



Organisation for Economic Co-operation and Development

Publication sponsored by  
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INSURANCE AND PRIVATE PENSIONS  
COMPENDIUM  
FOR EMERGING ECONOMIES

Book 1  
Part 1:3)c

ACTUARIAL ISSUES RELATED TO THE REGULATION OF  
PENSION SCHEMES AND LIFE INSURANCE

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2000

*This report is part of the OECD Insurance and Private Pensions Compendium, available on the OECD Web site at [www.oecd.org/daf/insurance-pensions/](http://www.oecd.org/daf/insurance-pensions/) The Compendium brings together a wide range of policy issues, comparative surveys and reports on insurance and private pensions activities. Book 1 deals with insurance issues and Book 2 is devoted to Private Pensions. The Compendium seeks to facilitate an exchange of experience on market developments and promote "best practices" in the regulation and supervision of insurance and private pensions activities in emerging economies. The views expressed in these documents do not necessarily reflect those of the OECD, or the governments of its Members or non-Member economies.*

**Insurance and Private Pensions Unit  
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## **I. The purposes of actuarial, accounting and regulatory valuations**

### *Life insurance*

There are a number of reasons for conducting valuations. The assessment of solvency for regulatory purposes is not necessarily the most important reason.

The first reason for undertaking a valuation is to assess the solvency of the company. This will be done for regulatory purposes but also because the avoidance of insolvency is a key issue for both shareholders and policyholders. It does not follow that the investigations for regulatory and for shareholders' purposes should be undertaken on the same bases. A range of techniques may well be used for internal purposes for producing results which require considerable interpretation. On the other hand, a basis for regulatory purposes will normally require simplicity and transparency.

Secondly, valuations will be undertaken for the purposes of published accounts. For a number of reasons, these may be different from those produced for the regulation of solvency. Where valuations are produced for accounting purposes, they will have to fulfil stock exchange standards as well as accounting standards. Secondly, published accounts have different purposes from valuations for solvency purposes. For example, published accounts are likely to require a true and fair view, whereas a valuation for solvency purposes may have greater margins. The published accounts should demonstrate the true profitability of the company to actual and potential shareholders and policyholders. In practice, in life insurance, valuations for the purpose of published accounts are likely to follow similar conventions to those used for published solvency valuations for regulatory purposes. However, footnotes will often be given which provide additional information on more realistic assumptions (for example, figures showing the "embedded value"). Conventions may change if international accounting standards are adopted.

Thirdly, valuations will be undertaken for tax accounting purposes. To the extent of our knowledge, there is no significant difference in life insurance between valuations produced for published accounts and valuations produced for tax accounts. However, in principle, rules for tax accounting may differ from those for regulatory or published accounts. Differences sometimes appear in the non-life field. In particular, the various types of account may differ because tax authorities may wish to accelerate the emergence of profit whereas valuations for the purpose of the regulation of solvency would normally delay the emergence of profit.

Fourthly, valuations are undertaken for determining the amount of surplus that can be distributed to shareholders and policyholders. Such valuations may be different from regulatory valuations and will generally form the basis of published accounts. There must be some compatibility between valuations for regulatory purposes and valuations to determine the amount of actuarial surplus however. In particular, such surplus cannot be distributed that would make an insurance company insolvent from a regulatory point of view. A valuation for the purpose of revealing surplus will normally be conducted using a framework which will ensure that surplus is revealed smoothly. Thus, for example, a sudden drop in market values of equities would not necessarily lead to a significant and immediate cut in bonus levels (although a statutory valuation may show a greater fall in the solvency margin).

There are a number of other valuations that are undertaken for the benefit of internal investigations. In particular, valuations can be performed under different financial assumptions, in order to test the resilience of the company to changes in financial conditions. In the US, dynamic solvency testing is used (indeed there are statutory requirements for this) to look at the evolution of the solvency position over a long period, under different assumptions. In addition management will want to determine the solvency position of the company under "realistic" assumptions, rather than using the "prudent" assumptions that have to be used for regulatory valuations. This will involve, for example, embedded value calculations.

## *Pensions*

The purpose of most pension fund valuations is fundamentally different from that of most life insurance valuations. We will look at three types of pension fund valuation here.

1. Valuation for funding purposes.
2. Valuations for regulatory purposes.
3. Valuations for company accounting purposes.

The three types of valuations have fundamentally different objectives, although one type of valuation may be used in place of another in some circumstances. For example, a pension scheme must always pass the regulatory test. Thus even if the valuation for funding purposes suggests that the scheme is properly funded, contributions may have to be increased if the valuation for regulatory purposes fails.

The purpose of the valuation for funding purposes is to try to ensure that the employer or fund sponsor controls the costs of the scheme in a systematic way. If the fund appears unable to meet the benefits that have been promised, it is likely that the employer will have to increase contributions (similarly, if the fund is greater than appears necessary to meet the benefits, a contribution holiday could be taken). Employers will wish to avoid too much variability in contribution rates and will therefore wish to ensure that the contribution rate set is such that the expected future benefits can be met from the fund plus the expected level contribution rate, set as a proportion of salary. Unnecessary margins might not be included in such a valuation, although benefits that have not yet accrued but are expected to accrue may be included. If rules exist within a country which dictate that surplus has to be used to enhance benefits (or otherwise returned to the members) but that deficits have to be made good by the employer, it is likely that companies will fund their schemes at the lowest level allowed by the regulatory standards. So-called asymmetric distribution of surplus rules therefore can lead to greater insecurity with fund sponsors sticking to the letter of the funding law, rather than funding prudently.

