The Value of Actuarial Values

Presented to the Staple Inn Actuarial Society 17 February 1998

John Pemberton FIA

Contents

Section 1: Introduction

Should we value an asset at an amount calculated using actuarial discounted cashflows, or at its current market price? Much hinges on this question - the possible answers dictate quite distinct programmes for the development and practice of the valuation of long-term business, and the theory and practice of the associated investment management.

Under what circumstances does the actuary wish to ascribe a value to an asset? Generally the actuary is facing a set of future asset/liability cashflows of which there is some, generally imperfect, knowledge available, and has a requirement to ascribe a number, or perhaps numbers, to characterise the financial position of the owner of the cashflows, for some defined purpose. The context for investment valuations can be characterised quite generally in this way - for traders we may often think of the liabilities as being cash.

The values placed on assets by traditional actuarial approaches are subject to the criticism that they can differ significantly from current market prices. The pricing approach has been proposed in response to such concerns, perhaps most notably in Exley et al, 1997, which has advanced this debate considerably.

The importance of these valuation issues is accentuated by recent proposals from the accounting profession which advocate the use of current market prices as a measure of value for long-term businesses, at least on the asset side of the balance sheet. The changes to dividend taxation as a result of the budget of 2 July 1997 have "also thrown into sharper relief the debate on the methods of valuing assets" (Masters et al, 1997, Section 502).

This paper attempts to progress this debate further. Whilst concerns about price/value differentials which arise from traditional actuarial valuations are valid, the pricing approach is unable to make necessary allowance for investor-specific circumstances, such as the tax and risk position. In addition to these position-driven price/value differences, opinion differences and mean reversion of prices may also lead to price/value differentials.

The relationship between price and value is thus complex. This paper proposes a "refined actuarial" approach to valuation: whereas the actuary should make appropriate use of the information available from market prices, it is also appropriate to consider the price/value differentials which may exist in any specific situation, and allow for these in deriving a helpful measure of value. In some cases, it may be appropriate to use assumptions more closely related to the market. In other cases, making adjustments to current market prices may be appropriate.

Outline of Paper

Section 2 sets out a characterisation of the traditional actuarial approach, the pricing approach, and the refined actuarial approach to valuation.

Sections 3-7 set out some arguments for preferring the refined actuarial approach to the pricing approach, as follows:

Section	Argument for Refined Actuarial Approach
3	The value of an investment may differ to different investors. This arises from, inter alia, differing tax or risk positions. The pricing approach is inadequate to capture the value for all investors - an actuarial approach, which respects the context provided by each investor's own liabilities and tax situation, is required.
4	Risk diversifies over time. For longer term investors, the risk of equities is lower and thus the value of equities higher, relative to cash, say. As argued in section 3, this value variation cannot be managed adequately in the pricing approach - an actuarial approach is required.
5	In order to assess the surplus of long-term business, it is necessary to have regard to the asset/liability mismatch risk. Prices come laden with a view of risk, but this does not in general represent a view of risk which is appropriate for the valuation measure of a given long-term investor. An actuarial approach can cope, but the pricing approach cannot.
6	Precise, universal efficiency claims are no longer generally considered plausible. The sort of approximate efficiency claims that would now appear to be widely accepted, raise questions for the pricing approach, but lend support to a refined actuarial approach.
7	Broader methodological developments have raised increasing questions about the pricing approach and the neo-classical economic programme with which it is allied, at the same time as establishing a firm basis for the actuarial approach to values.

Section 8 argues that there are serious unresolved practical problems in attempting to apply the pricing approach to the valuation of long-term liabilities.

Section 9 sets out some of the key implications of the refined actuarial approach. The actuarial profession should focus on a programme of developing actuarial valuation methods.

Section 10 outlines recent proposals within the accounting sphere concerning the treatment of long-term business. The arguments of this paper support recent recommendations of the IFAA.

Section 11 concludes that actuarial values have considerable value - this value may be realised through a refined actuarial approach.

Section 2: Characterisation of Alternative Approaches

The Traditional Actuarial Approach

Discounted cashflow (DCF) valuations have been close to the heart of the development of actuarial science since its inception. These techniques are still central to the education and practice of the profession. In its traditional form the DCF calculation employs a single fixed rate of discount across all durations. In more recent times this discount rate has been more closely associated with the yield on the assets. Such a development was advanced by, inter alia, Frank Redington, whose work encouraged a shift of focus to asset/liability interactions (Redington, 1952).

The Pricing Approach to Value

Neo-classical mathematical economics has developed techniques in which prices are used as values. This has now crystallised a challenge to the use of DCF values within the actuarial context. *The Financial Theory of Defined Benefit Pension Schemes* (Exley et al, 1997) propounds the use of prices as values for both the asset and liability side of the balance sheet. This work provides a constructive challenge to the traditional actuarial position - it highlights the problematic differences which can sometimes arise between actuarial values and prices.

There would appear to be two distinct possible justifications for the use of prices as values:

The Ontological Justification: "Prices are values". There is only a single concept so that it would make no sense to talk of possible differences. Moreover, there is no need for a separate account of what values are. Values and prices, being the same concept, are necessarily always exactly the same.

The Epistemic Justification: "The price of an investment is always the best estimate of its value". Value is now a distinct concept from price, so that this position leaves open the question as to what value is. In practice, those who adopt such a view generally regard value as arising from the future cashflows, without defining quite how.

This paper argues that the value of an investment differs to different investors due to, inter alia, differences in tax position, and differences in risk position (particularly time horizon). If this is so, then it is not clear what either the ontological justification or the epistemic justification might mean - there is no longer a single, free-floating value associated with each investment. The valuation of the assets cannot be coherently divorced from the context of the overall asset liability valuation.

Various possible arguments in favour of the pricing approach are reviewed in Section 6.

A Refined Actuarial Approach

In responding to the challenge of the pricing approach, one possibility is a refinement of the traditional actuarial position to ensure that actuarial values respect the information contained in market prices. The well-established DCF notion of actuarial value is retained unchanged. In order to incorporate price information into the valuation on a consistent basis, it is important that the asset cashflows first be incorporated alongside the liability cashflows

within the actuarial valuation. The overall basis of valuation, at least the discount rates and the treatment of risk, should be made explicit by the actuary. It is important for the valuation to embrace the full set of relevant cashflows, both asset and liability, in order to ensure that the main interactions between cashflows are captured within the view of risk which is employed for the valuation.

One possibility is for the DCF assumptions to be derived from observation of market prices. In particular, an approximation to the term structure of interest rates and inflation rates, implicit in market prices, might be used where such use makes a material difference to the accuracy of the valuation for the purpose at hand. The use of such market-derived assumptions is, of course, consistent with an actuarial approach, and is already sometimes practised.

In some cases, most notably for equities, direct DCF estimation of values is problematic. In these cases it may be best to estimate the chosen DCF value measure by making an adjustment to the current market price. Where prices are available, these may be used as a useful independent estimate of the DCF value of an investments cashflows to some class of investors, perhaps to a market typical investor. Position differences (e. g. tax and risk) are one reason why an adjustment to price may be required.

In deriving the overall valuation number to describe the financial position of the owner of the full set of cashflows for the purpose defined, DCF value numbers are ascribed to various cashflow subsets, most notably the set of assets. These numbers only have meaning in the context of the given valuation - the valuation of the assets cannot be validly separated from the context of the valuation of the liabilities.

Summary of Characterisation of Approaches

The following table provides a summary of the key points of the characterisations.

Comparison of Approaches to Value			
	Price (Ontological)	**Price (Epistemic)**	**Actuarial**
Definition of Value	Value is price.	Value is undefined - but generally viewed as arising from future cashflows.	A measure of value is provided by a well-defined, discounted cashflow (DCF) formula. Pragmatically this value measure can sometimes be estimated by making suitable adjustments to market price.
Price/ Value Relationship	Prices provide objective measure of value which is by definition correct.	Price is always the best estimate of value. To the extent we move away from prices, we are being subjective/ arbitrary.	Prices are determined by market trading processes. Often prices (perhaps adjusted, e.g. for mean reversion) may be taken as a best estimate of the value of an investment to some marginal, perhaps typical, investor. Price/ value differentials are complex and require careful treatment.

Section 3: Investment Value is Different to Different Investors

Introduction

Investments provide an entitlement to a stream of (one or more) future receivables, and the value of the investment is a function of these receivables (ignoring commodities, etc. for simplicity). The dependence of the value on the future receivables is explicit within the actuarial DCF approach and is also generally recognised, although not explicit, in the pricing approach (e.g. Exley et al, 1997, 4.1.2).

The pattern of receivables depends on the date on which the investment is sold. The assumption concerning this date, or more generally the pattern of such dates, thus influences the valuation. Suitable assumptions can be derived from the anticipated asset trading strategy of the investor, although the simplifying assumption that the asset is to be held is perpetuity is often sufficient for many purposes. It is appropriate for the investor to consider the implications for value of the asset trading strategy which he/she anticipates adopting - sensitivity-checking the value against a range of possible trading approaches might lead to a refinement of the strategy adopted.

