



Keep your lid on!

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**A Financial Analyst's View
of the
Cost and Valuation of DB Pension Provision**

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DECEMBER 2012
REVISED: JANUARY 2013



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A system is a big black box
Of which we can't unlock the locks,
And what we can find out about
Is what goes in and what comes out.
Perceiving input-output pairs,
Related by parameters,
Permits us, sometimes, to relate
An input, output and a state.
If this relation's good and stable
Then to predict we may be able,
But if this fails us – Heaven forbid!
We'll be compelled to force the lid!

Kenneth Boulding²

Acknowledgements: This paper simply could not have been written without the many discussions with, and insights of, Kris Wulpeputte. It has also benefitted greatly from comments and discussions with many other people. Among these are: Pat Burns, Iain Clacher, Jon Danielsson, Kenneth Donaldson, Robin Ellison, Chris Golden, Robert Hingley, Drago Indjic, Thomas Klepsch, Paul Klumpes, Dennis Leech, Trevor Llanwarne, Michael Mainelli, David Pitt-Watson, Derek Scott, Samuel Sender, Jon and Robert Spain, Henry Tapper, Janice Turner, Martin Veasey, Colin Wilson, Tim Webb, Juan Yermo and a number of others who were or wished to remain anonymous. We are deeply indebted. Any errors and omissions, though, remain the responsibility of the authors.

² "General systems as a point of view" in Views on General Systems Theory, Ed. M Mesarovic, Proceedings of the Second Systems Symposium, April 1963, John Wiley, 1964

Abstract

Different ways have been proposed and used to evaluate the state of pension funds for reporting and management purposes.

In this paper we introduce the Internal Growth Rate (IGR) of a pension system. We argue that discounting at the IGR meets reporting objectives. Moreover, if discounting at a single rate is used as a valuation mechanism for the sake of clarity and comparability, then the IGR is the only rate satisfying these requirements. The many alternatives in use (risk free rate, Gilts, expected asset return, ...) lead to over or under estimates, bias and volatility. The main reason for this is that they are exogenous to the system and do not reflect scheme arrangements and dynamics. The IGR avoids these by considering an element of the system which is overlooked in current arrangements, contributions. These are the inputs to the process which delivers the output, pensions. The IGR enables accurate and consistent evaluation of the state of the pension system when applied to the income and expense projections.

The added benefits of evaluation at the IGR include stability of reporting and elimination of spurious external effects in pension fund reporting. In this way it will be possible to avoid unnecessary and costly interventions in scheme management, which are purely aimed at improving reporting under current (misleading) standards rather than on improving fund dynamics.

The estimate of fund IGR may incorporate the entire fund design, including funding arrangements with sponsors and the use of insurance and guarantees. This is not possible using many currently-used methods, for example, a market value based approach. The IGR can be used to assess and compare pension system performance, and to measure the impact of management interventions such as liability driven investment and closure of schemes to new participants. It also sheds new light on the debate on the affordability of defined benefit (DB) schemes.

The valuation methods for pension funds have been highly contentious. The IGR and proposed method inform several aspects of those debates.