There are two types of valuation for regulatory purposes. Valuations are required by supervisory authorities for the monitoring of solvency and, in some countries, by the tax authorities, in order to control the extent of tax benefits given to pension funds.

A valuation for supervisory purposes will be less interested in valuing future accrual of benefits which have not yet been promised to members (or allowing for expected future salary increases), but it will be more interested in ensuring that the benefits which have been accrued by members to date are absolutely secure. Thus, for example, a supervisory basis may use a lower interest rate to value a lower level of benefits. It may come to a similar result as the funding basis for different reasons (although it is believed that the average scheme was about 15% over funded on the supervisory basis in the UK, known as the MFR, at the time of its introduction: see Booth et al 1997). When considering the requirements for a supervisory valuation, as opposed to a funding valuation, one should take into account the economics of regulation, discussed briefly below. Two principles which have underpinned regulation in liberal Anglo-Saxon countries (such as the UK and US) are:

1. the protection of third parties and
2. ensuring that pension funds publish sufficient information for members.

The first of these principles will involve establishing regulation that ensures the security of a sufficient level of pension so that a member does not have to rely on the state for his retirement income. In the UK, therefore, a pension scheme that had contracted out of state arrangements would be required to demonstrate that benefits broadly equivalent to those in the state arrangement were secure, within the pension fund. This has now been replaced by a funding requirement based on pensions accrued to date but without allowing for the full level of expected salary increases. The second of these principles may lead to

a requirement for actuarial valuations to be carried out and published to provide information to members but without necessarily prescribing the basis upon which the valuation is carried out.

Valuations carried out for the tax authorities may conflict with valuations carried out for the supervisory authorities. In the UK, the purpose of valuations for tax purposes is to prevent a pension scheme becoming too overfunded, allowing the fund sponsor to defer company taxes (because of the tax relief given to fund sponsors). In particular, schemes cannot build-up a surplus of more than 5% of liabilities without taking some action to reduce the surplus. It is clearly important that different schemes and fund sponsors are treated equally here so a prescribed valuation basis is used (see below).

In a number of countries, an estimate of the true cost of funding for pension liabilities has to appear in the income statement of the annual reports and accounts of a company (for example FAS 87 in the US and SSAP 24 in the UK). The purpose of this requirement is to give those who use the information provided in reports and accounts an indication of the ongoing cost of a pension scheme, which may not be related to the actual contribution flow. Here, the actuary is required to produce the “best estimate” of costs related to those pension benefits that have been promised according to normal accounting principles. The purpose of the valuation should be seen as part of the process of ensuring that the report and accounts of the company give a true and fair view of the state of the company. Thus if an approximation in the valuation does not lead to a material valuation error in relation to the balance sheet of the whole company, such an approximation would be permissible. However, the approximation might not have been appropriate in the funding valuation. Other differences between accounting and funding valuations may arise. The purpose of the funding valuation is to ensure that the costs of the pension scheme are spread in a way which seems optimal for the employer. This may involve a different pattern of funding and a different method of funding that accounting standards do not permit. For example, international accounting standards are moving in the direction of the use of market values for asset valuations and the use of fixed interest bond yields for discounting. Many actuaries would believe that these assumptions are inappropriate for the development of a stable funding pattern. However, this view is not universal and it is probably the case that the methods of determining the funding position of pension funds for valuation and accounting purposes are coming closer together in the UK.

There would seem to be no obvious reason why an accounting standard should enforce a particular valuation basis for accounting purposes, as long as the basis which is used is disclosed. However, FAS 87 in the US does so and proposed international accounting standards which could be used in the UK do so. These standards use fixed interest yields for the valuation of liabilities. Actuaries would not necessarily agree that this is appropriate.

## **II. Actuarial frameworks for assessing solvency**

### ***II.1 Life insurance companies***

#### *Valuation of liabilities*

Here we will assume that the valuation for regulatory purposes is mainly for the purpose of ensuring that relevant information regarding the solvency of a company is publicly available and that contractual benefits can be provided by the insurance company, if reasonable financial conditions prevail, without recourse to third parties (such as policyholder protection funds). Contractual benefits may include implicit contractual benefits such as policyholders’ reasonable expectations of bonus on UK with-profit style contracts. There are various methods of valuing both assets and liabilities. The key issue is that the valuation bases for assets and liabilities should be consistent with each other.

The purpose of the asset and liability valuations is to place a value on the assets to determine whether the assets are sufficient to accumulate, with interest, to meet the liabilities. The generally accepted principles of liability valuation for solvency control are as follows.

1. Generally accepted accounting concepts and bases should be used together with methods appropriate for life insurance companies (N.B. it should be noted that this still leaves a lot of areas for further debate).
2. Due regard should be made, on the participating side, for policyholders' reasonable expectations.
3. Reasonable allowance should be made for adverse deviation of relevant variables from assumptions (this is particularly important where there are guarantees such as guaranteed surrender values): see section on safety margins.
4. The basis should be sufficiently prudent to avoid future valuation strain.

