Different assets will, however, have different expected returns, since rational investors will require appropriate compensation for differing levels of risk. This reinforces the need to determine the level of risk incurred by capital financing policies, as this may differ substantially from that of the assets which would normally be held.

Risk adjustment

The return required on any use of funds should be adjusted for the level of risk incurred. This is widely accepted for the investment assets which could be bought or held instead (where the return available will vary with risk). Such an adjustment is also necessary to maintain equity among current policyholders (owners of policies which created abnormally high risk on the capital backing them would otherwise be subsidised by other policyholders and/or shareholders).

Care needs to be taken, however, in considering risk, in that some policy risks are correlated (e.g. backing guaranteed surrender values with equity assets), while others are virtually independent between policies (e.g. mortality). It is not necessarily obvious to what extent the office should require (or be able to obtain) additional return for these different types of risk. For instance, the pooling of independent risks to achieve a lower risk per policy (and hence lower cost to policyholders) is the basis of insurance. Furthermore, it can be argued that the ability of shareholders to diversify certain risks through their other asset holdings implies that these risks should not be able to achieve rewards in equilibrium. External markets for risky assets may be able to provide information on appropriate methods for pricing different kinds of risk.

Risk can be reduced by requiring additional reserves (known as contingency reserves or risk surplus) to be held backing the policy. Such additional reserves may be necessary to protect the office against adverse fluctuations (Cody [1988] discusses approaches to setting the amount of these reserves). These contingency reserves have the dual effect of reducing the volume of business possible and also of imposing an additional financing cost on the policy (due to the margin between expected earnings on the reserves and the target

rate). It should be noted that unless such reserves can be invested in risk-free assets, their ability to offset risk is likely to be reduced by correlation between the return on the reserve assets and the return generated for capital by the policies, since the major undiversifiable risks will tend to be those relating to poor asset returns.

Contingency reserves should in theory be set at levels which reflect each product's contribution to the office's insolvency risk. Even if insolvency risks are equalised, this will not necessarily make the return on capital distributions similar, due to the wide range of different "shapes" of underlying distributions. It may therefore still be appropriate to vary required returns by product to reflect the remaining differences in risk profile.

2 Impact of Capital Structure

In the general case, the cost of capital will vary by source, and different projects will have varying abilities to support different types of capital (e.g. some projects have higher debt capacity than others). It would then be necessary to consider the potential impact of a new project on the capital structure, as well as the cost of each type of capital, in order to assess the project's ability to add value. Under certain conditions the investment and financing decisions are independent, allowing much simpler analysis. Before examining these conditions, it is appropriate to review the sources of capital for a life office.

In life offices, the capital is provided by:

- i) shareholders,
- ii) debt providers and
- iii) policyholders.

The capital provided by policyholders is a distinctive element of life insurance operations as was noted by Launie [1971]. The provision of capital by policyholders is most obvious for mutual offices, but applies to all offices. This financing arises out of differences in funding requirements over the term of policies (i.e. movement from requiring capital to releasing capital) as well as accumulated policyholder capital from permanent contributions to the "Estate" of the office (which is the excess of realistic net asset values over realistic policy liabilities). Financing from policyholder capital is, roughly speaking, equivalent to an investment by one generation of policyholders into the next. The "cost of funds" from this source must be at least the return otherwise available from investing this capital in assets of equivalent risk, as otherwise the "investment" would not be equitable between the generations.

Estimating the cost of equity capital has been the subject of extensive study, which I shall not attempt to summarise. It is, however, reasonable to expect that the cost of equity capital to a firm will vary with the risk on that capital, which will depend on the risk on the underlying investments of the firm and its level of

gearing (usually through debt). There will therefore be interaction between the relative amounts of the different types of capital and their appropriate returns. As outlined below, under certain conditions it is not necessary to know the cost of equity capital directly to establish appropriate target rates of return.

There are three sets of conditions under which it would be appropriate to set target rates for projects without reference to their possible impact on capital structure:

- a) Competitive Equilibrium,
- b) Cost of Capital invariant under changes in structure, or
- c) Capital Structure can be assumed invariant.

a) Competitive Equilibrium

Competitive equilibrium requires that entry and exit barriers be minimal, no transaction costs, no market distortions (e.g. due to taxes or imperfect information) and that participants be rational investors motivated by return and risk considerations. Under these conditions, the available expected net return on any investment should be independent of capital structure and equal to the return on other investments of similar risk. This follows from the observation that excess returns would attract additional capital to this industry and that inferior returns would result in the withdrawal of capital (e.g. by investing in other assets rather than new policies) until equilibrium was achieved. It should be noted that investment restrictions on life companies might reduce returns on assets below the efficient risk/return frontier, but under competitive equilibrium in the capital market, this would be borne by policyholders in the form of lower benefits (both for the lower earning on assets and to supplement the return on capital). Similarly, any special tax benefits on certain types of policies would improve the policy benefits, and not the net return on finance provided.

