A Note on Financial Economics

Relevant issues for actuaries

Much has been written on the impact of financial economic thinking on actuarial areas of practice. There are major texts, financial economic primers, summaries, debates and guidance notes. And these are good; the best we refer to below. Yet they are also voluminous and often leave practical actuaries bewildered as to how to apply the theory of financial economics in everyday working life.

The Financial Economics Task Force of the IAA Enterprise and Financial Risk Committee spent some time thinking about and evaluating the key areas where financial economics were likely to impact everyday actuarial endeavours. Unsurprisingly, they all centre on the problems of determining present values for future liabilities and the consideration of equivalent values for assets.

We have specifically chosen eight areas to comment on. In each, our scope is modest: a brief description, practical and abbreviated commentary flagging where there is consensus and where there is divided opinion, where there is (in our opinion) a 'correct' approach, and where complexities of the task overwhelm notions of theory. The areas chosen are somewhat limited by the authors' individual experiences which tilt towards – but by no means exclusively – to pension practices.

But we have high hopes and ambitions. Actuaries should always adopt positions which can be defended as being intellectually reasonable, and be understood by the wider economic community. Everyday concepts used should be able to bridge the language and jargon divide across practice areas. We would like to think this note helps in achieving these aims. Above all, we hope this note is helpful. It should be viewed as high-level source material and not as a prescription for actuarial practice.

In drafting these eight commentaries, the authors were struck by three major themes that emerged in the course of drafting:

- **Theory versus practice**: In an ideal world, there should not be any academic difference between actuarial and economic theory. Issues where opinion is divided can usually be traced to differing opinion as to the proper application of theory or where theory would not apply because a theoretical assumption is violated.
- **Purpose**: A clear sense of the reasons why a task is being performed can in turn clarify how to go about that task. Confusion about the purpose of a valuation of liabilities is, in our view, the chief culprit for subsequent confusion and mis-communication.

- **Consequences**: Much of the actuary's job is working out and communicating the consequences of choices and decisions to customers and various stakeholders. At the practical level, choosing to ignore some area of financial economics can lead to bad decisions being made. We are though conscious that choosing to apply financial economics theory automatically when the underlying assumptions are violated can also lead to bad decisions.

In addition, and in the opinion of the authors, there are several concepts found in financial economics that are sometimes used in the literature more generally than their strict definitions:

- **Arbitrage**: Arbitrage is rigorously defined in theory but also is sometimes used in finance to describe near-arbitrage situations (not certain but likely free lunches) and also good-deal situations (where the return seems to far exceed risk). Finance lacks consistent terms to cover this continuum.
- **Liquidity**: Liquidity is a clichéd term and can mean transactional ease, market depth, cash, cash rates, short-term funding structures, aggregate money supply or market visibility.
- **Beta**: Whether the beta in Capital Asset Pricing Models (CAPM), a stochastic discount factor or state price deflators, much financial economics assumes that there is a single risk factor around which asset (and liability) prices orbit. The concept of there being multiple risks and therefore multiple betas receives less attention, though arbitrage pricing theory allows for multiple factors affecting asset prices. In practice, idiosyncratic risk is at least sometimes priced and coalesces into various cohorts; interest rate sensitivity, inflation sensitivity, liquidity, insurance risks and recession risk sensitivity are some examples. Complete, efficient and consistent markets and prices are theoretical concepts which might not quite be there in practice.

We have not attempted solutions to these issues here.