We will look at three types of liability valuation bases which could, in principle, be used for regulatory purposes:

#### *Gross premium/Bonus reserve method*

The liabilities are valued as the present value of expected future benefits and expenses minus the present value of expected future premiums. In the gross premium method, the premium valued is the premium actually paid by the policyholder (the office premium); also the expected future bonus is valued on with-profit policies. The advantage of the gross premium method is that it is realistic. The disadvantage is that the valuation result is very sensitive to assumptions. Some would argue that this merely reflects the reality of the financial world. Others would say that the gross premium method is not very subtle and the apparent realism is spurious.

There are other difficulties with the gross premium method, although these can be resolved with proper management. A gross premium method can give rise to negative reserves in the early years. This would be regarded as imprudent because policies may lapse and future premiums may not be received. It would be reasonable to set negative reserves to zero. Secondly, the method immediately capitalises the difference between pricing and valuation assumptions. This may be perfectly reasonable, as long as the valuation assumptions are not over-prudent.

#### *Net Premium Method*

The net premium method values liabilities as the present value of net liabilities calculated as the present value of future benefits (excluding future bonuses) minus the present value of future net premiums. Broadly speaking, the net premium for a policy is calculated as the premium which would be necessary to provide the guaranteed benefit (excluding bonuses and expenses) as calculated at the rate of interest at which the valuation is carried out. There are a number of problems with net premium methods. These problems really relate to the artificial way in which bonuses, expenses and premiums are valued.

Expenses and bonuses are valued implicitly in the valuation process. No expenses are valued (thus reducing the liability) but no expense loading is valued (thus increasing the liability). As long as expenses are level this does not cause a problem. However, initial expenses (which are often higher than renewal expenses) will flow out of the company when a policy is issued but the loading in the premium to make good these expenses will not be valued. Under UK regulation, a so-called "Zillmer" adjustment can be made to the reserve to allow for this problem. This is limited to a value of 3.5% of the sum assured, spread over the premium paying term. Despite the Zillmer adjustment, it is still possible to have a new business strain which is too large as a result of this net premium method.

With regard to bonuses, they are not valued as a future liability (thus reducing the liability) but the bonus loading in the premium is not valued (thus increasing the liability). The expectation is that the bonus loading will arise each year and be sufficient to pay the bonus (thus the absence of a valuation of a bonus loading and of the bonus cancel each other out). Unfortunately the bonus loading does not follow the same cash flow pattern as the required reversionary bonus pattern on most policies. Thus the valuation is artificial and, if no adjustment is made, inaccurate. The net premium method does not deal at all satisfactorily with terminal bonus. This particular problem only, of course, applies to participating policies.

The premium which is valued is artificial. It is not merely the premium received less any bonus or expense loadings. The premium is artificially recalculated when the interest rate basis for the valuation changes. This slows down any changes in the value of liabilities caused by changes in valuation bases. However, this might be appropriate if the purpose of the valuation is to ensure the smooth release of surplus.

### *Discounted cash flow*

A discounted cash flow valuation is a generalised version of the gross premium method. It involves projecting all liabilities, including expenses, explicitly and valuing them using appropriate mortality and interest rates. A range of different interest rates can be used, so that they are appropriate for different types of policy and over different terms. Formulae do not need to be used but computation is quite intensive. The advantage of this approach is that it is very flexible. The disadvantage from a solvency regulation point of view is that it would be very difficult to regulate the basis (although the regulation could simply require that the information was published, together with assumptions).

### *Other issues*

The more complex policy terms become, the more complex valuation procedures should be and the harder valuation procedures are to regulate. One particularly difficult area is that of reserving for guarantees. Guarantees can come in a number of forms, the most common involving guaranteed maturity values (for example a policy which is linked to the performance of a basket of equities but with a minimum set return per annum); guaranteed surrender values (for example, where the customer is given a guaranteed return whenever the policy is surrendered); and guaranteed mortality terms (for example, where a term assurance can be renewed without health evidence). There are a number of ways of reserving for guarantees. They all have their practical and theoretical weaknesses and it is very difficult to regulate the bases on which the relevant investigations would be carried out.

The first method is simply to allow the actuary to make prudent reserves, given his experience and the nature of the guarantee. This method was used in most life insurance companies until the recent past. A second approach is to undertake a form of scenario testing whereby the actuary would consider a number of different economic and mortality assumptions and ensure that the reserve was sufficient to meet the guarantees under reasonable assumptions. Assumptions about policyholder behaviour would also be necessary (for example, if interest rates increased, what rate of surrender of policies would be expected on guaranteed terms). A lot of work has been undertaken in the US on this subject as guaranteed surrender values are very common in the US. They are relatively uncommon in the UK and, on the whole, for most companies, guarantees are unlikely to be of major financial significance. A third approach, where guaranteed interest terms are given, would be to use some form of option pricing approach. This is difficult mathematically but can give more precise answers (albeit based on the underlying assumptions).

One of the principles of the Third EU Life Directive stated that, where a surrender value of a policy is guaranteed, the amount of the mathematical provisions for the policy shall be at least as great as that value. This is a sound principle and does, of course, allow for the possibility that the customer may surrender immediately, if it is in his interest to do so.