As the value of the investment is a function of the future receivable, this section shows that it depends, inter alia, upon the investor-specific tax and risk position, and that the pricing approach to valuation is thus problematic.

Contingent Capital Gains Tax

Supposing that an investor holds equities with a price of £100 against a cash liability of £90 which must be met in a few days time. If there is no CGT then all is well - the investor should sell the equities as soon as possible. Barring an immediate market crash, the investor should realise a small surplus. The equities are best valued at market price, perhaps with some allowance for sale expenses.

If however the sale of the equities will give rise to CGT of £20 then the position is altogether less good - the investor is unable to meet the imminent liability. To capture the financial position of this investor realistically, it is clearly necessary to allow for the imminent CGT payment within the valuation. Under the given circumstances, the value of the equity assets is £80 - the current market price less the amount of CGT. Importantly, the value differs from the market price.

It is possible to present the CGT on the liability side of the balance sheet - this allows the assets to be presented at market price. It is argued in Section 9 that the presentation of assets and liabilities should support correct decision-taking. CGT is causally linked to the assets and in general must be considered in conjunction with the assets to allow a coherent asset strategy to be determined. Presentation of the CGT as a liability does not change the reality of this causal link - the value of the total cashflows available from the sale of the assets to meet the liability is most helpfully thought of net of the negative CGT cashflow.

A Prospective Taxation Example

Consider example investors N and G, say, as follows:

Investor	Tax Position
N	Is a net investor. Pays 20 % tax on income (and capital gains, too, for simplicity).
G	Is a gross investor. Pays no tax, but is unable to reclaim the 20% ACT tax credit on equity dividends. E.g. a UK pension fund.

And consider investments A and B, say, as follows:

Investment	Entitlement to Future Receivable
E	Quoted equities with a price of £100.
I	A single payment to be made with certainty tomorrow of £100 of interest income

Suppose that both investors have similar liabilities, existing portfolios and attitude to risk, and that the gross value to them of the income from the equity holding is assessed to be £100. The approximate value position might be represented by the values shown in table 1.

Table 1

Investment Values to Example Investors

	Investment E	Investment I
Investor N	80	80
Investor G	80	100

In this simplified example it might be that trading of Investment I in the market is dominated by gross investors, and that the price is close to 100 - suppose that this is so. Suppose that Investment E is trading at a price of close to 80. Given £100 to invest, investor N should prefer to buy Investment E to Investment I. It would be quite wrong for N to take market price as an indication of value - an approach that would leave him/her indifferent between the two investments - an adjustment to reflect N's tax position is required.

Risk-driven Value Differences

Section 4 demonstrates risk-driven differences in the relative value of investments which arise from differing time horizons. Section 5 shows that the measure of surplus (i.e. the difference in the value ascribed to the assets and the liabilities on an on-going basis) should respect the investor's mismatch risk. Both of these show that the value which it is appropriate to ascribe to assets depends upon the investor-specific risk position.

Sustainability of Price/Value Differences

Supposing for some individual investor that $(P_1/V_1) > (P_2/V_2)$, where P_1 is the price of asset 1, V_1 is the value of asset 1, etc. Could the investor not create value by simply selling asset 1 and buying asset 2? This is certainly possible - by understanding the relative prices and values

of investments better (and a starting point is the recognition that prices and values may differ), the investor might be able to better design the shape of his/her portfolio.

Could the investor not continue this process to infinity thus forcing the prices of the assets to a level where they bring his/her own position back into equilibrium? This is the arbitrage argument of equilibrium economics, which focuses on perfect-knowledge, costless markets. There are a number of practical reasons why such behaviour is limited and will not tend to the infinite arbitrage elimination behaviour proposed by the equilibrium theorists:

- Costs place a limit on arbitrage activity (Reitano, 1997, page 105). Costs of trading and/or maintaining positions can be high. If price/value differences might continue for years or decades, then exploiting them may be very expensive.

- Investors do not have perfect knowledge - it is very difficult to estimate the value of many investments, and such estimates are always subject to error. The "arbitrage" does not lock in a certain profit.

- Short-selling is generally either not allowed or restricted.

- Many investors are constrained by their investment policy from diverging more than a limited amount from some agreed benchmark.

In addition to these practical reasons why we should not expect this arbitrage elimination behaviour, there is a theoretical reason. As the amount of some specific investment is increased within a given asset-liability portfolio, the risk associated with the overall portfolio changes as well as the expected return. To understand the overall implications, it is necessary to have an understanding of the investor's risk/return preferences. For the purposes of this paper it is sufficient to note that the standard arbitrage elimination argument assumes that the value of any investment remains the same regardless of the amount of the investment held, and that this is an implausible assumption, particularly for very large holdings of the investment.

In summary, it would seem perfectly possible that following an investigation of the price/value ratios of various asset classes, an investor might modify his/her benchmark portfolio. However, there is no reason to suppose that the investor will shift market prices so as to remove such price/value differentials.

Conclusion

The value of an investment is a function of its future receivables - it depends upon the investor-specific tax and risk position, which are in part liability-driven, and differ from one investor to another. The pricing approach is unable to deal with such investor-specific value differences.

Section 4: Risk Diversifies over Time

Introduction

The diversification of risk over time implies that those with a longer time horizon should expect higher returns for the same level of risk. If we accept that the equity risk premium is materially positive, and that the effect of risk diversification is significant, then equities are likely to be the preferred asset for longer term investors. A given equity holding (i.e. a given entitlement to some well-defined future stream of income from equities) is worth more relative to cash, say, to a longer term investor than to a shorter term investor (ceteris paribus), because it has lower relative risk.

As noted above, in section 3, this difference in relative value between different investors represents a problem for the pricing approach.

Time Diversification of Risk

This section explores the debate concerning the time diversifiability of risk which is currently taking place, principally amongst economists. Although many, perhaps most, economists believe that risk does diversify over time, some interesting contrary views have recently been put forward (see literature review in Marshall, 1994). The powerful actuarial intuition that risk diversifies over time is widely shared by financial theorists.

Arguments for Risk Diversifiability over Time

Both Marshall (Marshall, 1994) and Thorley (Thorley, 1995) provide particularly simple and compelling arguments in favour of the diversifiability of risk over time. Both arguments appeal directly to consideration of the growth path of equities relative to bonds over the long-term, and the increasing divergence of their expected values.

Thorley uses the concept of "shortfall" in measuring investment risk. A shortfall occurs when the market price of a stock portfolio at the horizon date falls below that which would have been achieved at the risk free rate of return. He compares the possibility of investing in the risk-free asset at 4%, with that of investing in a risky asset with an expected return of 12%, independent lognormal price movements, and a volatility of 16%. His results are as follows.

Initial Investment 1000					
			Shortfall		
Horizon (years)	**Risk-free value**	**Mean risk asset value**	**Probability**	**Mean amount**	**Probability * Mean amnt**
1	1,041	1,142	30.9	942	291
5	1,221	1,943	13.2	1,032	136
10	1,492	3,773	5.7	1,222	70
20	2,226	14,239	1.3	1,776	23
40	4,953	202,755	0.1	3,875	4

The rapid reduction in the probability of shortfall shows that, in this natural and simple sense, equities do become less risky relative to bonds as the time horizon increases. The probability

of shortfall continues to reduce rapidly as the time horizon is extended to even longer durations. Whilst the amount of the shortfall rises as the time horizon extends, the final column shows that it does so much more slowly than the fall in the probability.

Within the actuarial sphere, Dan Jelicic (Jelicic, 1996) has presented arguments consistent with those above to show that the optimal proportion of equities held in a portfolio increases as the time horizon increases to longer durations. His finding that the optimal equity proportion decreases with time horizon at short durations is consistent with a careful analysis of Thorley's results.

As Jelicic explains, "As the time horizon T increases the mean and the volatility [of the price of the risk portfolio] both increase approximately by the factor T and $\sqrt{T}$ respectively. The mean shift will tend to move the distribution away from the shortfall return. The volatility increase means that the tails are fatter and hence that more of the outcomes will fall further away from the mean" (Jelicic, 1996, page 24). For sufficiently large T, the size of the tail of the distribution, which represents the probability of shortfall, reduces as T increases.

Arguments Against Time Diversification of Risk

Exley, Mehta, Smith

Exley et al (Exley et al, 1997, Section 5.5) are right to identify the question of time diversification of risk as a key issue. Their argument that risk does not diversify over time seems to rest principally on the sort of mathematical arguments which are exemplified by Kritzman (Kritzman, 1994) and Bodie (Bodie, 1995) - these are discussed below.

The Case Against Risk Diversification Over Time

The arguments against risk diversification rely upon ascribing a higher weight to the downside tail events than to other outcomes. Thorley's table above suggests how this weighting of downside events must increase as the time horizon extends. This effect is usually achieved by ascribing a highly concave utility function to the investor.

Gressis, Hayya and Philippatos (Gressis et al, 1976), for example, assume a quadratic utility function. In a more recent example, Kritzman (Kritzman, 1994) employs the assumption of a logarithmic utility function. Although these simple analytic utility functions have been used widely elsewhere within the economic literature, no attempt appears to have been made to show their validity in this context by reference to either empirical data or other arguments.