Much useful material on financial economics has emerged in recent times. There are many major texts on financial economics which are helpful and accessible on websites such as that of the Society of Actuaries (these can be accessed through the IAA website). Some useful texts produced by actuaries in recent years include:

- *Financial Economics and Canadian Life Insurance Valuation* (Report of the Canadian Institute of Actuaries Task Force on Financial Economics) (2006)
- *Pension Actuary's Guide to Financial Economics* (Joint AAA/SOA Task Force on Financial Economics and the Actuarial Model) (2006)
- Vancouver Symposium organised by the Canadian Institute of Actuaries (2003)
- *A Primer in Financial Economics* (Whelan, Bowie and Hibbert) British Actuarial Journal 8.1.35 (2002)
- *Market Consistent Valuation of Life Assurance Business* (Sheldon and Smith) British Actuarial Journal 10.111.47 (2004)

The eight areas of commentary are:

1. Use of Discount Rates
2. Risk-Free Rates
3. Pension Accounting
4. Valuing Guarantees
5. Guarantee Funds
6. Investments by Corporations
7. Matching
8. Market-Consistent Valuations

These issues are interdependent in many ways: repetition and redundancy have been unavoidable. Some cross-referencing to related topics and the linking of related concepts has been attempted.

Topic 1: Use of Discount Rates

Discount rates are used to place value on a set of future cash flows. An important application of discount rates is to determine a relationship between various assets and liabilities, which takes into account the time value of money. Both assets and liabilities have cash flows (known or unknown) in future years. By determining a present value of these cash flows the relationship between positive (asset) and negative (liability) cash flows can be properly assessed.

Assets come in two recognisable forms: either assets in the conventional sense such as bonds and equities, or in the form of future promised inputs such as insurance premiums or pension scheme contributions. Liabilities also come in two forms: as a negative asset such as an issued bond, or, more usually, as a promise to make payments in the future.

The nature of the promise should be of vital concern to actuaries and their customers: failures to elucidate the exact nature of a liability promise is the cause of many an actuarial slip-up. Is it a contractual guarantee? If so, it needs to be recognised and valued as such. Or is it a best-endeavours commitment? In this case, careful attention is needed to avoid a bad contract (a contract where two sides are confused about details, or a contract that may promote moral hazard in certain circumstances).

There can be two principal purposes for determining liability values:

- **Solvency**. A determination of whether, without any future inputs, there are sufficient assets to meet existing liabilities. This is also described as balance sheet accounting valuation and termination valuation in pension work.
- **Projection**. An actuarial task that assists understanding about an entire system or contract: liabilities (accrued and future), assets (value and investment policy), benefits (insurance contracts or pension benefits) and expenses (total, periodic and pattern). The concept of a liability here may become broader than strict accounting definitions.

In the context of an insurance company, a solvency valuation will assume that no future premiums are paid, other than those which are contractual under the terms of policies in force; the liabilities are those due to the payments of past premiums and future contractual premiums, and the assets are those held to pay future claims together with reserves. A projection valuation is more to do with assessing either the sufficiency of future premiums or the value of the enterprise as a going concern.

In the context of a defined benefit pension fund, a solvency valuation assesses whether, if the accrual of benefits and the payment of future contributions stops today, there are sufficient assets held to meet accrued liabilities. A projection valuation assesses what level of future contributions is likely to be required to ensure that, together with assets held, accruing future liabilities can be met.

The arguments for the determination of a discount rate differ depending on the purpose of the valuation.

A Solvency Valuation

In a solvency valuation, the insurance company or pension fund is holding a block of assets which are intended to meet liabilities which have already been accrued. These liabilities are not usually known precisely; for example, they may depend on factors such as future mortality or the evolution of motor/auto insurance claims. The nature of the liability promise is likely to be contractual.

The value of the assets will normally be taken as their market value where such exists. If there is no market value, then a form of valuation should be used which, as far as possible, reflects market conditions and discounts the asset cash flows at an appropriate risk adjusted basis.

To value the liabilities in a solvency valuation, it is first necessary to establish an expected cash flow, using a best-estimate approach. In some cases, the cash flows will be reasonably well determined. Assuming this to be the case, then it should be possible to produce a matched, or near matched, portfolio of assets with identical cash flows to that of the expected liabilities. (The concept of matching and its possibility and desirability is dealt with under Topic 7 of this note). If the cash flows of both assets and liabilities are identical (or very similar), then the question of solvency is insensitive to the choice of discount rate; whatever rate is chosen will produce the same result (or similar results).