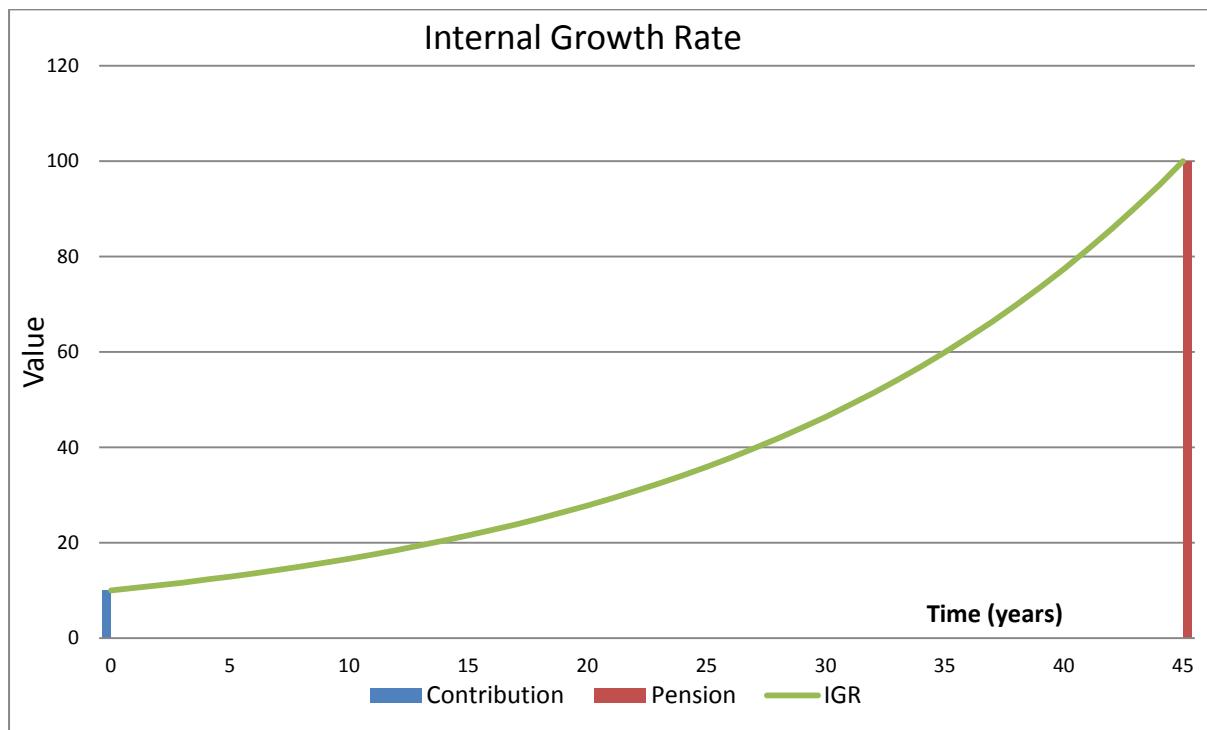
The Innovation

Viewed from a systems perspective, the evaluation of the current state of a pension fund is a matter of considering the inputs (contributions) and the desired outputs (pensions). With contributions and pensions separated in time, it is rational to consider interim states. The valuations can inform observers as to the sufficiency of the arrangements in place, and interventions made if necessary or desirable.

For sustainability and stability of the system, this amounts to no more than requiring that the **present value of contributions must equal the present value of the promised pensions³**. This determines the internal growth rate (IGR) for the system or fund. The IGR is unique and is fully determined by the terms of the award. Formally, this is simply a fair value condition.

To estimate the IGR, we utilise the total contributions made, the total pension benefits expected and the time separating these. Estimation of the IGR value for a scheme may be conducted in a number of ways. Figure 1 below illustrates the simplest situation: a single contribution and a lump-sum pension paid 45 years later.

Figure 1: Illustration of the IGR concept



The IGR shows us exactly what we should expect the state of the system to be at all interim times. It is fixed and remains so, in the absence of revisions to either or all of the inputs, the contributions made, the amount of the pensions payable or the time separating these payments. The IGR is the rate of investment return to the beneficiary; equivalently, in a book-reserve arrangement it is the