It follows that the equilibrium target rate of return on financing policies under competitive equilibrium should not be dependent on the capital structure, but rather on the net return on investments of similar risk.

b) Constant Cost of Capital

As outlined above, there are three types of capital: shareholder, debt and policyholder. The cost of each will vary with its share of the underlying risk of the operations. This total risk is, however, not dependent on the capital structure and thus its apportionment should not affect the total cost of capital. If different groups of investors prepared to pay different prices for risk could be isolated, then a riskless arbitrage could be created, effectively buying risk from the more risk averse and selling to the less. Market distortions due to factors such as taxes or barriers to capital transfer may, however, cause differences in the total cost associated with various structures.

Effect of Taxes

For the cost of capital to be invariant with structure, we need the total tax burden (i.e. tax paid by the office, its shareholders and its bondholders) to also be invariant with capital structure. Because of the substantial differences between countries in tax regimes (especially for life insurers), it is very difficult to generalise the conditions for tax burden invariance. It is worth emphasising that the underlying operations are assumed to be the same, and that it is the impact of changes in capital structure on tax payable that is relevant. It should also be noted that because of the uncertain nature of the underlying operations, tax benefits (e.g. deductions for debt interest) or penalties (e.g. tax on profit) may not always apply, and that this would need to be factored into the assumed average rate. I shall attempt to outline below the main considerations for examining invariance, illustrated using the Australian tax system.

Relevant factors in assessing whether invariance under changes in capital structure is a reasonable assumption would include:

1) any differences in the tax treatment of mutual and proprietary offices (if mutualisation or demutualisation is an available option)

In Australia, the tax treatment is the same for all offices.

2) any variation for proprietary offices in tax treatment of office with proportion of shareholder finance

No variation in Australia, except that the franking (tax) credits available to shareholders do not vary with shareholder capital, so that above a certain level share capital becomes more expensive to service.

3) tax treatment of retained surplus (return to the "Estate")

No tax on retained surplus in Australia.

4) tax treatment of shareholders on dividends and capital gains (in aggregate, so that an average investor tax position will need to be determined)

In Australia, capital gains for individuals and corporations are taxed at their marginal rate, but (for most investors) only after an inflation adjustment to the cost price (capital losses are against unindexed cost). Dividends are tax free to corporations (and attached franking credits are available to frank dividends), except when received by life funds, and are taxed for individuals and life funds at their marginal rate (up to 47.25% for individuals, between 15% and 39% for life funds) as though equal to dividend+franking credit, with a tax credit for the franking credit. In proprietary offices, 20% of the tax paid by the life insurance funds plus all tax paid on other operations is available to provide franking credits on dividends at the rate of 39/61 of the dividend. This tax available would generally exceed the amount required to frank all dividends, provided (as would be usual) that shares constituted only a moderate proportion of total capital.

5) tax treatment of interest paid by office (allowing for probability of availability of any deduction dependent on profit)

Australian mutual offices are restricted in their ability to borrow directly, but they may be able to structure borrowings (e.g. through a subsidiary) so as to be eligible for a deduction at the company tax rate of 39%. Proprietary offices will normally be able to gain the 39% deduction.

6) tax treatment of interest received by bondholders (in aggregate, so that an average investor tax position will need to be determined)

Australian investors are subject to tax on interest receipts at their marginal rate.

It may be instructive to consider the invariance conditions under Australian tax.

Invariance of total tax under changes in debt/share mix is a normal consequence of the Australian dividend imputation system (provided all stakeholders are Australian taxpayers). Because of the somewhat concessionary nature of the franking credits available to proprietary life offices, invariance will apply not for them when their tax deduction for interest is below the full 39% rate (at lesser rates shares will usually be cheaper).