However, this is never the case in practice. Liability cash flows are often not known with certainty, there are likely to be surpluses and deficits, and exact matching is almost impossible to achieve.

It is reasonable to work on the practical assumption that a third party taking on the liabilities would evaluate them on the basis of matching assets with minimum risk. For brevity, we ignore that they may also require a margin above this to offset the cash flow uncertainties and make a profit (but please do not ignore this in real life). In effect, the discount rate choice would involve

government guaranteed bonds of the correct duration (See Topic 2). The discount rate for a liability in a solvency valuation should therefore be chosen as the bond rate for its duration. In theory, this means using a set of discount rates in line with the bond yield curve, although some approximations to this are normally necessary in practice.

In practice, solvency valuations may be carried out at rates which are not, strictly speaking, 'risk free' in the sense of being government guaranteed. For example, regulators may choose to use what can be termed a 'reference' rate; such a rate could be determined by relation to interest rate swaps. It is important that such reference rates have a sound intellectual basis, are the result of agreement between regulator and regulated, and are based on transactions which reflect underlying matching.

Under what conditions would discount rates be used that reflect anything other than a matched asset portfolio? Certainly for some defined benefit pension plans in some jurisdictions, solvency valuations are carried out at discount rates that reflect expected returns on an asset portfolio carrying matching risk.. This can be based on the argument that the assets actually held are higher risk/higher return than a matched portfolio. Topic 7 addresses this point-of-view as confusion between matching and investing. To be clear, if the purpose of a valuation is to prove that a pension fund is solvent if terminated, it is hard to imagine a third party taking on the liabilities on termination using anything better than the discount rate derived from a matched portfolio of assets and probably an additional risk margin to cover uncertainties in the cash flows and make a profit.

A Projection Valuation

A common valuation task, potentially very different in purpose to a solvency test, is a valuation where the purpose may be to establish a future premium, a funding rate or an enterprise value, or may be to explore the domain set of future management plans (what might happen). In these cases, solvency testing may not be the primary objective, and thus the actuary has a freer hand in setting the discount rate.

This choice of discount rate should be guided by the purpose of the valuation and the consequences of this choice for all stakeholders.

A common situation that arises in choosing a different discount rate is where an actuary chooses to value pension liabilities using the discount rate applicable to the actual assets associated with the liability. This typically has the effect of reducing the value of the pension liability compared with a solvency valuation by the expected gain from investing in risky assets.

The purpose of the valuation may be to establish long-term contribution rates: a projection valuation that explores the notion of smoothing and lowering cost through time by introducing expected profit from investing in risky assets (not matched to the liabilities). In and of itself, this purpose is a noble one.

One consequence of using a higher discount rate is to allow intergeneration transfers of risk. Solvency for the next generation will be affected by the experience of the previous generation.

Where there is a solid covenant from the pension sponsor this may be perfectly acceptable to members: for a given cost they may well receive a higher expected benefit than the sponsor would otherwise be prepared to support. Where the covenant is weak, the need for continuous solvency may over-ride the benefits of risky investing.

Sponsor and members need to understand that using riskier investments may well reduce long term costs and/or allow higher benefit accruals but at the price of introducing extra risk to the payment of the benefits. Members of a scheme with a strong guarantor may accept this on the grounds that their benefits might otherwise be less; where there is a weak guarantor, the trade-off may not be acceptable.

A potential adverse consequence of a projection valuation where a liability is valued at other than a risk-free discount rate is where the 'cost' of the liability can get separated from the purpose of the study. For example, pension benefit costs are often expressed as a percentage of total remuneration. A projection valuation with a high discount rate to reflect a risky asset strategy may arrive at a pension remuneration cost of 8% (say). But is it clear to the sponsor that this cost is composed of 12% remuneration 'cost' (say) and a 4% 'profit' (say) representing expected gains from investment?

Finally, advocacy of a risk-free discount rate for use in valuation (whether for solvency or projection work) does not imply advocacy of pursuing a matching investment strategy. There is a danger, however, that applying a high discount rate to liabilities could be seen as advocacy of a risky investment strategy. Where possible, advocacy of risky investing should be separated from discount rate choice.