The Shape of Investor Utility Curves

Extensive work has been done to explore the choices of individuals when confronted by risk. Moreover, much of this empirical work has focused on consideration of downside risk. Kahneman and Tversky (Kahneman and Tversky, 1979), for example, show that individuals do tend to overweight small downside risks beyond the level implied by their mathematical expectation. This is consistent with the proposition that individual marginal utility of wealth curves slope down. However, this work would not seem to provide a justification for the extreme concavity implied by either the quadratic or logarithmic curves which have been used. Kahneman and Tversky's work also shows that individual risk choices are generally

context dependent - the underlying utility curve is likely to be less concave than that exhibited in individual test situations.

Providing guidance on the shape of investor utility curves is an area in which the actuarial profession, with its understanding and experience of liabilities, has much to contribute. Considerable further work is required in this area.

Kritzman's reliance on the assumption of a logarithmic utility curve is a serious weakness. The assumption of a stable logarithmic utility function over the relevant range of wealth levels seems implausible for individuals, and even more implausible for the institutional investors who dominate the market. Kritzman's argument is incomplete without some justification of this assumption.

Bodie's Argument

Bodie sets out a somewhat different argument that risk does not diversify over time in his recent paper *On the Risk of Stocks in the Long Run* (Bodie, 1995). Bodie notes that the cost of insuring against shortfall is given by a put option with term equal to the investment horizon, at a strike price calculated as the accumulated amount of the risk-free portfolio. He then uses the Black-Scholes equations to calculate the value of the option, and argues that the risk of holding equities relative to bonds actually increases over time.

Bodie's arguments have given rise to a fierce debate, much of which concerns discussion of the nature of investment risk (Merrill and Thorley, 1996; Bierman, 1997; Zou, 1997)

Oldenkamp and Vorst cast doubt on whether option pricing theories developed within a risk neutral framework can hope to resolve issues which are primarily concerned with investment risk (Oldenkamp and Vorst, 1997). That is my position too. In a forthcoming paper (Pemberton, 1998a) I shall explicate the assumptions concerning risk, including the risk neutrality assumption, which are required by Black-Scholes, and show how these assumptions are similar to the assumption of a highly concave utility function used by Kritzman.

Mean Reversion

These calculations have assumed independence of price movements over successive time periods. If we allow for mean reversion, then we should expect the argument in favour of time diversification of risk to become stronger.

Conclusion

Risk diversifies over time. Time diversification reduces the risk of equities as the time horizon increases to longer durations. The value of equities thus increases, relative to cash, say, as the time horizon of investment is increased. As noted in section 3, this shift in relative values requires the use of actuarial values - it cannot be captured using a pricing approach.

Section 5: Surplus Measure Should Have Regard to Mismatch Risk

Introduction

In assessing the surplus of a long-term business, i.e. the excess of the value of the assets over the liabilities (as discussed below), it is important to treat risk realistically. It is necessary to have regard to the investor's asset/liability mismatch risk, within the context of the planned long-term asset strategy.

Prices come laden with a view of risk - a view formed by the market. Particularly for investors with long-term liabilities, this may differ materially from their mismatch risk.

Surplus

A common task which a valuation seeks to address is to provide a measurement of the value of the surplus for an on-going long-term business. In this context, the surplus is the value of the assets less the liabilities on a realistic on-going basis. (The surplus can, of course, be negative - it is then sometimes referred to as a shortfall.) Section 1 noted that valuation concerns ascribing a number to describe the financial position of the owner of a set of cashflows, for some defined purpose - surplus is an example of such a number, where the liabilities are long term and the institutional framework is on-going. The estimation of this amount may be important, for example, in assessing the market value of a business.

For life assurance business, surplus is usually positive on prudential grounds, which are reinforced by the operation of solvency regulations. Embedded value techniques for assessing the surplus are well-established. These techniques have been developed to deal with such complexities as the apportioning of expenses between existing and future business, or the need to distinguish between the interests of the life fund and the shareholder in respect of with-profit business.

In the pensions area, a funding level of over 100% implies the presence of a positive surplus on the basis chosen. The security provided by the future contributions of the employer may allow a shortfall under some circumstances.

Assessment of Surplus Requires Consideration of Mismatch Risk

Assets are used to meet the liabilities of the investor as they fall due. The risk which is important from the investor's perspective is thus the stochastic variation of the net asset less liability cashflow, i.e. the mismatch between the assets and the liabilities. To assess mismatch risk, it is necessary to have regard to the nature of both the assets, which it is planned to hold, and the liabilities.

Example

Suppose that trustees are responsible for some liabilities which, by good fortune, are exactly matched by some long-dated index-linked gilt. Suppose that they have, until now, held all their assets in the matching index-linked gilt, and that the amount of these gilts is exactly sufficient to meet the liability cashflows as they fall due.

Suppose the trustees now sell their gilts for cash. There are two effects: (1) they reduce the expected amount of future asset cashflows (assuming the expected return on cash is lower than on index-linked), and (2) they increase the level of the mismatch risk. If the trustees choose to hold cash over the long-term in preference to index-linked gilts, then the scheme is worse off, and it is appropriate that the estimated surplus, which was previously nil, should now be negative.

The pricing approach to value does not recognise any change in the position, of course. It ignores the actual assets held, and thus fails to capture the effect of the asset/liability interactions on the amount of the surplus.

Price Volatility is Inadequate as a Measure of Mismatch Risk for Long-term Business

One-period price volatility has been a popular measure of risk. This section argues that, although this model may have some relevance for short-term business, there is a distinction between the risks associated with the short-term and the long-term. Risks within long-term business are not in general reducible to the risk associated with price variation over some fixed period.

Price Volatility as Risk

In exploring investment risk, the usual starting point for economists is the standard two-period model (see e.g. Ingersoll, 1987, page 45). In the first period, the investor selects a portfolio of assets, subject to some initial budget constraint. In the second period the investor consumes the wealth, benefiting from this to the extent implied by his/her utility function. The rigid timescales of this model drive a focus on one-period price volatility as the principal investment risk. Although some attempts have been made to explore multi-period, utility models (see e.g. literature review in Marshall, 1994; or discussion in Lewin, et al, 1995, Section 4.6), the focus on one-period price volatility as risk has remained.

Within the two-period model, provided that the investor's consumption utility function is concave, then increased price volatility has a direct cost which is exhibited by a reduction in the level of expected utility. Under these circumstances, mismatch risk can be equated with one-period price volatility - this allows an explicit exploration of risk-return pay-offs.

Unfortunately, long-term business gives rise to more complex problems concerning the stochastic variation between the asset and liability cashflows.

Risk Characterisation

Consider the following characterisations of the risks associated with differing liability terms:

Term of Liabilities	Description of Key Risks
Short	Short-term price variation risk - i.e. the risk which derives from the variation in the possible price of a security on some fixed future date in the near future.
Long	The risk which derives from the possible variation of the future income stream from a security, perhaps together with the variation in the possible price of a security on some fixed future date in the long-term future.

An example of a short-term investor might be one that consumes all wealth at the end of one year, say, and has no other assets.

An example of a long-term investor might be a large, mature, final-salary pension fund which pays benefits as they arise, and which anticipates future pension fund contributions from a financially sound employer. Such an investor has relatively little exposure to short-term price risk. Assets fund the difference between the future income and the future outgo of the fund. This is likely to be very long-term indeed, perhaps over 100 years - it is unlikely that it will be necessary to sell investments in the short/medium term, except in the extreme event of the bankruptcy of the company. Although the new constraints imposed by MFR require that the fund remain solvent on the basis laid down, it is likely that there would be some leeway allowed in the event of a market crash.

Long-term Risk Differs from Short-term Risk

It is possible for the price of an investment to vary, even if the future income from the investment is held fixed. Short-term risk, which is closely related to short-term price fluctuations, differs from long-term risk, which is more closely related to the variability of future income.

Variations between price and DCF value measures are addressed in the discussion of market efficiency in Section 6. Set out below are reasons why DCF values can vary when future cashflows are held fixed:

1. Changes in the market's discount rate.

   This might arise, for example, from a change in the market's attitude to risk or a change in the mix of investors (perhaps with differing liability characteristics). Unless we need to sell our investment, there is no direct reason why a shift in the market's discount rate should change our view of our own financial position (although it is possible that the reasons which underlie the market shift may also influence our own choice of appropriate discount rate).

2. Changes in taxation

The recent removal of the ACT tax credit for certain investors within the UK provides an excellent example of a change in taxation which might affect prices, but which might have no direct effect on some investors' existing holdings (e.g. investors that have not at any stage received the tax credit).

3. Change in view of future income (rather than shift in actual future income), i.e. "epistemic" risk.

Investors have imperfect knowledge of the future. If investors' views of the future change, even though there is no (or less) change in the actual expected level of income receipts, then prices will fluctuate relative to values. A buy/hold strategy is not exposed to this risk of sentiment-driven price fluctuations.

Conclusion on Risk as Price Volatility

Price volatility is inadequate as a measure of risk for long-term business - it is unable to capture the asset/liability interaction over varying time horizons.