Invariance under changes in the shareholder/policyholder mix for Australia requires that the marginal investor have no net tax liability or benefit on shares. This implies a marginal tax rate slightly below 39% so that the franking credits cancel dividend tax liability (slightly below 39% to allow for years when full franking is not possible and for the possibility that capital gains tax might be payable). This probably higher than the actual marginal rate, given the presence in the market of superannuation funds taxed at a concessional 15% rate, and the relatively low level of direct ownership of shares. This implies an advantage for share capital, but the extent is probably not major (and it would disappear for share capital in excess of that which can obtain fully franked dividends), so that an invariance assumption is not entirely unreasonable.

Invariance under changes in debt/policyholder mix for Australia requires that the average rate of tax deduction to the office (allowing for probability of availability) equals the average rate of tax on interest for bondholders. As noted above, the average marginal tax rate of investors will be below 39%. Those offices able to gain a 39% tax deduction should therefore benefit from debt relative to policyholder finance. For many offices (e.g. mutuals), however, direct debt finance may only yield a deduction at their marginal tax rate on life funds (range 15% to 39%, with 25% about average), and the costs of other methods (e.g. via subsidiary) will reduce benefits so that invariance is a reasonable assumption.

In summary, invariance of tax with capital structure is probably not true in Australia, but the variations are small enough that it is not an unreasonable assumption. A similar result may apply in other jurisdictions.

Capital Barriers

In practice there are usually substantial barriers to capital transfers in life insurance. The effects of these on the appropriate target rates of return therefore need to be considered.

The main exit barriers on capital are usually limitations on transfers to shareholders and the presence of infrastructure assets (e.g. computer systems, distribution networks, etc) with little or no resale value. Investment restrictions on life office assets may also be considered a barrier to exit, in that they may hinder the efficient redeployment of capital out of financing products.

I would suggest dealing with unredeployable (infrastructure) assets by excluding them initially from the return on capital process, and aiming to have sufficient positive net present value projects to provide the return on these assets. This is consistent with the "macro pricing" approach (see Shuttleworth [1988] or Chalke [1988a]), where products are priced on marginal expenses subject to the requirement that the sum of the net present values over the whole line is sufficient to meet overheads. Other exit barriers may require capital in life companies to accept sub-standard returns, at least down to the level of free market returns less the cost of exit. This will apply equally to both shareholder and policyholder capital in the short term, since neither could be redeployed. Under these circumstances, lower target rates might be appropriate, however the difficulties of determining the appropriate reduction probably make it more practical to use the fair market return and attempt to minimise negative net present values.

Capital entry barriers in life insurance would include the limited ability to obtain additional capital from policyholders, regulatory limits on debt finance, large start-up costs and regulatory restrictions on ownership (e.g. "fit and proper person" tests). The presence of these barriers may allow returns above the free market return (i.e. economic rents) on the capital already in the industry, due to reduced competitive pressures. Despite the restricted supply of policyholder capital, it is hard to justify higher returns on these funds than on investments of similar risk, due to considerations of equity between generations of policyholders. If the fair market return is adopted as the basis for target rates under these circumstances, the economic rents available will be reflected in the ability to obtain substantial positive net present values on new projects (which will add value to the office and can be apportioned among the capital providers as desired).

Therefore, even allowing for capital barriers, the fair market return will remain a useful target rate for projects. Furthermore, as outlined for Australia, it may be possible to assume that tax effects will not disturb the invariance of cost of capital with structure. In combination, these allow investment decisions to be independent of financing, within a reasonably realistic framework.

c) Optimal Capital Structure

An assumption sometimes used in corporate finance theory is that there is a constant "optimal" capital structure for a firm, which backs all projects. Financing and investment decisions can then be separated because the acceptance or rejection of any project will not affect this "optimal" mix. This is not a reasonable assumption for a life insurer (except an ungeared mutual) over the long term, due to the inability to directly vary the level of policyholder capital. It may, however, be a reasonable assumption in the short term, due to regulatory restrictions, etc, in relation to relatively small projects.

For simplicity, I shall ignore capital structure in the following sections and concentrate on methods of estimating the appropriate return for risk, equivalent to that available on investment assets. The implicit assumption is competitive equilibrium, which I feel should be the starting point for any examination.

3 Methods of Setting Rates

D'Arcy and Doherty [1988] provide a good introduction to the use of financial theories, in the context of pricing general insurance.