Topic 2: Risk-Free Rates

Central to the establishment of discount rates is the concept of a risk-free rate. If liabilities have been guaranteed to be paid, then we would expect them to be valued on a discount basis which assumes certainty – or is risk free. This expectation ignores the credit risk of the guarantor, the treatment of which is outside the scope of this note.

The concept of a risk-free rate in practice is complicated and a productive area for future actuarial research.

The boilerplate definition of risk-free is a zero-coupon government bond curve. While taxes are on the list of things that are certain in life, governments honouring contractual commitments are not. But the concept has to start somewhere and, considering the lengths that governments have gone to protect reputation, and considering the state of economic contracts in a government default situation, it is a good place to start.

So, starting with a zero-coupon government bond there are a number of practical modifications and alternatives to consider:

- There may be other economic benefits attached to owning a bond not reflected in the yield (asset lending or repo markets).
- There may be distortions caused by regulation (classes of investors may *have* to own them), capital controls (classes of investors are not allowed to own them), or by convention (owning government bonds reduces career risk). Markets that are not complete or arbitragable will mean that the yield will be less than would be the case for complete markets.
- There may be distortions due to central bank activities that attempt short-term manipulation of the short end of the curve to achieve their aims.
- There may be alternative assets that are more liquid than physical bonds or simply accepted as the risk-free rate by convention (sometimes due to the distortions listed above). The swap market is the obvious example.
- There is the usual model risk. Government zero-coupons may not exist at the maturity needed to value liabilities and there is some bond price modelling to do.
- Finally, there may be a liquidity/credit/confidence crisis that distorts all prices and causes arbitrage relationships temporarily to break down. The concept of a risk-free rate could be more or less clear depending on circumstances.

As recent financial events have shown, AAA does not mean risk free or certain (whether attached to government or private debt).

An interesting principle arises in consideration of the concept of liquidity. In valuing an illiquid liability should you use a liquid or illiquid risk-free rate? Arguments for the use of the illiquid rate (where the covenant or rating is practically the same) centre on recognising that liquidity may not be important to the particular investor (holder of the liability) and therefore using a very liquid instrument to establish a risk-free rate is being over stringent. Arguments against suggest that the quality of liquidity may be different: they are not matched. In the event of a sale of the liability, the purchaser is likely to require the discount rate to be the liquid risk-free rate and perhaps even lower to compensate for the illiquidity and uncertainty of the liability.

Topic 3. Pension Accounting

Accounting for defined benefit pension varies widely by jurisdiction, often due to historical contingency and evolution of accounting rules and conventions. Presented below is a template that has been derived from considering principles of financial economic and the theory of accounting. It is recognised that some areas may be contentious and other approaches valid, given local conventions and practices. It should be noted, however, that this treatment follows quite closely the embedded value accounting principles for life insurance companies.

Assets

- At market (or mark-to-model if no market exists).

Liabilities

- Equal market value of reference portfolio matching plan cash outflows in amount, timing and probability of payment (see Solvency Valuation in Topic 1). This includes optionality, which should be valued using a referenced option portfolio or using option pricing theory if no referenced option exists.
- Not less than the value of the employee's benefit on voluntary exit (E).
- Not more than the value determined as if the employer terminated the plan (T).
- Not more than the market price of the liabilities (V).
- When the difference T–E or V–E is attributable to vesting or other employee retention features of the plan, it may make sense to book a liability for T and an asset equal to some or all of the difference.

Periodic expense

- Equals the surplus (assets minus liabilities) at the beginning of the period plus contributions during the period minus the surplus at the end.
- The compensation cost portion of the periodic expense is that part of the total attributable to benefits earned during the period, computed using an end-of-period reference portfolio.
- Any benefits attributable to formula changes will be recognized immediately in full. No amortization over future periods.
- The remaining cost may be attributable to asset and liability returns. In the simplest model, this is the profit or loss on the "pension insurance subsidiary" attributable to a return on surplus (or deficit), asset liability mismatches, and demographic gains or losses. How these might be broken out or characterized is more of an accounting issue than one of actuarial science.