Prices do Not Reflect Investor-Specific Mismatch Risk

If risk were intrinsic to the portfolio of assets, and could be considered independently of the interaction between the assets and the liabilities, then it is possible that asset prices might somehow reflect the mismatch risk appropriate for all investors. One proposed measure of asset-intrinsic risk is price volatility - but the above section shows how this founders on the problem of the differing time horizons of different investors. Other asset-intrinsic measures would seem to founder on the same rock.

Asset prices may reflect the mismatch risk of some average or marginal investor, perhaps, but they will not in general reflect the mismatch risk appropriate to the circumstances of any specific investor.

Liability Pricing does Not Help to Capture Mismatch Risk

Exley et al (Exley et al, 1997) set out an account of how to extend the pricing approach to the valuation of liabilities. They propose that in pricing the liability cashflows we should use the market price of the "hedge portfolio" (section 4.7.1). The hedge portfolio is: "a set of traded cashflows with similar risk attributes" to the liabilities (section 4.5.3). Section 5.3.2 sets out in more detail how to identify an optimal hedge: we are advised to select a hedge portfolio which ensures that the residual price movements of the overall portfolio (i.e. price of assets - price of liabilities) is uncorrelated with market price movements (presumably the price of any asset within the market). These proposals would seem to be based on the price volatility view of risk.

Using the price of the identified assets as the value of the liabilities extends the limitation of price-based risk to both sides of the balance sheet: the prices may adequately reflect the mismatch position of some exemplars amongst investors, but using prices of both assets and liabilities does not capture the asset-liability mismatch risk of the specific investor (see e.g. the example of the investor with index-linked liabilities earlier in this Section).

Actuarial Models Have the Ability to Capture Mismatch Risk

By using an explicit DCF definition of value, actuarial models treat both asset and liability cashflows on a consistent basis. Such consistent treatment of cashflows provides a basis for considering the total cashflow pattern (assets as positive, liabilities as negative), and its stochastic variation. Such models introduce investor-specific liabilities explicitly, and thus grasp mismatch risk directly.

Conclusion

In order to assess the surplus of long-term business, it is necessary to have regard to the mismatch risk. Prices come laden with a view of risk, but this does not in general represent a view of risk which is appropriate as the valuation measure of a given long-term investor. An actuarial approach has the ability to cope, but the pricing approach does not.

Section 6: Market Efficiency Issues

Introduction

The two justifications for the pricing approach to value, outlined in Section 2, tie up with the two accounts of market efficiency which are commonly proposed. The epistemic justification for the pricing approach, that prices are best estimates of "value", is closely linked to the version of the Efficient Market Hypothesis (EMH), usually associated with Eugene Fame, that assumes prices reflect all available information (see e.g. Fama, 1970). The ontological justification is more closely linked with the account of market efficiency which proposes that prices are always equal to "fundamental value".

Problems with Efficiency Market Hypothesis (Fama's Version)

Considerable efforts have been made to test Fama's EMH empirically (see e.g. Keane, 1986; Exley et al, 1996). A common approach is to search for mechanical trading rules which outperform the market. If a rule which uses only available information can be shown to produce systematic outperformance, then this would be taken as evidence that available information was not reflected in the stock price. The failure to discover such a rule would be taken as evidence in favour of market efficiency. Other tests search fund management performance league tables for correlations between different time periods to see whether there is evidence that past performance is a guide to future performance.

What are the results of such tests? As is usual in the empirical testing of the propositions of neo-classical economics, the answer is that there is fierce disagreement about whether the test results support the proposition or not. Why should this be? A major source of the disagreement between the various experts is a failure to state clearly the claims which are being made - especially their quantifiers.

Paul Samuelson, for example, concludes a recent review with the claim that *"the case for efficient markets is a bit stronger in 1989 than it was in 1974"* (Samuelson, 1989). But he then goes on to list a set of exceptions, provide a list of people (Warren Buffet, John Templeton, John Neff, etc.) whom he believes have the ability to systematically outperform, and discuss the current credence attached to mean reversion! I am not clear quite how he would state the EMH to be consistent with these views, but it would presumably need to read something like "*prices reflect, to some acceptable degree of approximation, most of the time, all available information*", the "Approximate Efficient Market Hypothesis" (AEMH) say. If this is taken to mean that "*prices are approximately equal to values most of the time*", then this seems to be a much more plausible proposition than the universal version of EMH. Unfortunately it is also much weaker - it does not provide a compelling basis for unquestioningly using prices as values.

In their recent paper *Market Efficiency* (Exley et al, 1996), Exley, Mehta and Smith discuss some of the empirical problems with EMH, for example the size effect (in Section 3), the out-performance of Warren Buffet (in Section 4), and stock price auto-correlations (in Section 6). They appear to reach a position similar to Samuelson's AEMH (Exley et al, 1996, 5.4.1). Robert Clarkson has expressed a yet more cautious position (Clarkson, 1996; Clarkson, 1997).

Yet more problematic for the EMH is recent evidence that stock prices are mean reverting. If this claim is right, then there are simple trading strategies which deliver expected outperformance - and the market is not efficient.

Mean reversion

David Wilkie's stochastic investment model has formed a focus for debate within the actuarial profession concerning the mean reversion of equity prices (Wilkie, 1986). Wilkie selects a form for his stochastic model which implies that equity prices do mean revert. This has been criticised by, inter alia, Malcolm Kemp (Kemp, 1996).

Kemp's main concern about assuming mean reversion is precisely that it does imply the existence of trading strategies that will out-perform the market: *"If such inefficiencies existed in the past, they should now have been 'identified' and should disappear in the future, being arbitraged away"* (Section 5.11). But any investor wishing to exploit such inefficiencies would need a considerable set of qualities:

1. Considerable capital - the investor must accept an exposed position in order to achieve an expected percentage of out-performance.
2. Long time horizon - the trading strategies may require the exposed positions to be maintained for long durations, perhaps for many years or decades.
3. Prepared to accept absolute investment risk - the trading strategy may out-perform the asset class, but might under-perform cash, for example.
4. Prepared to accept relative under-performance risk short-term - moving away from a competitor-based benchmark carries significant short-term risks.
5. Prepared to accept relative under-performance risk long-term - Although the identified strategy may be expected to outperform, variation of possible outcomes generally means that it will sometimes underperform. Moreover, we cannot be sure about the form of the mean reversion which will occur over the future, there is an "epistemic" risk. If a structural shift in the model describing the market has occurred, we may under-perform the mean reverting asset class over the long-term.

At least one well-known investment manager with excellent historic performance has recently adopted a high-profile bear position within the UK equity market on grounds of over-pricing. Anecdotal comment suggests that many other fund managers share similar views. But this is a bold strategy for those measured on short-term relative performance - there would seem to be few rushing to follow this example.

Kemp's use of the term "arbitrage", although common parlance, risks misleading the unwary. This is certainly not an opportunity to lock-in a guaranteed profit through a set of simultaneous trades. It is far from clear that the availability of this sort of "arbitrage" opportunity will be effectively removed by the operation of the market.

Direct empirical evidence for mean reversion has been identified by a number of investigators who have explored the available history of price data from the main equity markets (e.g. Poterba and Summers, 1988; Fama and French, 1988). Even many of those who reject these findings generally put forward alternative hypotheses which are not consistent with the EMH (e.g. Kim, et al, 1991).

There is a strong case for believing that the market does exhibit mean reversion to some extent. This view would seem to have strong support both from within and from outside the actuarial profession. As noted above, if the market does mean revert, then it is not efficient.

More recently, Andrew Smith has suggested that mean reversion may be consistent with efficient markets (Smith, 1997, 1.2.5). His argument appears to be that even if we knew that the dividend yield were low, we would not know whether dividends would rise or the price would fall. Whilst this may be true, it does not seem to alter the fact that buying the low dividend stock will yield expected outperformance (even though it may under-perform some of the time).

On a separate tack, Exley, Mehta and Smith have argued that the shape of investors' utility curves could give rise to mean reversion (Exley et al, 1996, Section 6). If this were the case, investors could still achieve expected outperformance in nominal monetary units, but not in units of utility. Unless empirical evidence were able to establish widely held utility curves of the shape proposed, this result would seem to have limited application.

The Ontological Justification of Price

The ontological justification, that prices are values, is necessarily a universal and precise claim, prices are always exactly equal to values. The universal quantifier is invariably suppressed in the statement of EMH, and this leads to the plausibility of the claim. Correctly stated, with the universal quantifier, EMH is highly vulnerable to disconfirmation. A single relevant counter-example is sufficient to gainsay it. Some counter-examples to this efficiency hypothesis do seem compelling:

1. During periods of 1996, NatWest apparently quoted prices for certain classes of options which were later deemed to be wrong. Since NatWest was an option trader in the market for these options during this period, it would seem that the keenest price available in the market sometimes differed from value.

2. It is not apparent that any significant new news became available on or around Black Monday. If prices were correct after this crash, then it would seem they must have been wrong before.

3. Many commentators have suggested that the market prices of the UK banking sector are currently influenced by the technical position following the flotation of a number of former building societies - they suggest that these prices are higher than "fundamental values".