I have deliberately excluded consideration of option-pricing models which have been proposed for general insurers. These models have an implicit inclusion of bankruptcy probability, and hence limited losses for external capital. An application of this theory to life insurance would therefore require that the external capital (shares and debt) be treated separately from the policyholder capital. It would then be necessary to include consideration of the capital structure in determining appropriate pricing mechanisms and the required rate of return on capital.

a) Internal Specification

Judging by the available literature, it is not uncommon for offices to set target rates (at least initially) on an ad-hoc basis, i.e. without reference to external factors (other than on an intuitive basis). The resulting target rate may be a nominated figure (e.g. internal rate of return of 15% is commonly quoted) or the required return on capital may be implicit in a target such as present value of future profits at nominated discount rate being at least equal to a set proportion of initial commission, of first year's premium or of present value of premiums. Because these rates generally have little or no theoretical basis, and ignore market information, there may be problems:

- i) the rates are usually not adjusted for risk, which implies complete reliance on other elements (e.g. the contingency reserve level) to compensate, and

ii) there is no mechanism linking the rate to the external situation, so that the rate may be, or become, out of line with alternatives or the cost of capital.

Offices can adjust these target rates for risk directly by specifying their desired risk/return trade-off (i.e. their utility curves). This requires defining a measure of risk for the firm (Clarkson [1990] has a discussion of the limitations of standard risk measures, such as variance), as well as the desired trade-off of risk vs return. Chalke [1988a and 1988b], Longley-Cooke [1983] and Shuttleworth [1988] all examine the use of an exponential utility for pricing risk to capital for a life insurer.

The office's risk-return preferences could be estimated through questionnaires (e.g. Van der Sar and Antonides [1990] examine individuals' preferences by questionnaires) or by examining historical profit distribution, as suggested by Longley-Cooke, or current investment policies, as suggested by Shuttleworth.

A purely internal approach to risk adjustment has the advantages of reflecting the company's own outlook and of the involvement of decision makers in setting the trade-off. However, the difficulties would be substantial:

- who decides?
- what risk measure is appropriate?
- risk measure may not be additive
(thus risk combinations difficult to assess)
- may be very complicated to apply
(probably needs stochastic model of office)
- the desired trade-off may not be available
(other offices may adopt lower targets).

In summary, I believe that an approach not related to external factors will have considerable difficulties and that firms can set more appropriate target rates (i.e. price capital more fairly) by including external market information. A significant part of corporate finance theory is aimed at extracting information on the pricing of risk from market prices, and may therefore provide useful insights.

b) Capital Asset Pricing Model

This model is well known and fully described elsewhere (Copeland and Weston [1988] for an introduction or Sherris [1987] for application to discount rates) and I shall assume readers are familiar with its main elements and the resulting security market equation:

$$E(R_i) = R_f + \beta_i [E(R_m) - R_f].$$

This simple but powerful equation relating expected return to risk (undiversifiable variance) has considerable appeal as a means of estimating appropriate return for risk, and it has been widely used (e.g. in general insurance rate regulation in the US as well as portfolio asset allocation and security analysis). There have been

many empirical investigations to test the CAPM (Copeland and Weston [1988] and Harrington [1987] have good overviews), which generally agree that the model is not a complete explanation of returns. Despite this, and concern over the model's inherent untestability (Roll [1977]), the CAPM is probably the most widely used financial theory relating risk and return.

The standard CAPM is a one-period market equilibrium model, and, as shown by Fama [1977], to extend it to multiperiod budgeting requires assuming that the portfolio opportunity set is non-stochastic, e.g. that all future risk-free rates and future risk-adjusted discount rates are known with certainty. These are fairly restrictive assumptions but are usually considered preferable to the additional complications arising from non-stationarity. For instance, Merton [1973] has developed a modified CAPM assuming stochastic risk-free rates, which requires an additional term for the portfolio perfectly negatively correlated to the risk-free asset (i.e. hedge portfolio for changes in the risk-free rate). Also Constantinides [1980] has outlined a more general non-stationary multi-period application of the CAPM, but it is computationally complex and impractical.

One area that requires considerable attention is the proper treatment of taxation. There are two methods of allowing for tax while retaining the CAPM format.

The first allows for variation in the tax rates paid by different investors, but assumes that all asset returns are treated equally for tax. This leads to a CAPM formula based on gross returns, with an appropriate tax rate applied to the resulting risk-adjusted gross rates for each investor.

The alternative method allows for variation in tax rate by type of asset, but assumes that all investors have the same tax position. This single tax position is usually justified as being that of the "marginal investor" who determines prices. This method leads to a CAPM formulation based on net returns under the assumed tax position.