Unit linked policies need special consideration. Here a unit reserve is necessary (units have to be created and the appropriate investments undertaken to match the liabilities). However there also may be currency liabilities (for example expenses or mortality costs for policies which pay out a benefit on death higher than the value of the units). There should be both a unit and currency reserve. The latter will often be calculated using cash flow projection methods (see for example Squires 1987). Unit linked personal pensions would be valued in a similar way.

### *General issues*

There are two general principles of reserving for solvency which it is worth reiterating. The first relates to the assumptions. The assumptions used in calculating the liability value should not necessarily be a best estimate of the future, where the valuation is undertaken for solvency purposes, but should involve prudent margins. The value of the liability calculated should relate to the amount of assets which would be necessary, under reasonably prudent assumptions to accumulate to meet the liabilities of the company. The second principle is that the method and basis for calculating the value of the assets should be consistent with that used for valuing the liabilities. There is an important difference between the approach used in life insurance and the approach used in industries such as banking. For the regulatory solvency valuation in life insurance, the assumptions used are “prudent”. This means that there should be a small probability of insolvency, even if no margin of solvency was held. Regulatory margins of solvency should take this into account. In the retail arm of a bank, liabilities are generally known with certainty but assets (for example, loans) are valued on a “best estimate” basis. It would therefore be reasonable for margins of solvency or capital adequacy (such as those in the Basel accord) to be more stringent than their equivalent in life insurance.

### *Cash Flow Projections and Stochastic Projections*

All of the basic methods discussed above were developed a century or more ago. Although regulation has not moved much further in recent decades, in terms of its requirements of companies, actuarial practice has. Insurance companies will now do a range of projections and stochastic cash flow tests in looking at the solvency of the office. We will discuss some of these ideas below under dynamic solvency testing, but it is worth looking at some of the principles here. The valuation methods discussed above were necessary in the days before computers but when computation techniques were sufficiently developed to allow actuaries to compute one number which represented the value of the actuarial liabilities. Computing techniques now allow actuaries to do forward projections of the office. Thus, the cash flows from the assets and liabilities of the office can be projected forward and the actuary can see, firstly, whether there are sufficient assets to meet the liabilities which have been underwritten by the office so far and, secondly, in which years liability cash flows might exceed asset cash flows. It can also determine the amount of assets which are necessary to meet future liabilities but with more specific and explicit assumptions than when using a valuation formula. Thus, practice in the management of solvency has run far ahead of regulation. In fact, it is very difficult to specify a basis on which cash flow testing might be undertaken because of its complexity. It may be possible to specify that it has to be undertaken but it would be very difficult to specify how it would be undertaken.

Often cash flow projections would be undertaken with stochastic parameters in the cash flow model. This enables the office to determine the probability of insolvency. However, the accuracy of the result depends on how realistic the assumptions of the model are. It would be impossible to specify the use of a particular stochastic model in regulation as, there is, of course, no “correct” model (all are approximations to reality) and there is much legitimate debate about which models are the most appropriate for different purposes.

### *Valuation of assets*

There are various methods of valuing assets. The important point is to ensure that the interest rates which underlie the valuation of assets and liabilities are consistent. This consistency can, theoretically, be achieved using any of the three methods described below.

#### *Market value*

Using the market value of the assets in the valuation has an attraction because most market participants would regard the market value of the assets as being, in some sense, an objective value. It represents the real worth of the assets. This is true but the argument loses some force when it is realised that using an objective method of valuing the assets does not reduce the subjectivity of the valuation process. The liabilities should be valued using the rate of interest it is expected to be earned on the assets over the term of the liabilities (allowing margins for prudence). If the market value of the assets is used, this will have to be imputed from that market value. This is easy for some securities (such as fixed interest bonds) but less easy for other types of asset. It should also be appreciated that, in the event of a wind-up, the assets could not necessarily be realised for their market value (although most solvency valuations would assume that the company was to continue as a going concern). For some types of asset, the market value is not readily ascertainable (for example property). In these cases, subjective valuations have to be used.

One problem of using market valuations for assets is that they are volatile. However, many actuaries would argue that volatility is inherent in investment markets and values should be used which are objective and reflect real life conditions. Volatility does not necessarily cause problems if the rate of interest implied by the asset values (and therefore used to value the liabilities) is adjusted. A combination of asset market values and a passive approach to determining the rate of interest for valuing the liabilities could produce an unrealistic valuation result and this approach should not be encouraged by regulation. It should be mentioned that life insurers are interested in the stream of income produced by long-term assets and not just in their market value. This could make a discounted cash flow approach appropriate.

#### *Discounted cash flow valuation*

A discounted cash flow valuation of the assets would involve estimating their future income stream and valuing the income stream at an appropriate rate of interest. The rate of interest would not necessarily be the rate of interest which would be implied by market values (otherwise this approach would not give an answer any different from market values). The rate of interest used should be the rate of interest used to value the liabilities and this should be equivalent to the rate of interest it is expected that the assets will earn over the period of the liabilities. This is a subjective concept. The main disadvantages of using a discounted cash flow approach are that it is often not understood by those who are not involved with the valuation process; it is also sensitive to the assumptions used (just as a market valuation is sensitive to changes in market values).