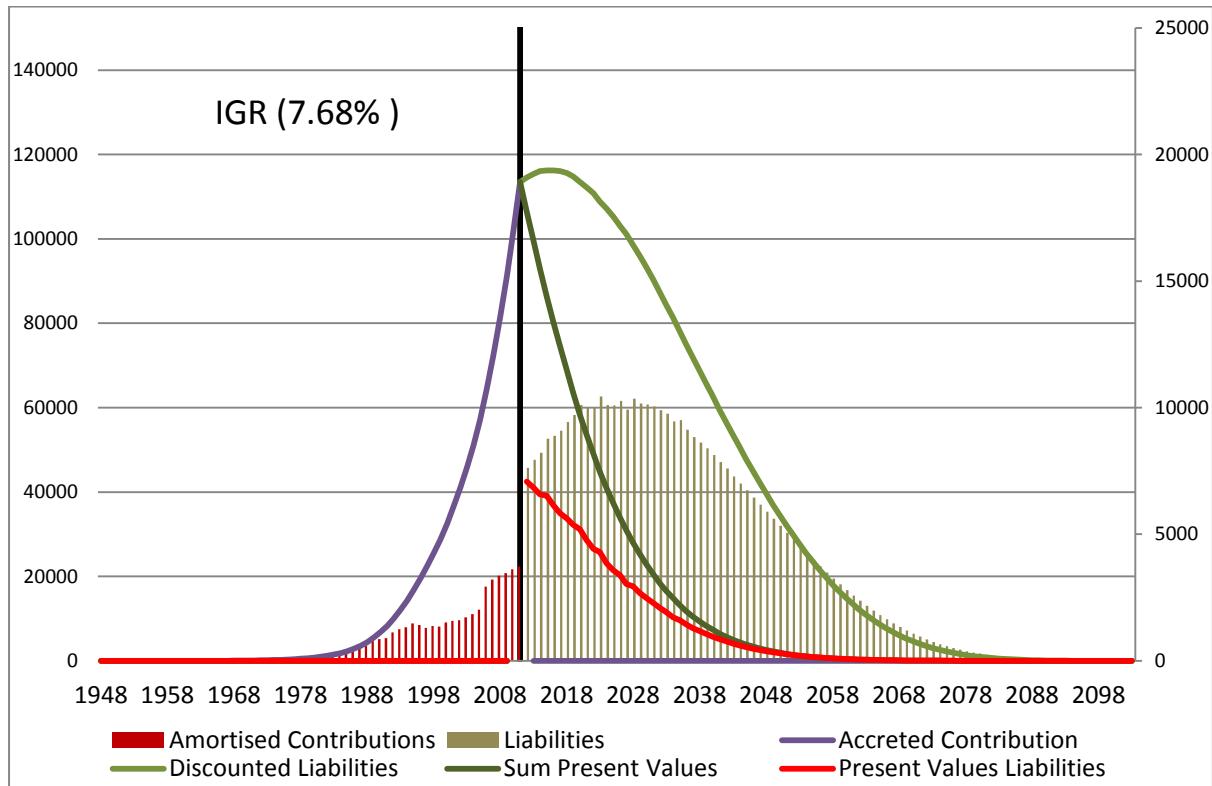
³ It is also not necessary to hold that the contribution must equal present value relation as an absolute truth; it is sufficient simply to justify it as an analytic convenience.

cost of the contributed capital to the sponsor employer. It is not necessary that the contribution should consist of an actual cash payment; in a book-reserve arrangement, we can impute the contribution from the lowering of member wages or equivalently the reduced working capital requirements of the sponsor employer.

In later sections, we examine the variability of these inputs and the resultant variability of the IGR. We will distinguish between errors of precision in current estimates and the variability of these terms over time. The multi-year, multiple contribution nature of schemes and the sequential payment of pensions introduces some complexity that we also discuss and illustrate later. The IGR does not vary greatly from year to year, as we have only marginal adjustments to contributions received and the pensions remaining payable. This is far lower than variations due to changing exogenous market-derived discount rates.

Next, we illustrate the most elementary application in figure 2. Here the expected pension outflows over time are shown together with the contributions received.

Figure 2: The Internal Growth Rate (IGR) applied to an illustrative scheme



The IGR in this illustration is simply the common rate at which the present value of liabilities is equal to the present (or accrued) value of contributions. It has a value of 7.68%. The IGR calculated in this manner is the correct weighted average cost of pension provision. This is not to say that pension awards are always priced correctly, merely that this is the correct cost given the contributions made and benefits awarded. Income and expense evaluated at this cost of provision discount rate will return an accurate view of pension funding status.

The immediate objective is to estimate or measure the state of the pension scheme at a particular date, as indicated in figure 2 above. If we are to measure and compare things, it is essential to use

the same measure for both. It is evident that discount rates and equity market prices do not satisfy this requirement⁴. Indeed, diversification between bonds and equities is a central tenet of prudent investment management policy – this would be pointless if these measures were identical.

It is also helpful if the things we wish to measure are similar in nature; this is apples with apples, and trees with trees. Assets and their income streams are not similar; one is a stock and the other a flow. Accordingly, we will later illustrate the projection of both income and expense, and their comparison, rather than asset and liability aggregate values.