Many other examples of possible inefficiencies, such as the discount or premium on closed end funds, have been proposed over the years (see e.g. Samuelson, 1989). If any of these examples is correct, then the universal version of EMH is false.

Lawrence Summers undertakes an empirical investigation of the relationship between prices and "fundamental values" in *Does the Stock Market Rationally Reflect Fundamental Values?* (Summers, 1986). He notes that empirical tests of EMH do not generally address whether prices are equal to "fundamental values" and concludes that frequent divergence of prices and such values by over 30% is consistent with available empirical data.

It does seem to make sense to suggest that the price of an investment may be too high or too low. Certainly there is an industry in the City of London based on this premise. If we are to adopt the ontological justification for the pricing approach, such a suggestion is literally meaningless.

The Role of Technical Factors in Prices

In practice, market prices are determined by the trading activities of investors within the market. The perfect knowledge and behaviour hypothesised to underpin the theory that prices and values always exactly equate are not present in practice. Investors do not in practice hold the market portfolio, they do often trade in the expectation of achieving out-performance, and sometimes they make mistakes.

The pricing process should lead us to expect that technical factors (i.e. immediate supply and demand within the market) might influence prices. Amongst those that operate directly in investment markets, especially the equity markets, the observation that short-term price moves are often driven by trading activity of investors who are adjusting their exposures is almost universal. It is not clear what mechanism would ensure that, despite this activity, prices are always precisely equal to some given measure of values.

Gordon Pepper has been amongst those who have moved beyond the acceptance of liquidity driven price movements, to discuss their possible exploitation within trading strategies (Pepper 1996). The possibility that prices are not driven by fundamentals over the short-term, but are more influenced by fundamentals over the long-term, provides one possible explanation of mean reversion (excess short-term price volatility).

Divergence of Opinions

Sections 3-5 have outlined how position (e.g. tax and risk) differences amongst investors lead to differences in investment values to different investors. Another reason that value estimates of the same investment will differ between different investors is divergence of opinions concerning the future. Such differences of view arise even when investors face identical information sets.

Some of the assumptions on which the pricing approach is based have become so deeply engrained that it is easy to overlook them. Perhaps the best example is the "homothetic assumption", the assumption that all investors have identical beliefs about the future (see e.g. Miller, 1977, page 1151). Empirical evidence shows that this assumption is wrong (we don't need to look very far!). Some theorists, recognising the implausibility of the homothetic assumption, have assumed instead that although there are opinion differences, these differences don't matter. On this view, price is equal to some average opinion concerning "value", and may thus be taken as a best estimate of "value".

However, this view is highly problematic. An interesting body of work within economics has explored the implications for price/value relationships under the more plausible assumption of divergent beliefs amongst investors (e.g. Smith, 1967; Miller, 1977; Mayshar 1983; Shleifer, 1986). An excellent example is provided by R. G. E. Smith's discussion of marginal opinion theories. This challenges the view that prices are necessarily equal to some average of investors' values - rather the price reflects the valuation of a marginal investor, which may be

quite different from the average. The shares of a small company, for example, may be bought, and thus traded, by a subset of investors that rate the company more highly.

Possible Example

A possible example of a price that currently differs markedly from value is Eurotunnel shares. In recent years the shares have tended to move from UK institutional portfolios to private portfolios, mostly in France. These private investors are now thought to dominate trade in the stock. From my discussions with UK institutional investors it would seem that a view predominates amongst this group that, on conventional valuation yardsticks, based more or less directly on DCF measures, the price of Eurotunnel shares exceeds the value by some considerable margin.

From a purely anecdotal understanding of the French private investor's view, the trading strategy appears to be driven largely by the proposition that *"what goes down must come back up"*. If this is true, then it provides a striking (if untypical) real-world case study to illustrate R. G. E. Smith's model: price is driven away from value by the behaviour of traders whose view of value differs. Whether or not the French investors are right, it explains why price and a conventional Anglo-Saxon measure of value might diverge considerably right now.

Could we make money out of this "arbitrage" opportunity? It would be necessary to sell short Eurotunnel shares, perhaps for some decades. What happens to the price during this period is far from clear. Even for a hardened long-term professional investor, this is not a bet that I would countenance recommending. This is an arbitrage opportunity that looks set to remain.

Whether or not the details of this story are correct is less relevant than the points which it illustrates. Where opinions diverge, value may be very far from price.

Actuarial Position

Historically, actuarial science has not adopted a well-articulated view of market efficiency. The traditional actuarial approach has sometimes led to values which are very different from prices, and this has given the appearance, at least, of disregarding any information which prices might contain about values. This seems unwise. The refined actuarial position proposes that the information available from market prices be respected. Often prices (perhaps adjusted, e.g. for mean reversion) may be taken as a best estimate of the value of an investment to some marginal, perhaps typical, investor. This position is compatible with AEMH.

Conclusion

If efficiency arguments were able to establish a universal and exact relationship between price and value (*"price is always exactly equal to value"* or *"price is always the best estimate of value"*) then the pricing approach would have a powerful foundation. This paper has shown that both position-differences and opinion-differences drive differences in the value of an investment to different investors. This would seem to destroy the possibility of a simple, exact relationship between price and value of the form required. Moreover, the case against the universal version of the EMH seems compelling. Even those who appear sympathetic to market efficiency claims appear to support an approximate version of EMH such as AEMH.

Where prices (perhaps adjusted, e.g. for mean reversion) may be taken as a best estimate of the value of an investment to some marginal, perhaps typical, investor, prices provide an invaluable basis for determining actuarial values - all that is required is an adjustment to reflect position differences from this identified marginal investor (e.g. in respect of tax or risk).

Section 7: Methodological Issues

The methodology (study of method) of science, i.e. the philosophy of science, is a vast and well-established body of theory. One of the central questions addressed in recent investigations is the relationship between models and reality: how can we best design our models to ensure they capture reality in the way that we would like? This is a difficult and complex subject, but one that is highly relevant to current debates within the actuarial profession, perhaps most importantly in allowing us to characterise actuarial models. Realising the Power of Actuarial Science (Pemberton, 1998) summarises recent developments in the methodology of science and the methodology of economics, and begins to explore actuarial science within the framework provided.

Positivism dominated the philosophy of science for many years. This philosophical school encouraged a focus on observables, and denied the reality of causal mechanisms and unobservables. Prices are observable, and thus readily acceptable to Positivists. However, consideration of such unobservable features as "the anticipated future cashflow pattern of assets and liabilities" is highly problematic from a positivist standpoint. The powerful positivist influence on economics has thus tended to constrain consideration of such unobservables as the value of investment cashflows.

Realising the Power of Actuarial Science (RPAS) shows how the broader context provided by the philosophy of science and of economics has progressed. Positivism collapsed in the 1960s and new philosophical approaches acknowledge both the existence of unobservables and the reality of causes. These broader developments in the philosophy of science have raised questions concerning aspects of the pricing approach, and now provide a framework which underpins the exploration of the relationship between price and value in the manner developed within this paper. The actuarial approach to valuation is soundly based within the broader methodological context.

Section 8: Practical Issues with Liability Pricing

In order to fully apply the pricing approach, it is necessary to determine prices appropriate to the liability cashflows. This section identifies a number of serious practical difficulties in attempting such pricing, which have not been overcome.

Pricing Liabilities

Not all liabilities have an easily identifiable hedge portfolio. Shyam Mehta, for example, discusses the practical problems associated with determining the relationship between lapse risk and market price movements in his paper on the valuation of life offices (Mehta, 1992, Section 5.5). There are no apparent solutions to this problem, and the best that can be achieved is a very approximate estimate of the link between the two. Lapse risk is perhaps the most important of a series of characteristics of liability cashflows which are not generally shared by commonly priced asset cashflows.

Discretion within the Liabilities

Discretion is Widespread

A large proportion of UK long-term liabilities relate either to with-profit life business or to defined benefit pension schemes. Within both of these areas, the role of discretion in determining the level of the benefits, and thus the magnitude of the liability, is a key issue.

UK WP life offices now almost universally define policyholders reasonable expectations in terms of asset shares. Generally the actuary in charge of the bonus policy will attempt to smooth the benefits payable from year to year, although the extent of smoothing varies markedly from office to office. The targeting of payout to asset shares creates a powerful causal interaction between the assets and policyholders' benefits. The risk to the fund is a complex set of option-like risks which arise from the guarantees and the cost of smoothing. The position is complicated further by the additional discretion of the office to depart from standard smoothing rules in the event of exceptional market movements.

In the case of defined benefit pension schemes, Wise, amongst others, has argued the case for believing that there is often considerable discretion in determining the magnitude of the liabilities (for example, in the debate on Exley et al, 1997). The withdrawal benefits, post-vesting inflation increases and ad hoc uplifts to benefits are examples of areas in which the trustees have discretion. As Exley et al note (Exley et al, 1997, section 8.6.3), discretion gives rise to some complex option-type liabilities in this area too.