If tax rates are allowed to vary both by type of asset and by investor, then each investor will, in general, hold a different portfolio of risky assets. The market portfolio, which is the weighted average of the investors' risky portfolios, will not necessarily be an efficient portfolio for any particular investor.

It is therefore necessary to choose one of the above methods. Preference should be based on whether it is more significant to examine differences in tax rates by investor (e.g. differences between taxed and tax-exempt) or by asset (i.e. more realistic assessment of the margin between net returns on risk-free and the market). For the purposes of setting target rates, it will usually be preferable to make the "marginal investor" assumption, as this is both consistent with cost of capital invariance (as discussed above) and is more realistic (e.g. it will reflect dividend imputation more clearly).

To apply the CAPM we need estimates for the risk-free rate of return and the market rate of return (before or after tax depending on basis chosen) plus the beta for the risk (i.e. the correlation coefficient of the return on the investment with the market return). Estimation of the risk-free return and the market return is a common problem of application of the CAPM and is well covered in the literature, e.g. Harrington [1987]. Estimating the beta appropriate for life insurance operations is difficult and also has not been widely addressed. Possible approaches to this estimation include:

- i) estimating from the betas of listed life insurance companies, and
- ii) estimating directly the correlation of profit/return on capital with return on the market.

Estimation from listed life offices' share prices has several difficulties, including:

- listed companies may not be of similar size or composition of business (to each other or to one's own office)
- changes in the nature of their business over time
- need to adjust for differing levels of debt (gearing)
- share market investors are likely to base assessments on published data (e.g. statutory returns and GAAP accounts) and dividend levels, which for life insurers are not necessarily true indicators of profit.
- the listed office may also operate in other fields, e.g. general insurance, fund management, etc.
- estimation procedures based on a traded assets market proxy may underestimate the level of correlation with the total market, e.g. mortality results will be correlated with human capital (see Ang and Lai [1987] for a discussion of this effect in general insurance).

Direct estimation of the correlation between profit on life insurance business and the return on the market will also have considerable difficulties. Historical data on profit is likely to only be available on an annual basis (due to limitations of life office measurement systems), and for a limited number of comparable years (due to changes in the nature of products, etc). Direct estimation from simulation models will provide more data, but the accuracy of the results will be dependent on the quality of the model used. Such a simulation model is probably the only available method for trying to estimate risk under the CAPM on a product line basis where this has not been equalised by the contingency reserves held.

Despite the significant theoretical and practical difficulties of application, the CAPM remains one of the most widely used financial theories and it has potential to improve the setting of target rates of return, by relating them to external risk and return considerations.

c) Arbitrage Pricing Theory (APT)

This is a more recent development in asset pricing theory, and is less familiar to most actuaries. For a complete explanation of its development see Ross [1976] and Roll and Ross [1980], but I shall attempt to outline its main elements.

The basic assumption is that the return on any asset is a linear function of k factors:

$$R_i = E(R_i) + b_{i1}F_1 + \dots + b_{ik}F_k + e_i$$

where the noise term e_i is independent of all factors and all error terms for other assets, and has an expected value of zero. The number and nature of the factors in the function are not specified in the theory which gives it considerable flexibility.

In equilibrium, it can be shown that, provided all portfolios which use no wealth and have no risk (arbitrage portfolios) have nil expected return, then

$$E(R_i) = r'_f + l_j b_{ij}$$

where

r'_f = the expected return on a portfolio with zero

f sensitivity to all factors

l_j = excess return on portfolio with unit exposure to factor j and nil to all other factors.

Wei [1988] has shown that in a finite economy an APT model which uses too few factors will have the "market return" as an explanatory variable. The CAPM can in a sense be viewed as a special case of the APT with only a single factor.

A significant feature of Arbitrage Pricing Theory is that the factors are normally estimated from the available data rather than pre-specified. This creates problems when trying to interpret results and relate the factors to external variables, although Chen, Roll and Ross [1986] found correlations between their estimated factors and certain macroeconomic variables.

To apply APT to setting target rates of return requires estimating a large number of parameters (e.g. net risk-free rate of return, excess net returns for all factors and factor exposures for the activity). This will involve determining the factors from a sample of securities (not necessarily life offices), then examining the factor exposure of similar life offices. The usefulness of this may be reduced by variations in the sensitivities of and between life companies (e.g. due to business mix, level of gearing, management style, etc). These difficulties are further increased when attempting to apply the APT to product lines, since it will then be necessary to use internal measures of profit and value (e.g. accounting information), which will not necessarily be good proxies for the true market prices of risk.