A further desirable property of a measure is for it to be invariant over time and location; a ton is considered a ton no matter when or where it is used. It is evident that the current valuation standards also fail this test. Market prices and yields can and do vary for highly specific reasons, such as the recent quantitative easing in the gilt market. Prices may be observable, but their driving factors are not. If we are to experience change in our measure⁵, it is important that all change should reflect, or be rooted in, some inherent identifiable real change in relevant factors. The ton weight will vary marginally with gravity across geographical locations, but in predictable and correctible fashion. It is a locally valid comparator even in this distorted condition. The IGR will vary only if change occurs with respect to contributions, pensions payable or their timing.

In this paper, we advocate a method for comparison that eliminates the problems with current standards; a method that removes all dependence upon market prices and rates, by utilising the IGR. It is unbiased and volatile only to the extent that real change occurs. This volatility is far less than under current standards and practices. We illustrate this method and compare the results with those derived under current standards. In addition, we will consider several other proposed methods advocated elsewhere.

The method is:

- 1) **Project Liability Expense Cash Flows**
- 2) **Project Asset Income Cash Flows**
- 3) **Compare these at the Internal Growth Rate integral to the awards**

Liability projection is standard actuarial routine in scheme valuation; we do not propose any change. In order to achieve consistency in comparison, we compare the projected cash flows from assets, rather than current asset values derived from market prices⁶, with the pension liability projections. The projection of asset cash flows is well established in the econometric literature. However, we do later consider some issues associated with cash flow projection. The comparison of cash flows for both assets and liabilities also mitigates a technical issue which might otherwise be relevant; the question of the convexity or concavity of these payment sequences⁷. In Figure 3 we show, the cash flow projections of income and expense for the illustrative scheme.