#### *Book values*

A book value approach to asset valuation involves valuing the assets at the price at which they were bought. Book values can be modified, for example by allowing some writing-up to reflect capital gains or if the lower of book and market value is used. The major disadvantage of using book values is that they are unrealistic. Their use can therefore give a false picture of the state of the company. On the other hand, where a smooth emergence of surplus is required, book values can be used in conjunction with a net premium valuation of liabilities to achieve the required effect. For valuations for statutory purposes, book values can also be regarded as providing a conservative approach. However, it is arguable that it would be better to use realistic values and add in margins for prudence.

## ***II.II Pension Funds***

### *Valuation of liabilities*

The concept of solvency is different for a pension fund as compared with a life insurance company. Many of the benefits paid by the fund are discretionary or are not guaranteed by contract and they are funded gradually over time; if the fund becomes underfunded, the employer can increase the future contribution rate. Before determining the basis on which liabilities should be valued, one has to determine the purpose of the solvency valuation. In the last section, reference was made to valuations for funding, accounting, taxation and supervisory reasons. We will concentrate mainly on supervisory valuations but make some reference to accounting and funding frameworks.

### Benefit assumptions

Different benefit assumptions can be made and this is related to the issue that different funding methods can be used. It is common in valuations for funding purposes to use what is known as the projected unit credit method. Here, the actuarial liability for all active members is calculated taking into account all expected future decrements. Pensionable pay is projected, according to certain assumptions, until the expected date of decrement (death, leaving or retirement).

However, whilst this is appropriate for a funding valuation, a solvency valuation should probably be more restricted in terms of the benefits it values. The second objective that we have identified, for pension fund solvency regulation, is the protection of third parties. In this case the protection is best afforded by ensuring not that the full benefits of the scheme are necessarily secured but that a minimum level of benefits is secured which are regarded as fundamental to the scheme or would be available from state support if the scheme failed. For example, the benefits valued for members for a solvency valuation could be those which would be available from the state scheme alternative to the private scheme. If this approach is taken, it would be reasonable not to produce a best estimate but to ensure proper margins for prudence in the basis (see below). It would also be reasonable to specify the basis upon which the valuation takes place.

The UK in its recent Pension's Act 1995 reforms has deviated from those principles. Conservative interest rate assumptions are not used and, although the benefits valued are not the full benefits of the scheme, those valued are generally greater than the individual would get from the state scheme. However, the legislation was not justified according to third party effects but according to a desire to protect individual members. A reasonable approach here would be to value the benefits to which members are entitled, allowing for revaluation at whatever rate is required by the scheme rules or by law.

If valuations are carried out for the provision of solvency information to members and for the protection of individual members, it would be reasonable to use slightly different principles. The members do not wish to know just whether a basic level of benefits is absolutely secure but whether the benefits they are expect are as secure as they could reasonably expect. If a valuation is done of realistic benefits on a realistic basis, for publication to members, then it should be appreciated that the basis would contain many subjective elements, including expected future salary increases (if a funding method such as projected unit credit were used). The main requirement should be that the basis used by the actuary should be published. As has been mentioned, the UK has recently revised its pensions solvency regulation. The liability valuation assumptions are less conservative than best estimates, but more conservative than those suggested above for regulation to protect third parties. The basis would therefore fall in between the aims of protecting third parties and ensuring that all expected benefits are fully funded for members. However, the latter is not the aim of the legislation and other valuation information should also be published for members.

## Interest assumptions

The interest rate assumptions are the other major assumption in the valuation of pension funds. One can distinguish two areas where there may be differences between the type of interest assumptions used. Firstly, one can distinguish between prudent and best estimate rates; secondly one can distinguish between interest assumptions gained from the a consideration of the market value of assets and those used in an assessed valuation of the assets.

In a valuation for the regulation of solvency it would be reasonable to use a prudent interest rate to value a level of benefits which is less than the level expected by members. The use of a prudent interest rate to value the level of benefits expected by members would give unnecessary margins and lead to the fund producing consistent surpluses. The UK Pensions Act 1995 has a hybrid situation with the valuation rate of interest, just as it does with the determination of the benefits to be valued. Expected returns from equities are used to discount those benefits which have accrued to active members. This is reasonable given the fundamental difference between a pension fund and insurance valuation: the former merely tries to develop an optimal pattern of funding benefits whereas the latter gives contractual guarantees which should be met from existing assets. Expected returns from bonds (index-linked bonds where pensions are linked to inflation) are used to value benefits close to or already in payment. A mixture of the two different types of interest rates is used as members approach retirement. Where valuations are required to provide information for members, it would be reasonable to use best estimate interest rates to value best estimate benefits. This is likely to be the expected return from the assets held in the portfolio. In the UK, the assets are likely to be equity assets.

Some would argue that risk-free rates of interest should always be used for valuing pension fund liabilities. The argument is that the benefits can only be assumed to be safe and therefore the fund solvent if the present value of the benefits at risk free interest rates is less than the value of the assets. Index-linked bond returns may be used, where index-linked bonds exist, to discount those liabilities which are linked to inflation or to real variables such as salaries. This approach underlies FAS 87. The author's own view is that this misunderstands the process of valuation for funding purposes or for providing information to members regarding the solvency of the scheme.