Discretion Causes Modelling Difficulties

Unfortunately, the way in which discretion might be exercised at some future date, under the circumstances then ruling, is far from easy to determine with any precision. It is likely to depend in part on who is responsible for the decision at the time and their attitude. Under these circumstances, models based on simple, powerful assumptions are especially problematic. The emphasis on approximation and judgement is increased.

Discretion may Encourage Equity Investment

Discretion within the liabilities generally has the effect of transferring risk from the institution (i.e. the life fund or the pension fund) to the policyholders or members. This may increase the effective time horizon, further reducing the dangers arising from price risk, and encouraging an increased weighting in equities.

Exley et al also argue that discretion may improve the case for holding equities, although following a somewhat different logic (Exley et al, 1997, section 8.6.3).

Equities as Hedging Asset

If the hedge portfolio does contain equities, then there are serious practical problems in using the portfolio to price a set of liabilities (except in the case of an explicit equity link). In the case of equities, we know the current price, but not the level of future income or the expected return on the asset. (Of course, either of the latter is sufficient to determine the other.) This problem would be less serious if the estimates for the expected return fell into a narrow range, but as Wilkie notes (Wilkie, 1995), estimates for the equity risk premium vary considerably. Even where we know sufficient about a set of liabilities to estimate the future expected cashflows, and we are given equities as the hedging asset, we do not know the price we should associate with the liability-set because this depends on the unknown equity risk premium.

Conclusion

There are serious unresolved practical problems in attempting to apply the pricing approach to the valuation of long-term liabilities.

Section 9: Implications of the Refined Actuarial Approach

Introduction

The above sections have set out a number of arguments for preferring the refined actuarial approach to the pricing approach. The refined actuarial approach has much in common with both the traditional actuarial approach (as characterised) and the pricing approach. However, there are some important implications of the differences between these approaches.

Implications of Refined rather than Traditional Actuarial Approach

One of the major criticisms of the traditional actuarial approach is that it has sometimes adopted a rather cavalier attitude to differences between the assessed value of the assets and their market price. In some cases, this criticism might be addressed by selecting DCF assumptions which more closely mirror current market views. In particular, a suitable simplification of the market-derived term structure of interest and inflation rates might be used. In other cases, it may be appropriate to derive the actuarial value by making an adjustment to current market prices.

The refined actuarial approach should result in a more explicit recognition of the relationship between current market prices and the actuarial measure of value chosen - this should facilitate a presentation format which makes clear the consistency of the actuarial value with market prices.

Mean Reversion

One of the situations in which assets have commonly been valued at a level different from market price arises from the traditional actuarial practice of valuing assets on an income approach using a long-term dividend yield assumption. This approach appears to assume that the dividend yield should be expected to revert to its long-term mean either on average, or over the long-term. This paper has summarised the key elements of the current debate concerning mean reversion in Section 6. There is now empirical evidence which apparently supports the widespread actuarial intuition that stock prices do mean revert.

This empirical work on mean reversion would appear to bring the traditional actuarial approach more into line with current economic understanding. It is possible that this recent work in economics could be used to justify a mean reversion adjustment to the current level of market prices, based on empirical price data, to derive a trend level of price about which the mean reversion occurs. If this were so, it would provide a firmer justification for the traditional actuarial approach, and would claim credibility as a modern refinement of the pricing approach.

Such work is beyond the scope of this paper, which has not attempted to derive a firm conclusion to the mean reversion debate.

Implications of Refined Actuarial rather than Pricing Approach

In addition to differences in price/value due to mean reversion, this paper has identified position differences and opinion differences as distinct reasons why price and value might differ.

Theoretically a DCF valuation for the assets might be used to determine a value directly, which could then be compared with price. In practice, for the key asset class of equities, the available DCF models are simple developments of the classical dividend discount model (DDM). One such development, for example, allows for dividend growth assumptions to be made explicit for the first few years (typically two years), a growth rate relative to the long-term market growth rate (e.g. 2% above this rate) to be specified for some period following that (e.g. years 3-7), and the long-term market growth rate to be assumed thereafter. Whilst there are a number of variations on this theme, it is usual to assume that growth fades back to some long-term rate over some defined, finite period - usually of only a few years.

A weakness of the DDM model is that the price of stocks is highly sensitive to the assumed difference between the long-term dividend growth rate and the discount rate. This limits the power of such models as direct valuation tools. Models with the sort of highly simplified assumptions used within the various forms of DDM model are sometimes referred to as “toy models”. Despite their weaknesses, such models can play an important role in providing comparative values.

<u>Price Adjustments to Allow for Position Differences.</u>

Given the limitations of DCF models, at least for the equity proportion of the assets, direct estimation of asset values is problematic. A more pragmatic approach to assessing the value of the assets appropriate to a specific tax and risk position is to use a toy DDM model to estimate an appropriate percentage adjustment to the price of each asset class, and then to apply this adjustment to current market prices. A suitable range of assumptions concerning such parameters as tax, risk, turnover levels of investment within the portfolio, and investment strategy, are required for both the specific investor in question, and for the class of investors for whom the current market price (perhaps adjusted, e.g. for mean reversion) is to be taken as equal to value. Investigation of a toy DDM model with these ranges of parameters should allow the actuary to estimate a suitable range for the price adjustment. Tax can be allowed for directly within the toy model by netting down either income or capital gains cashflows at the appropriate rate. Risk can generally be best managed via the choice of a suitable discount rate for the set of cashflows in question. These sorts of toy models are widely used by actuaries to estimate the appropriate reserve to hold against contingent capital gains tax on an existing equity portfolio, and have been used more recently to investigate the implications of the changes to dividend taxation.

This process may also help to make explicit the discount rate assumption which underlies the asset valuation. This has the advantage of facilitating more consistent treatment of the asset and liability cashflows. This method will also allow the use of a variety of value measures, e.g. differing discount rates, to sensitivity check the results of the valuation.

Allowing for Opinion Differences.

Section 6 noted the economic literature dealing with divergence of opinions, of which R. G. E. Smith's paper is an excellent example. The implications of this work are the possible presence of perhaps systematic, and perhaps sizeable, differences between price and various measures of value (e.g. perhaps for small vs. large stocks; or new issues vs. seasoned stocks). This economic literature provides a starting point for investigation by the actuarial profession into price/value differences which arise from divergences of opinion. The actuarial machinery which deals with value provides a firm foundation on which to tackle this investigation. One of the reasons that economics appears to have made relatively little progress in this area in recent years is its difficulty in discussing values.

Although it seems clear that opinion differences do drive price/value differentials, it is as yet unclear how the actuary should allow for these within the valuation process. It is possible that the suggested investigation would recommend the use of adjustment factors to market prices under some well-defined circumstances.

Presentation of Asset/Liability Values should Support Decision-Taking

Section 2 noted that the aim of a valuation is to produce a number which represents the financial position of the owner of the asset and liability cashflows - the asset and liability values are produced as an incidental in this process. In communicating the results of the valuation, it will usually be necessary to present values for both the assets and liabilities - it is important to present these numbers in a helpful way.

Much comment has been made concerning the benefits to communication of presenting the asset value as equal to market price. This is clearly a sensible suggestion. Moreover, it is always possible to present the assets at market price and make adjustments to the liability side of the balance sheet to compensate.

However, the presentation of the valuation should not be such as to misinform decision-taking. Where it is possible to present the value of assets at market price without disguising important aspects of the financial position, then this would generally seem sensible. Where this would disguise aspects of the financial position which might be important to decisions concerning the future management of the assets/liabilities, then there is a need for caution.

Investment Tax

Investment taxes, i.e. investment income and capital gains tax (CGT), should, of course, be taken into account in determining an appropriate asset strategy. Investment tax is causally connected to the assets - a shift in asset prices, for example, drives a change in the amount of contingent CGT. It is most natural to present investment taxes as a negative cashflow within the asset side of the balance sheet. If investment tax, e.g. contingent CGT, is not presented as a deduction from assets in the valuation model, then this model will probably be inconsistent with the model needed to present the asset strategy. It is far from clear that this is the most helpful presentational approach. The use of an explicit adjustment for investment tax on the asset side of the balance sheet would probably have facilitated easier presentation of the impact of the recent changes to UK dividend taxation.

Mismatch Risk

Similarly, this paper has argued that value can be created or destroyed by holding assets which are (or are not) a suitable match for the liabilities. A long term investor holding an all cash portfolio over the long term, for example, is likely to be destroying value. In most current presentation formats used by actuaries, the impact of the matching strategy, e.g. the benefit arising from time diversification of risk, is generally reflected implicitly on the liability side by taking equities at market price and increasing the discount rate used to value the liabilities. This may be satisfactory, but the value of the liabilities now depends on the mix of the assets - if we switched to holding cash over the long term, for example, the value of the liabilities would change. It would seem presentationally clearer to show at least some of the impact on the valuation which arises from the matching strategy on the asset side of the balance sheet.

Where all the valuation effects of investment changes are shown on the liability side of the balance sheet, the link between investment policy decision and the valuation may become somewhat obscure presentationally. This method of presenting the impact of risk and return within the fund is again likely to drive a need for separate models to present investment policy decisions (e.g. justification of high equity content) and the valuation results. Making the link to the valuation model explicit by presenting value adjustments on the asset side of the balance sheet may be more helpful.