In summary, while the avoidance of the CAPM's restrictive assumptions provides considerable theoretical appeal, the practical difficulties of application are likely to severely limit the usefulness of APT in setting life office target rates of return.

d) Empirical Pricing Model (EPM)

This is a relatively new approach outlined by Black and Gupta [1990]. It assumes the presence of efficient secondary markets in all forms of risk, from which it follows that the costs of hedging product cashflows will be a market assessment of the systematic risk involved. The implicit risk adjusted rate of return can be derived from the equivalence of the risk free net present value of expected returns less hedging costs to the risk adjusted net present value of expected returns:

$$\sum_{t=0}^n \frac{(\text{Net Cashflow})_t}{(1+r)^t} - \text{Hedging Costs} = \sum_{t=0}^n \frac{(\text{Net Cashflow})_t}{(1+c)^t}$$

where r = after tax risk free rate
 c = risk adjusted net return for the product.

It should be noted that if the product were actually fully hedged then contingency reserves would be unnecessary. Where risks are unhedged, reserves to cover adverse fluctuations will still be needed for solvency protection. Their effect will be to move the risk adjusted return required (on the increased capital) to a level between that on the product without such reserves and that on the contingency reserve assets themselves. Reduction below this weighted average level would only be possible if we could hedge the combined product plus reserves more cheaply than the sum of the two risks separately (i.e. if hedging diversifiable risk were costly).

A straight-forward example of the effect of extra reserves is when the risk reserves are invested in risk-free assets; the net cashflow will increase (extra earnings on reserves), but the hedging costs will be unchanged, so that the risk adjusted return must decrease to c' such that:

$$\sum_t \frac{(\text{NPC})_t}{(1+c)^t} + \sum_t \frac{(\text{NRC})_t}{(1+r)^t} = \sum_t \frac{(\text{NPC} + \text{NRC})_t}{(1+c')^t}$$

where NPC = net product cashflow
 NRC = net reserves cashflow
 r and c as above.

The Empirical Pricing Model can be viewed as a variation on the Certainty-Equivalent Approach (see Sick [1986]), but with market determined hedging costs instead of certainty equivalent factors applied to each cashflow.

The EPM is intuitively appealing, robust and capable of being applied in a straight-forward manner to individual product lines. It is, however, critically dependent on the existence of efficient secondary markets in which risks can be hedged. It is, unfortunately, not clear that such markets do exist except for some investment risks (e.g. via futures and options) and perhaps mortality (reinsurance). For instance, I am not aware of any method by which an office could hedge its expense risk, with the possible exceptions of:

i) contracting out its administration (even this would almost never be at a fixed price for the whole policy term), or
ii) fully reinsuring all elements of the policy (i.e. effectively on-selling the policy).

A major office might find that neither of these is available to it, due to lack of alternative capacity.

Where hedging markets are not available or are incomplete, the EPM provides no guidance in dealing with the unhedgeable risks. Application of a more general Certainty-Equivalent approach to pricing for these risks would retain the form of this method, within a consistent framework. Without the market pricing discipline this would be subject to many of the caveats associated with Internal Specification (above), however, these will have less force if the major risks have been priced on an EPM basis.

4 Conclusion

Life insurers need to have adequate rates of return on capital (including policyholder supplied capital), which should be at least equal to the returns available on assets of equivalent risk. This is a necessary condition for balancing the interests of all policyholders, as well as of external capital providers.

Furthermore, under certain assumptions, useful target rates can be set without directly determining the cost of capital or considering the capital structure.

I believe that setting target rates solely on the basis of internal considerations runs a substantial risk that the resulting rates will be unsuitable because they do not reflect the fair market price of capital and of risk. The application of financial theory to the setting of target rates of return for life insurers offers considerable potential benefits through linkage of targets to external market conditions (allowing variation over time in response to changing circumstances) and the ability to establish suitable variations in return required for differing levels of risk.

Of the financial models examined, I feel that EPM is both theoretically and practically the best, provided that hedges for the major risks under the policy can be priced in an efficient market. Where this is not possible, I believe that the CAPM should be favoured as a more practical approach than APT, given the uncertainties involved.

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