## *Valuation of assets*

Although a book value basis could be used to value assets, for most purposes, either market values or discounted values would be used.

## Market value

The arguments for using a market valuation of assets are similar to those explained above for life insurance valuations. In particular, they are objective and understandable for those using the valuations. On the other hand they are volatile and, if there is a mismatch between assets and liabilities, the expected return from the market value of assets may not be appropriate to be used over the life of the liabilities. Market values do not remove the subjective element of the valuation process because the expected return from the asset portfolio has to be estimated. For all assets other than index-linked and conventional bonds, this is subjective. There is a movement within the UK and within the US, partly because of regulatory changes, towards the use of market values. Where a valuation for solvency purposes is carried out which does not value all the benefits of the scheme and where an objective approach is required, it is probably best to use market values of assets in conjunction with the long-term returns from bonds, both of these being broadly objective.

A fundamental decision has to be taken when market values of assets are used together with the expected returns from equities to discount liabilities. That is, if market values have changed, does the solvency position of the pension fund change or has there been a revaluation of assets so that the implicit discount

rate in the market has changed? This is a subjective matter. The Minimum Funding Requirement basis, under UK law, implicitly assumes that, whenever equity values change, the implicit discount rate that the market is using to value equities changes.

#### Discounted value of assets

The alternative approach is to estimate the long-term income stream from assets and discount assets and liabilities at the same rate of interest. This is the approach which has traditionally been used in funding valuations in the UK. It is also the basis upon which the solvency valuation for tax purposes is undertaken. As far as bonds are concerned, the income stream is known with certainty (similarly the real income stream is known from index-linked bonds). However, income streams from equity and property have to be estimated. If a valuation is carried out to provide information to members, it would be sufficient to use this approach but for the assumptions to be published. If the valuation is to be carried out for statutory purposes, the assumptions may need to be laid down in regulations. This is done in the UK, in respect of valuations undertaken for tax purposes. One of the advantages of the discounted value approach is that it does make the actuary consider explicitly the long-term income earning power of the assets.

#### *Other issues*

It is important to make the distinction between liabilities which are linked in some way to inflation (or real variables such as salaries) and those which are fixed in nominal terms. Some liabilities may be indexed to prices or wages with an upper limit. Davies (1991) provides a breakdown by country of different types of liabilities.

Where liabilities are denominated according to real variables, they should be matched by real assets (such as index-linked bonds and equities). Discounting should then be done with variables expressed in real terms (or the same inflation assumptions used for assets and liabilities). If the valuation method for regulatory purposes uses discount rates from conventional bonds this could encourage a mismatch of assets and liabilities or give misleading values for the value of liabilities. There is a danger that supervisory authorities, in an attempt to use objective quantities for supervisory purposes (such as conventional bond yields) may create a valuation framework which is fundamentally wrong, particularly if the inflation assumption used to project the liabilities is not related to the fixed interest bond yields. It is better for supervisory authorities to allow flexibility and actuarial discretion but encourage disclosure than try to impose rigid and inappropriate over-legalistic frameworks. Pension fund valuations are subjective and no amount of regulation can change that.

The methodology of calculating present values and looking at the solvency position of a pension fund by considering the net present value of the assets less liabilities (or the ratio of the present values) was developed before computer technology was developed. It perhaps gives a spurious air of objectivity. It is not only the case that the assumptions which underlie the valuation are subjective and thus difficult to lay down in regulations but the key feature of a pension fund is the projected variability of the solvency position. Using modern computing techniques, actuaries will perform stochastic asset/liability projections which will try to give an indication of the variability of the funding position of a pension fund. The models that are used to make projections are both highly subjective and require judgement in their use and in the interpretation of the results. The application of these techniques is expensive and smaller pension funds may not use them. However their use is increasingly common in the UK and US. They may also be used to project benefits, and the probability distribution of benefits in defined contribution schemes. Although such schemes do not technically have a solvency position and their regulation is normally defined in terms of a minimum contribution rate, the anticipated benefits position can be investigated, at least in theory.

In some countries (notably Germany) book reserving is a common way of funding pensions. This involves a balance sheet item being used for the value of future pension liabilities. There is no reason, in principle, why book reserves need to be calculated differently from the reserves for schemes that have independently

invested funds. They do, however, give rise to other issues, such as the security of the fund and the problems that arise if the sponsoring company becomes bankrupt.

#### *Asset and liability bases: Compatibility*

Having considered the types of asset and liability valuation, for both pension funds and life insurance companies, we have to look at the important issue of compatibility of the asset and liability valuation basis. The key principle behind a present value calculation is the theory that, if the present values of the assets and liabilities are equal, the assets will be just sufficient to accumulate, at the assumed interest rates, to provide the liabilities as they become due. Many would argue that this means that a realistic asset value must be used, together with the interest rate which underlies that realistic value of the assets. This is not the only approach to ensuring compatibility, although it is a sound approach. If a value for the assets is used other than market value, the rate of interest used to value the liabilities should be that which is expected to be earned on the assessed asset value. Many actuaries have suggested that only market asset values should be used as they are objective. However, this point of view, whilst not invalid, might be unduly restrictive. It also does not reduce the subjective nature of the valuation process, as the actuary has to determine the implicit rate of interest at which the market appears to be valuing the assets held.