Defined Benefit Vs Defined Contribution Pensions

The benefits of time diversification of risk play a significant role in the debate concerning the relative merits of defined benefit (DB) and defined contribution (DC) pension schemes. In most cases, it will be fairly straightforward to show that the time horizon of a DB scheme is longer than that of a corresponding DC scheme. Showing the benefit which arises from time diversification explicitly as an adjustment to the asset side of the balance sheet, rather than implicitly on the liability side of the balance sheet (through the use of a higher discount rate), may be a more helpful presentational format for comparing DB and DC.

Explicit Presentation of the Link between Price and Value

Where presenting the value of assets as equal to current market prices is not considered appropriate, it may be helpful to show both the current market price of the assets and the adjustments which have been made explicitly. Showing the adjustments explicitly (e.g. for contingent CGT, time diversification of risk, or mean reversion) should make clear that the valuation is consistent with current market prices, and provide a clear presentational tool for decision-taking. Such a format is likely to establish consistency with the models used to present investment policy.

Summary

The most appropriate presentational format for any given situation is necessarily a matter of judgement. The form of the presentation does not, of course, change the underlying reality. Nevertheless, it is important that the presentational format chosen is adequate to support correct decision-taking.

Management Measures of Value

Very often in taking strategic or business decisions, it is necessary for the executive of a company to decide what it is they are trying to maximise. Historically, profits, dividends or return on capital have been popular choices. More recently, holistic DCF measures of the future cashflows of the business have been advanced as a better solution. These DCF measures, often termed "economic value" or "shareholder value", are generally designed to act as a proxy for the share price of the business. Historic data may be used to establish a correlation between the chosen measure of value and the share price, perhaps with some adjustment for accrued dividends. However, such historic correlations will generally be far from conclusive in determining the best measure to use as a proxy for the share price going forward.

Perhaps the best approach is for the executive of the company to discuss the matter with some its larger shareholders in an attempt to inform their choice of measure. In many cases, shareholders will regard systematic risk (risk which is correlated with overall market movements) with more disfavour than diversifiable risk. Through such discussions, it should be possible to determine some suitable and simple treatment of risk to act as a basis for an appropriate DCF measure.

Where the shares of the company are held by more than one investor, and especially where they are widely dispersed, as for a publicly quoted company, the liability context for establishing a shareholder value measure is not immediately apparent. This might, at first sight, appear to be an exception to the proposition in Section 1 that determining a value generally takes place in the context of a set of liabilities. However, the view of risk to be used as the basis of the DCF measure is best chosen in the light of the views of shareholders, and will thus have regard indirectly to the various liability contexts.

The Value of Asset/Liability Matching

A powerful challenge has recently been issued to the actuarial profession to provide a justification of asset/liability management. Andrew Smith, for example, suggests that attempts to add value in this area are akin to the search for a perpetual motion machine (Smith, 1996, page 1071). This important challenge is based on a view of risk as a homogeneous, fungible property of individual assets and liabilities, usually price volatility.

Few actuaries believe that maintaining an all-cash portfolio would be an appropriate asset strategy for a long-term investor such as a pension fund or life office - in practice most such funds are predominantly invested in equities. Nevertheless, the challengers to this received wisdom are correct to note that such views require justification.

This paper has argued that, in many circumstances of relevance to the actuary, the relevant risk is mismatch risk. Mismatch risk arises from the relationship between assets and liabilities, especially the pattern of their cashflows over time - it cannot be factored into some simple measure of risk of the individual asset/liability components. The actuarial task of optimising the assets in the context of the liabilities by reference to the mismatch risk can thus add value.

Limiting the Role of Actuarial Judgement

The concern is sometimes expressed that the actuary should not appear to be claiming that he/she knows better then the market. This would seem an eminently sensible concern. The refined actuarial approach addresses this concern by proposing that information in prices should be respected.

This paper has argued that prices reflect a measure of the value of an investment to some typical, or perhaps some marginal, investor. The actuary should be very cautious in contradicting such market information. Recognising that position-differences drive divergence of values around the value estimate provided by the market price does not involve a contradiction of the market price. Actuaries, with the experience of the liability side of the balance sheet, are particularly well-placed to assess these value divergences.

If mean reversion is empirically well-founded, then consideration of price/value differences which arise from this phenomenon does not contradict the information provided by market prices. Similarly, R. G. E. Smith's work on divergences of opinion does not require him to adopt a stance which is in opposition to current market prices.

It is of course possible that the actuary, as much as any other market investor, may on occasion disagree with the market assessment of value, as evidenced by the price. As an investment analyst, it used to be my job to develop just such opinions. Nevertheless, in the general scheme of things, we should expect the actuary to take such a stance only infrequently. Even where such an opinion is held it may be inappropriate to reflect it within a valuation, especially if it improves the valuation position derived.

Recognising the need to assess price/value adjustment does not imply the need to contradict the information available within market prices - i.e. to suggest the actuary knows better than the market. The use of judgement within the valuation need not be inconsistent with respect for market prices.

Stochastic Valuation Models

The cashflow models of actuarial value, which have provided a starting point for this paper, are an excellent framework within which to consider the implication of stochastic variation. It is not the aim of this paper to pursue the issues involved.

A Programme for the Development of Actuarial Valuation

As noted, there has been powerful advocacy of the pricing approach within the Institute in recent years (e.g. Mehta, 1992; Exley et al, 1997). This paper proposes that the actuarial profession should sponsor a programme to develop a refined actuarial approach to valuation as an alternative to the pricing approach.

One appropriate avenue of development of actuarial valuation is further exploration of the relationship between actuarially derived values and market prices when market related valuation assumptions are used within the actuarial approach. This exploration should have

regard to the varied purpose of the valuation (see e.g. Exley et al, 1997, Section 4.3.1), recognising that this influences the way in which it is appropriate for values to reflect market prices.

Other appropriate avenues of development include exploring the use of toy DCF models, giving further consideration to the implication of opinion differences, and further exploring the empirical work in economics on mean reversion of prices in order to assess its implications for actuarial approaches.

Section 10: Implications for the Accounting Debate

Recent Accounting Proposals

International Accounting Standards Committee

A recent International Accounting Standards Committee (IASC) discussion paper, *Accounting for Financial Assets and Financial Liabilities* (IASC, 1997), has proposed that 'fair values' should be used in accounting for financial assets. Fair values are effectively equivalent to market prices where liquid markets in the financial instrument are available.

The Steering Committee responsible for this paper proposes that the objective should be to recognise and measure all financial instruments, including pension and insurance obligations, in accordance with the principles which they have laid down. On the other hand, they also recognise that addressing the issues involved with long-term business is beyond the scope of their paper and propose that additional study and consultation are necessary to resolve these issues (IASC, 1997, para 2.6.26).

In response to this paper, the International Forum of Actuarial Associations (IFAA) has argued (IFAA, 1997) the case for consistent treatment of assets and liabilities. Moreover they comment that "the [discount] rate should also reflect the extent of the mismatching of asset and corresponding liability cashflows". They propose that the proposed accounting should not be implemented in relation to long-term business until it has been agreed.

Pension Accounting

Paul Thornton describes moves to develop a new international accounting standard for pension costs in a recent article for *The Actuary* (Thornton, 1997). In broad terms, it is proposed (IASC, 1997a) that assets be included at market value, and the liabilities be discounted at the yield on corporate bonds of appropriate maturity.

The IFAA has argued (IFAA, 1997a) that the discount rate should be based on the actual spread of assets used to fund the liabilities - in particular this should reflect equity returns where these are the appropriate asset.

Life Accounting

In addition to the above, an accounting directive concerning the treatment of life business is anticipated early this year. It is likely that these proposals will reinforce the trend towards the use of market values.

Investor-specific Tax and Risk

This paper has argued that the valuation of assets cannot be coherently divorced from the valuation of liabilities. This argument applies with full force to the values used within the accounts.

Further exploration is needed of when using market prices of assets in conjunction with the actuarial value of liabilities provides a sufficiently good approximation for accounting

purposes. Where this is sufficient, the liability valuation should allow for (1) the expected returns on the actual assets expected to be held, and (2) the investor-specific tax and risk position. This conclusion supports the arguments made by the IFAA in favour of the use of a discount rate for liabilities which reflects the holding of equities within the assets (IFAA, 1997a), and the adjustment of the discount rate to reflect the asset/liability mismatch risk (IFAA, 1997).

Although it is always possible to present the value of the assets as equal to market price, and make adjustments to the liability side of the balance sheet to compensate, it is not clear that this always provides the clearest picture of the financial position, or is always consistent with other accounting rules (such as “true and fair”). This approach may lead to inconsistencies in the treatment of liability values. Section 9 argues that the presentation of the asset and liability values should facilitate accurate decision-taking, and that presenting the asset value as equal to price may sometimes disguise relevant aspects of the financial position. The IFAA is right to be cautious about moving towards more rigid accounting rules which prescribe the use of prices as values for long-term business (IFAA, 1997).

Section 11: Conclusion

Traditional actuarial values are subject to the criticism that they can differ significantly from current market prices. Such differences are not only difficult presentationally, they are also incompletely understood.