Topic 4: Valuing Guarantees

In an actuarial context, guarantees are essentially options which can be exercised by members or policyholders against the institution providing benefits. Examples include guaranteed annuity options, guaranteed surrender values, options to take part of an annuity in cash form, and ability to renew insurance without further underwriting. Guaranteed annuity options – where policyholders have the right to either take their accumulated savings to the annuity market or to

buy at a previously guaranteed rate – have been a major source of financial difficulty for some insurance companies in recent years.

Some actuaries have argued that options are best valued at their intrinsic value. That means establishing now which of two alternatives is likely to be more costly, and to value on that basis. Most actuaries now accept in principle that options also have a time value which can usually be quantified using some sort of stochastic model; they would also accept that market prices of traded options provide a useful source for calibrating the volatility of such options.

Market implied volatilities are often different from historically observed price volatilities. This raises the question of what adjustment, if any, should be made to historic volatilities for option pricing purposes when no market implied volatility is available. This dilemma may occur, for example, when pricing guarantees on property portfolios, actively managed funds or emerging market equities. Any evaluation of a 'to hedge or not to hedge' question should recognise that the Black-Scholes-Merton model is a simplification. Market implied volatilities also contain loadings for transaction costs, financial distress costs, capital costs, taxation and much more.

It is widely accepted that there is no way of deducing expected risk premiums from option prices, or conversely, that expected risk premiums are not a required input into option pricing models – but there is a grey area where risk premiums may enter into utility calculations underpinning optimal hedges in incomplete markets.

Non-financial options are more difficult in practice, although few actuaries would quibble over the principle. For example, guaranteed annuity options are not only options on interest rates but also on mortality tables. In theory, then, mortality tables should be projected stochastically and the volatility thereof incorporated into the assumptions used for valuing guaranteed annuity options. Options to renew term assurance on standard terms should, in theory, reflect fluctuations in individual mortality, to the extent that sick people are more likely to take advantage of the option. In practice, such stochastic mortality models are seldom, if ever, used. This may reflect a relatively small perceived value of such options, or inertia arising from the unpopularity of an increase in stated liabilities.

The greater controversies arise with options where policyholder behaviour is a major factor. Although a policyholder is entitled to the greater of two benefits, they may not in practice have the inclination or information to determine which is the more valuable, so may end up taking the 'wrong' option. The controversy concerns the extent to which such 'irrational' behaviour can justifiably be used to reduce the stated liability. Similar debates arise to an even greater degree for guaranteed surrender value, where theoretical 'rational' exercise algorithms are the result of a complex calculation which few policyholders are likely to replicate.

Against these arguments are examples where an arbitrage is recognised and taken advantage of by third-party investors buying policies and exercising surrender rights rationally.

Topic 5: Guarantee Funds

Guarantee funds are funds which stand behind possible insolvency of other funds. Examples include:

- Investor Compensation Funds. These insure against the risk of failure of deposit and insurance organisations. Often they represent a call on solvent companies in the event of an insolvency and are not prefunded.
- Pension Guarantee Funds. These are funds which seek to compensate for at least part of shortfalls in pension funds which themselves have guarantees. Examples are the Pension Benefit Guaranty Corporation (PBGC), active since 1974 in the US, and the Pension Protection Fund (PPF) recently started in the UK.

Assessing the liability of a guarantee fund includes accounting for several factors:

- The creditworthiness of the sponsors of the underlying schemes.
- The nature of the sponsor 'guarantees'.
- The nature of the guarantee being a put option on solvency issued by the guarantee fund.
- The level of funding within the schemes.
- The nature of the assets of the underlying schemes and the extent to which these are matched with the liabilities.
- The method and assumptions underlying the basis of funding within the schemes.