Some EU countries suggest that the basis for valuing liabilities should not be higher than that used to calculate premiums (see Wilkie 1992). Indeed, the European Parliament seemed inclined to suggest that this requirement was enshrined in the Third Life Directive. This sort of provision can be very damaging and can lead to a loss of compatibility between asset and liability bases.

### ***II.III Valuation of liabilities: Bases and key assumptions***

The issues in the valuation of liabilities have been covered above. Here we look at the assumptions under different bases.

#### *Life insurance*

##### Interest

In the UK, regulations have been developed which are compatible with EU law. The reliable yield on the assets is used to value liabilities. In fact, this involves using the gross redemption yield on fixed interest assets (reduced for risk in the case of corporate bonds) and the running yield from equities and property. The yields are reduced slightly (to 97.5 per cent), presumably to allow margins for prudence. Because the running yield from equities and property is lower than the redemption yield from gilts, a switch from equities into gilts allows the insurance company to increase the valuation rate of interest for the liabilities. The basis takes no account of future growth from equities or property. It may be more sensible to allow the gilt redemption yield to be used regardless of the assets used to back contracts. If the assets held are not gilts, any capital value risk can be taken into account in resilience testing (see below). The UK regulations have been changed to allow insurance companies to use the earnings yield from equities when computing the valuation rate of interest. However, the specific details of the regulation are so complex, it is unlikely that most life insurance companies will use this new method until computer systems are updated.

Index-linked contracts should be valued using an appropriate real rate of interest. If they exist, real rates of return from index-linked government bonds of the appropriate term should be used.

##### Mortality and disability

With regard to mortality and disability assumptions, these should be prudent and based on country experience. However, it would be inappropriate to impose particular mortality or disability tables because experience will deviate from office to office, from area to area and from policy type to policy type. The

insurance company should make its own investigations and make adjustments to published tables. Mortality improvements should be allowed for in annuity products but not in respect of insurance products.

## Expenses

Prudent allowance should be made for future expenses. This allowance should include the effects of future inflation and the inflation assumption should be compatible with the interest rate assumption. For example, if interest rates have increased as a result of an increase in the market's expected rate of future inflation, higher expected inflation should be allowed for when projecting expenses. The expenses used should not be those assumed in the premium basis but projected expenses on a realistic basis.

## Asset valuation

It would be reasonable to value assets at market value if the above assumptions are used to value liabilities. Quoted assets should be valued at their quoted value and unquoted assets should be valued using accepted techniques. For example property should be valued by a professional valuer, using accepted valuation principles.

UK regulations do not direct asset allocation. To prevent imprudent investment policy, there are certain restrictions on the assets that can be taken into the valuation. These restrictions do not inhibit the freedom of the insurance company but ensure proper diversification of assets. For example, if more than a given percentage of the fund is invested in a particular asset issued by a particular company, the additional percentage cannot be taken into account in the asset valuation.

## *Pension funds*

### Liability valuation

The crucial assumption here is the rate of salary growth. As has been explained above, this should not necessarily be the full expected rate, where a valuation is being carried out for statutory purposes.

According to Davis (1997) only the benefit obligation accumulated to date is used for solvency valuations in the US. Here there is effectively no allowance either for inflation or salary increases.

In the UK and the Netherlands, some indexation of benefits to salaries is required in respect of members' obligations accumulated to date. To some extent, benefits may be required to be indexed after retirement in Germany and Sweden (and recently in the UK for further accrued benefits). In general, the author believes that the most appropriate benefit increase assumptions are those which are required either by law or under the scheme rules, for deferred pensions which would be assigned to members if the scheme were to close.

Allowance should only be made for the indexation of pensions currently in payment if it is required by scheme rules or by law. Allowance should be made for increases in deferred pensions as required by law or under the scheme rules. Allowance should be made for expenses and inflationary increases in expenses. Specific figures which may be appropriate for inflation and salary inflation assumptions are given below.

### Interest

If a market value approach to the valuation of assets is used and benefits are projected for salary increases, it would be reasonable to use long-term expected equity returns to value the liabilities. This could be the return from conventional gilts plus 2 per cent or 3 per cent. If benefits are not projected for future salary increases, it would be reasonable to use the long-term gilt yield for valuing the liabilities, to allow margins for prudence. Index-linked bond yields could be used to discount payments which are linked to inflation.

Where an inflation assumption is needed, it would be reasonable to use the difference between the return from conventional gilts and the real return from index-linked gilts.

#### Valuation of assets

Assets could be taken at market value. If they are valued using discounted cash flow techniques, assumptions are necessary for future dividend increases and the interest rate at which future expected payments from assets are discounted. It is reasonable to assume that dividends will grow at between 0 and 1 per cent above inflation, although particular country history should be studied as different assumptions may be appropriate in different countries, depending on the level of retentions.

Asset and liability cash flows should be valued at the same rate of interest used to value the liabilities if a discounted cash flow approach to asset valuation is used. If future salary increases are being projected, the precise interest rate assumption should not matter too much, as long as it is consistent with the future salary increase projection. For example, an interest rate of 10% could be used to discount asset and liability cash flows and salary increases could be assumed to be 8%. If an interest rate of 10% is used, it would be reasonable to assume an inflation rate of 5%, giving total dividend growth of 5% to 6%.