In response to this situation, the pricing approach has been advanced, in which current market prices are taken to be values. Whilst this clearly has the advantage of eliminating price/value differentials, this approach has serious limitations in both a theoretic and practical sense. Prices cannot make necessary allowance for investor-specific tax and risk positions - they may thus assume away the context provided by the investor's liabilities. Moreover, both mean reversion of prices, and opinion-differences amongst investors, may cause prices to diverge from values.

This paper advocates a middle path between the traditional actuarial and the pricing approaches to valuation: a refined actuarial approach. Whereas the actuary should make appropriate use of the information available from market prices, it is also necessary to consider the price/value differentials which may exist in any specific situation, and allow for these in deriving a helpful measure of value. Although a well-defined DCF measure of value is retained, this may be used with market-based assumptions. Another alternative is to use adjusted market prices, perhaps with the adjustment derived from a DCF toy model, as an estimate of the DCF value. Showing both the price and the value of the assets explicitly within the presentation allows a demonstration of the consistency between them.

As noted, there has been powerful advocacy of the pricing approach within the Institute in recent years (e.g. Mehta, 1992; Exley et al, 1997). This paper proposes that the actuarial profession should sponsor a programme to develop the actuarial approach to valuation as an alternative to the pricing approach. Some suitable developments are suggested.

The case for using actuarial values highlights the importance of asset liability matching, identifies arguments in favour of equity investment for long-term investors, and also identifies some advantages of defined benefit over defined contribution pension schemes.

Although the refined actuarial proposals are supportive of the trend towards the valuation of assets to closely reflect current market prices, they identify limitations on the use of prices as values for assets. It would be unwise to adopt rigid accounting rules which prescribe the use of prices as values for long-term business, until the relationship between refined actuarial values and prices is better understood. In order to allow for tax and risk it is necessary to use actuarial values for liabilities - the discount rate should reflect the expected return on the actual assets.

Actuarial values have an essential role to play in the valuation of assets and liabilities. A refined actuarial approach can facilitate this role, whilst respecting the information inherent in market prices.

Acknowledgements

My thanks to Colin Wilson, Dan Jelicic, Malcolm Kemp, Jon Exley and Andrew Smith for their helpful comments on earlier drafts of this paper. Views and errors remain, of course, my

own.

References

Bierman, H. (1997). *Portfolio Allocation and the Investment Horizon.* The Journal of Portfolio Management: Summer 1997.

Bodie, Z. (1995). *On the Risk of Stocks in the Long Run.* Financial Analyst Journal, May-June 1995.

Clarkson, R. S. (1996). *Financial Economics - An Investment Actuary's Viewpoint.* BAJ, forthcoming.

Clarkson, R. S. (1997). *Inefficiencies in the UK Equity Market and Strategy Investment.* Paper for 1997 Actuarial Investment Conference.

Exley, C. J., Mehta, S. J. B., Smith A. D. (1996). *Market Efficiency.* Paper for 1996 Actuarial Investment Conference.

Exley, C. J., Mehta, S. J. B., Smith A. D. (1997). *The Financial Theory of Defined Benefit Pension Schemes.* BAJ, Forthcoming.

Fama, E. F. (1970). E*fficient Capital Markets: A Review of Theory and Empirical Work.* Journal of Finance, May 1970.

Fama, E. F., French, K. R. (1988). *Permanent and Temporary Components of Stock Prices.* Journal of Political Economy 96(1988):264-273.

Gressis, N., Hayya, J., Philippatos, G. C. (1976). *Mulitperiod Portfolio Analysis and the Inefficiency of the Market Portfolio.* Journal of Finance 31(1976): 1,115-1,126.

Ingersoll, J. E., (1987). *Theory of Financial Decision Making.* Rowman & Littlefield Publishers.

International Accounting Standards Committee (1997). *Accounting for Financial Assets and Financial Liabilities.* Discussion paper.

International Accounting Standards Committee (1997a). *Exposure Draft E54*. Discussion paper.

International Forum of Actuarial Associations (1997). *Comments on International Accounting Standards Committee "Accounting for Financial Assets and Financial Liabilities" A Discussion Paper*. Draft of 14 July 1997 (available from Institute of Actuaries library).

International Forum of Actuarial Associations (1997a). *Comments on International Accounting Standards Committee Exposure Draft E54.* (available from Institute of Actuaries library).

Jelicic, D. (1996). *Asset Liability Modelling for Pension Funds.* Dissertation for City University (available from Institute of Actuaries library).

Kahneman D., Tversky A. (1979). *Prospect Theory: An Analysis of Decision-Making under Risk.* Econometrica 47: 263-91.

Keane, S. (1986). *The Efficient Market Hypothesis on Trial.* Financial Analysts Journal, March-April 1986.

Kemp, M. (1996). *Asset Liability Modelling for Pension Funds.* SIAS paper, October 1996.

Kim, M. J., Nelson, C. R., Startz, R. (1991). *Mean Reversion in Stock Prices? A Reappraisal of the Empirical Evidence.* Review of Economic Studies,(1991) 58,515-528.

Kritzman, M. (1994). *What Practitioners Need to Know About Time Diversification.* Financial Analyst Journal, January-February 1994.

Lewin, C. G., Carne, S. A., De Rivaz, N. F. C., Hall, R. E. G., Mc Kelvey, K. J., Wilkie, A. D. (1994). *Capital Projects.* BAJ, 1, II, 155.

Marshall, J. F. (1994). *The Role of the Investment Horizon in Optimal Portfolio Sequencing (An Intuitive Demonstration in Discrete Time).* The Financial Review, Vol. 29, No. 4, November 1994, 577-597.

Masters, N., Kemp, M., Nowell, P., Pomery, M., Russell, C., Strang, G., Tompkins, P., Walton, A., Young, A. (1997). *Actuarial Implications of the Change in the ACT Rules and the Corporation Tax Rate.* A Report of a Working Party of the Faculty and Institutue of Actuaries, August 1997 (available from the Institutue of Actuaries library).

Mayshar, J. (1983). *On Divergence of Opinion and Imperfections in Capital Markets.* American Economic Review, 73, 114-28, March 1983.

Mehta, S. J. B. (1992). *Allowing for Asset, Liability and Business Risk in the Valuation of a Life Office.* JIA, 119, III.

Merrill, C., Thorley, S. (1996). *Time Diversification: Perspectives from Option Pricing Theory.* Financial Analysts Journal: May/June 1996.

Miller, E. M. (1977). *Risk, Uncertainty, and Divergence of Opinion.* The Journal of Finance, Vol. XXXII, No. 4, September 1977.

Oldenkamp, B., Vorst, T. C. F. (1997). *Time Diversification and Option Pricing Theory: Another Perspective.* The Journal of Portfolio Management, Summer 1997.

Pemberton, J. M. (1998). *Realising the Power of Actuarial Science.* BAJ, forthcoming.

Pemberton, J. M. (1998a). *Equity Option Valuation - Beyond the Risk Neutrality Assumption.* Forthcoming.

Pepper, G. (1996). *The Liquidity Theory of Asset Prices.* Paper for 1996 Actuarial Investment Conference.

Poterba, J. M., Summers, L. H. (1988). *Mean Reversion in Stock Prices, Evidence and Implications.* Journal of Financial Economics, 22 (1988) 27-59.

Redington, F. M. (1952). *Review of the Principles of Life Office Valuation.* JIA 78, 286-315.

Reitano, R. R. (1997). *Two Paradigms for the Market Value of Liabilities.* North American Actuarial Journal, Vol. 1, No. 4, October 1997.

Samuelson, P. A. (1989). *The Judgement of Economic Science on Rational Portfolio Management: Indexing, Timing, and Long-Horizon Effects.* The Journal of Portfolio Management, Vol. 16, No. 1 (Fall 1989).

Shleifer, A. (1986). *Do Demand Curves for Stocks Slope Down?* The Journal of Finance, Vol. XLI, No. 3, July 1986.

Smith, A. (1996). *How Actuaries can use Financial Economics.* BAJ, 2, V.

Smith, A. (1997). *Modelling Global Returns on Assets with Fat Tails.* Paper for 1997 Actuarial Investment Conference.

Smith, R. G. E (1967). *The 'Marginal Opinion' Theory of Stock Price.* Financial Analyst Journal, November-December 1967.

Summers, L. H. (1986). *Does the Stock Market Rationally Reflect Fundamental Values?.* Journal of Finance, Vol. XLI, No. 3, July 1996.

Thorley, S. R. (1995). *The Time Diversification Controversy.* Financial Analyst Journal, May-June 1995.

Thornton, P. (1997). *Pension Costs for Multinationals.* The Actuary, July 1997.

Wilkie, A. D. (1986). *A Stochastic Investment Model for Actuarial Use.* Transactions of the Faculty of Actuaries, 39: 341-403.

Wilkie, A. D. (1995). *The Risk Premium on Ordinary Shares.* BAJ, 1, II, 251.

Zou, L. (1997). *Investments with Downside Insurance and the Issue of Time Diversification.* Financial Analysts Journal: July/August 1997.