Assessing such liabilities will clearly involve modelling since many of the key elements are volatile and are likely to be correlated to at least some degree. For example, an economic crisis leading to a sharp rise in insolvencies and a sharp fall in interest rates is going to affect all the above factors in some way. There may also be other options against the guarantee funds – for example, the use of Chapter 11 by a number of US airlines involved the transfer of liabilities from their pension funds to the PBGC.

The risks to the guarantee fund tend to be systemic. Apart from the factors outlined above, matters such as the state of the economy, levels of interest rates, inflation and asset values affect general solvency. Particular industries can also be affected systemically – such as the airline and auto manufacturing industries in the United States.

In assessing the risk of guarantee funds:

- From the point of view of assessing risk within the guarantee fund, the discount rate for liabilities needs to be risk free given the solvency nature of the valuation.
- If underlying funds are pursuing investment policies which are not matched vis-à-vis the guaranteed liabilities, then additional risk is being passed on to the guarantee fund and this risk if skewed or option-like. To the extent that a more aggressive investment policy is pursued, the risk/reward ratio is skewed against the guarantee fund and the value of the option increases.

- The guarantee fund is most likely to be called on by poor economic conditions, falling asset values, reckless investment policies etc. Its own investment policy needs to run counter to this and is likely to be low risk.

Insurance premiums charged to the underlying funds should properly reflect funding levels (on a risk-free basis), sponsor creditworthiness and investment policies. Finally, the optionality of the guarantee may increase the incentive of the underlying funds to pursue riskier investment policy thus increasing the value of the option.

Topic 6: Investments by Corporations

Much portfolio construction theory centres on the concept of utility: how should an individual invest to maximise wealth subject to risk (for example). The solution is portfolio optimisation, which emphasises the selection of appropriate risk levels and utilizes the benefits of diversification across different investments.

But a corporation or a trust is not an individual: it is a coalition of different groups with different utilities. Corporate finance has evolved differently to individual finance in response to this different situation; utility calculations need to also balance competing interests and thereby avoiding frictional (or deadweight) costs. Corporations should seek to maximize net present value for their shareholders, in theory leaving shareholders free to make their investment selections based on utility. There is a separate issue of frictional costs which arises from the nature of corporate structure, the costs of doing business such as taxation and the agency problem that shareholders and the managers they appoint to run their companies may have different objectives. In the finance literature, frictional costs are defined as anything that takes cash flow away from investors and includes additional taxation (above and beyond direct equity ownership), agency costs, moral hazard costs, and financial distress costs.

The key controversy of using portfolio construction motivated by utility theory within a corporate system is that increasing generalized risk (such as a diversified equity portfolio within a sponsored defined benefit pension fund, say) increases many of these frictional costs.

In a pension system (which is part of a corporate system), the utility perspective treats the fund as having its own utility with the preferences of the stakeholders being balanced in some way. This leads to pension funds balancing risk and return, choosing a middle way between a closely matched approach and one with 100% risk investments. The corporate finance perspective, however, suggests that shareholders can diversify for themselves and do not value diversification within the corporation. Given this, a risky investment approach within a pension fund context may be increasing frictional costs for no good reason.

However, the frictional cost approach of corporate finance is not widely embraced. An individual utility perspective is often used in corporate decision making, leading to firms being concerned with risk premiums, diversification and efficient portfolios. If firms adopted the

corporate finance perspective, they would be unconcerned about risk premiums and would, rather, focus on volatility and associated frictional costs.

The use of a utility perspective may well be because it is difficult to apply the corporate finance perspective in practise. Investors (shareholders and bond holders) also display behaviour at odds with corporate finance; most prefer to 'outsource' some of their diversification to corporates or to mutual funds. This may be sensible: corporate insiders may often be in a better position to understand and diversify risk in their business than the outside investor.

Whatever the normative perspective of the actuarial community, corporate participants will continue to use and demand a utility approach for now. In practice, this means that the determination of investment policy for corporate reserves will be based on risk, reward and diversification. An actuary should be aware of frictional costs when participating in portfolio construction discussions. This awareness should extend to knowing that an efficient portfolio constructed using an individual utility framework may well be inefficient within a corporate framework.