#### Demographic assumptions

In some cases, demographic assumptions do not matter because there is no strain where a member leaves a scheme. If this is not the case, country mortality and disability tables should be used, adapted for trends which relate specifically to pension funds and the experience of the particular fund being valued. Assumptions will be needed for: mortality, ill health and rates of withdrawal.

### ***II.IV Safety margins/Capital adequacy***

#### *Safety margins*

Whatever method of valuation is used and whatever the assumptions, it is important that the solvency of an insurance company is secured against and tested for its resilience to changes in financial conditions. We can identify three main methods approach. One is to require the holding of solvency margins, the second is to use resilience testing or dynamic solvency testing and the third is to hold risk-based capital. However, it should be noted that it would not be sensible to add margin upon margin in valuation regulation, as this would lead insurance companies to hold too much capital. For example, if a prudent valuation basis is used and then there are solvency margins and then the company has to ensure that it has adequate solvency margins in the face of changes in financial conditions, there may be too many margins.

#### *Solvency margins*

A valuation ensures that an insurance company is solvent on a particular date, under particular assumptions. However, financial conditions may change. Whilst it may be possible to control the effects of some changes in financial conditions, it is prudent to hold solvency margins. In the UK and throughout most of the EU, the following solvency margin requirements are in force:

#### **for non-linked business**

4 per cent of gross reserves

0.3 per cent of gross capital at risk (where greater than zero)

the 0.3 per cent figure can be reduced under certain circumstances and the figures can be reduced to allow for reinsurance

In general terms it could be said that the 4 per cent figure is to protect against investment risk and the 0.3% figure is designed to protect against mortality risk.

### **for linked business**

the 4% figure above is reduced to 1 per cent or 0 per cent if the company does not carry the investment risk. Whether the reduction is to 1 per cent or 0 per cent depends on the guarantees regarding expenses and the term of the contract.

#### *Risk-based capital*

The calculation of risk-based capital is an attempt to determine how much, in addition to reserves, a life office should hold to safely meet its liabilities. Parallels can be drawn between risk-based capital and solvency margins and between risk based capital and value at risk, used in banking regulation. A solvency margin is a kind of fixed risk-based capital, calculated on an arbitrary basis without reference to stochastic parameters. Value at risk attempts to determine the maximum amount of capital which could be lost in the banking business with a particular probability. Risk-based capital could be calculated as the value at risk (so that the probability of insolvency is limited to that pre-determined probability). Like value at risk, risk-based capital should be determined using stochastic parameters so that it is varied to reflect the risk that the business faces. Thus a business which has mismatched its investment policy will face a higher risk-based capital requirement than one which is well matched. There are differences between risk-based capital and value at risk. Firstly, risk-based capital is a more generalised concept and can be calculated with reference to a number of different approaches to measuring risk. Secondly, whereas value at risk indicates the amount that could be lost with a pre-determined probability, risk-based capital indicates the capital requirement. These numbers will not necessarily be the same.

#### *Resilience testing*

Risk based capital or solvency margins can be seen as a way of ensuring that there is a “buffer” against changes in financial or demographic conditions. Resilience testing is a method of testing the effects of changes in financial conditions: it is an application of stress testing, often used in banks. The Institute and Faculty of Actuaries, in the UK, requires that actuaries carry out some form of testing but leaves the basis to the professional judgement of the actuary. No basis is set by regulation, although the Government Actuary’s Department provides guidance. This guidance relates to changes in gilt yields and equity values. A rise in gilt yields will adversely affect the office if its assets are generally longer than its liabilities. A fall in gilt yields will adversely affect an office if its liabilities are generally longer than its assets. A fall in equity values adversely affects an office if equities are used to back contracts where bonuses cannot be adjusted quickly to compensate for falls in equity values. In practice, for most offices, the most worrying scenario would be a fall in gilt yields and a fall in equity values. In practice, this combination of circumstances rarely arises to the extent to which actuaries tend to test resilience (although the individual circumstances could arise). It could be argued that more work could be done to test resilience scenario combinations to ensure that those which are used are likely to happen in extreme conditions.

#### *Dynamic solvency testing*

Whereas, in resilience testing, valuations are reworked according to different financial and possibly demographic assumptions, dynamic solvency testing takes a somewhat more sophisticated approach. Dynamic solvency testing makes a model office projection of the financial position of the life office. It is therefore a forward-looking projection. In the first place, cash flow projections of the office can be undertaken on the basis of prudent assumptions or best estimates of the future. These projections can be more illuminating than a traditional valuation because they show the possible future experience of the office in greater detail. Single parameters can be changed (this would be known as sensitivity testing) or combinations of parameters can be changed (known as scenario testing). The parameters which could be

changed could include: investment returns, future investment yields, expenses, inflation, future new business, bonus and mortality. As with resilience testing, it is important to ensure that the combination of changes is sensible. For example, it would not be sensible to combine a very big increase in gilt yields with a big fall in the inflation assumption, a fall in future equity dividend growth and a rise in bonuses. It is a matter for debate whether the regulation should prescribe the particular scenarios that should be used. It is the author's view that it is reasonable for the profession to require that dynamic solvency testing be carried out by an actuary but the scenarios should not be specified in detail.

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