Topic 7: Matching

The choice of assets to match insurance and pension liabilities encapsulates some of the most difficult and open issues in the application of financial economics to actuarial problems. Matching issues can be usefully split into two categories: where liabilities are 'closed' and all cash flow variation is due to mortality experience and other actuarial assumptions, and where liabilities are 'open' and represent an ongoing concern business where future liabilities are expected and where cash flows are affected by non-actuarial assumptions such as wage inflation, guarantees and other option-exercising choices.

Closed Liabilities

With closed liabilities, it is clear which assets are matching if the liabilities are precisely defined (albeit with mortality as variables). If there is a sufficiently deep market in bonds of a wide range of durations, then it should be possible to reference a portfolio of assets which closely matches the cash flows of the liabilities. Mortality does create a problem, particularly if the liabilities are very long term. If the liabilities include annuities escalating with cost of living, then a similar supply of index linked bonds will be necessary.

For example, the typical annuity fund of an insurance company will start from a matched position, in so far as this is possible, given asset availability. The following points need to be noted:

- There is an open argument as to whether AAA bonds or government backed bonds are the best match (See Topic 2).
- If the liabilities are index-linked, it is less likely that exact matching can be achieved.

- The scarcity of index linked-bonds may create unavailability and artificial pricing. If an alternative matching asset is sought for long liabilities, then equities or property may be just as good (or bad) a match as conventional bonds. This is an unresolved question in finance.
- An insurance company which is well capitalized may believe that it is justified in taking some investment risk with at least part of the assets and pursue a more adventurous investment policy in the pursuit of shareholder wealth maximization.

Departure from a matched asset position (if such exists) represents taking on investment risk and it is important that this risk be fully understood. In considering a mismatched asset portfolio, variations in the value of these assets needs to be understood and the consequences made clear. It is important that the reader of a balance sheet with mismatched assets and closed liabilities understands the effect of price changes and of the need for capital support if these movements are unfavourable.

Open Liabilities

In an open liability pool, it is possible to take two positions on matching. The first is to corral the liabilities accrued to date and treat these as a closed liability, ignoring future liability accrual. The second is to group current and future liabilities in the same pot; in this case, the course of the liabilities will depend on new factors such as future salary rates, demographic changes and actuarial risk selection. If the primary purpose of the valuation is a solvency test, then explicit separation of accrued and future liability is warranted. If the purpose is to assist with management of the entire scheme over time (a projection valuation), then introducing matching concepts raises two extremely interesting (and open) questions:

- Can future liabilities be matched?
- Should future liabilities be matched, especially in preference to matching accrued liabilities?

The projection of total liabilities will depend on assumptions such as future salary growth, economic growth and the future strength of the entity which stands behind the fund. Matching liabilities which grow with salaries is difficult. Actuaries have often argued that equities were the best asset for this purpose but the evidence for this is quite weak. The equity investment argument leans more heavily on risk and reward than on matching. It is hard to separate consideration of the open fund case without taking into account the position of its sponsor. This leads us back to the corporate finance/utility theory arguments set out in Topic 6.

But even if it is possible to match future liabilities, is it good practice? From a frictional cost (corporate finance) perspective, the change in liability over time should be considered to be the periodic expense of a scheme (Topic 3). So matching future liabilities is similar to a corporation using existing shareholder funds to hedge future business conditions (such as future salary inflation).

“Should a gold miner hedge the future price of gold?” is a very similar question. Application of pure theory suggests the answer is maybe not. The gold miner should not hedge as the shareholders can if they choose to, and hedging a known risk decreases transparency of the

corporate mission and thus increases frictional costs. The gold miner now needs to be assessed for both the ability to dig gold out of the ground and ability to correctly hedge (size of hedge, choice of time horizon, assessing the limits of arbitrage, and potentially to time the gold market). The ability of a corporation trying to match future salary inflation (say) needs to now include assessment of expertise on working out whether equities are a valid match for future salary increases.

Good theory is not always good practice, however. Practical points to be considered include:

- The Theory of Competition. If there are five companies making all cement used on an island, all with defined benefit pension schemes, and four pursue a particular investment policy for their pension schemes, then the fifth needs to take account of that strategy. Competitor behaviour does matter.
- Almost free lunches. There are arguments which suggest that in dynamic markets, information and values change and that some of this may be partially predictable. An example is the tendency in the UK in the last ten years for the bond yield curve to be inverted, i.e., longer bonds yield less than shorter bonds as a general rule. The UK is unusual in this regard – inversion is much stronger than in the Eurozone or the United States for example. It does seem at least possible that this offers some value opportunities.
- Pursuit of Alpha. There are really two ways in which funds may take investment risk. One is by pursuing asset strategies which differ from matched positions, e.g. by substituting property for bonds. The second is by attempting to outperform within an asset class. These strategies cannot be totally separated but are often confused.
- Risk Diversification. If a mismatched strategy is being pursued, then it can be argued that the risks are mitigated by using a multitude of assets with unrelated characteristics. We do not propose to consider this in detail; it is a complex area which relies on historic data which may or may not be relevant.

In giving asset selection advice it seems prudent to begin with matching asset advice, and state why and in what ways departures are being made. In particular, the pursuit of matching future liabilities should be separated from the pursuit of investment risk premia and alpha.

Topic 8: Market-Consistent Valuations

In the area of solvency testing (balance sheet, periodic expense and solvency studies), it seems clear that a market-consistent approach to liability valuation is essential.

A market-consistent approach means setting up a corresponding set of assets (calibration assets or reference portfolio) and valuing the liability cash flows in a consistent manner to that which creates the market values of the calibration assets.

Market-consistent valuations can be difficult in practice, particularly if non-matching assets are not readily available (See Topic 7). Complications also arise if the cash flows are not precisely defined and need to be modelled in some manner which allows for variation. Market-consistent valuation is occasionally complicated and difficult but also necessary given the purpose of reporting liability value and given the consequences of using another method.

For projection work, where an actuary is assisting with understanding the entire system of liabilities (accrued and future), assets (value and investment policy), and expense (total, periodic and pattern), the concept of a liability may become broader than accounting definitions. Non-market-consistent approaches to liability valuation can clarify and simplify modelling the future. In a projection valuation, there may be several advantages, however, for nevertheless pursuing a market-consistent valuation:

- For most projection work, the question of solvency through time is important.
- Using market-consistent discount rates separates the tasks of valuing liabilities and formulating investment policy.
- They also enable better understanding of a company's share price in the case of an insurance company or the sponsor of a defined benefit pension. For example, comparing market-consistent embedded or appraisal values for life insurance companies makes explicit the consideration of choice of various strategies to management. This enables management to understand the effects of changing the underlying factors affecting cash flows and leads to more informed management.
- They should allow the entity to clearly consider how and whether risks should be closed out. For example, if the solvency of a defined benefit fund is very sensitive to equity market performance, and may threaten the solvency of an entity in certain circumstances, then alterations to the investment policy need to be considered. This is more difficult if these alterations affect the liability value through use of a now lower discount rate.
- In theory, market-consistent valuations should be objective, enabling valuations to be compared. In practice, this objectivity is not easy as the valuations may involve options and guarantees, for example, which are unique and assessment of whose behaviour is highly subjective.
- Often, projection work involves considering the amount of capital required for the reserves of the entity being considered. In this context, we need to consider to what risks the assets and liabilities are exposed and whether these risks are systematic or non-systematic. At an extreme, an asset portfolio consisting of one highly geared, unquoted stock is a great deal more vulnerable to non-systematic risk than a broadly based portfolio of assets. Equally, if the cash flows of the liabilities are highly dependant on one unique guaranteed option, then the same holds. Modelling can draw this out by showing the extremes of possible outcomes.

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