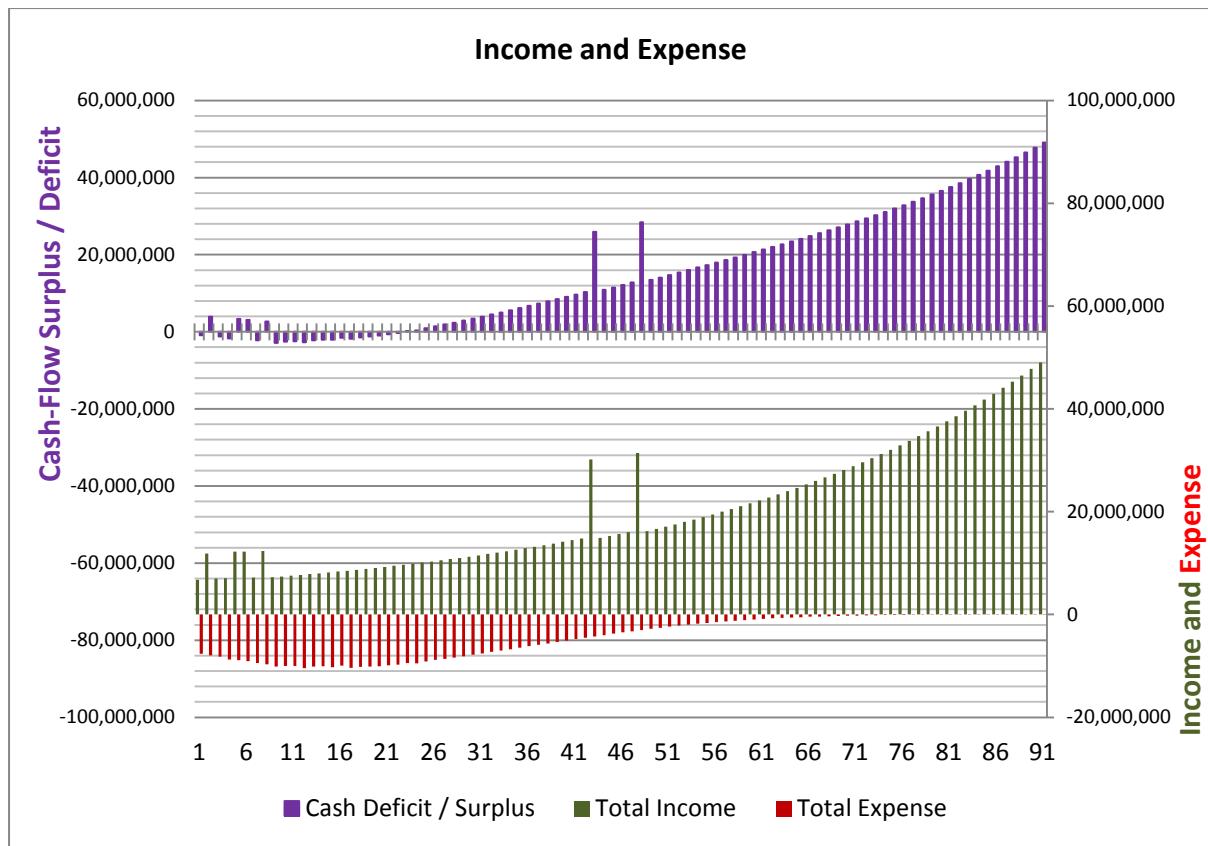
Figure 3: Income and Expense

⁴ This is referred to as ‘mixed attribute’ accounting. This is a source of bias and volatility in results reported.

⁵ We are using the term measure to indicate the mapping function. In this case, a mapping that reduces all future cash flows to a single, current point value.

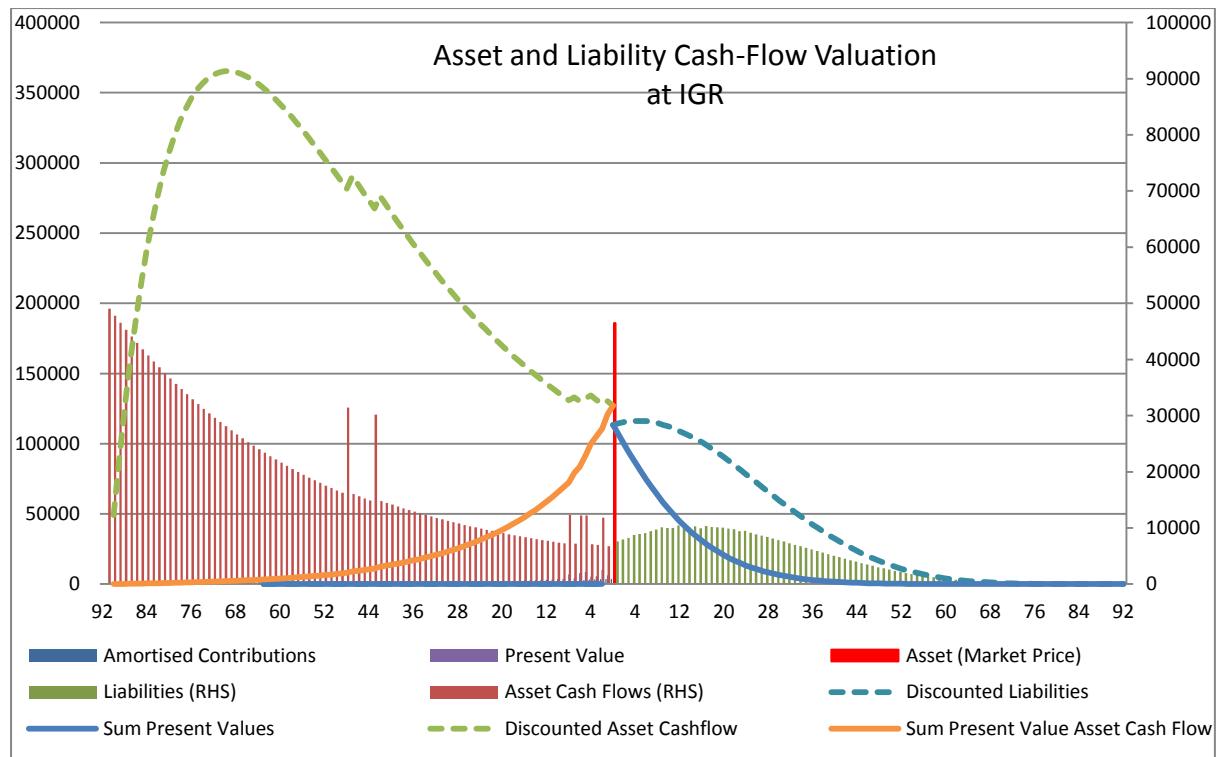
⁶ The use of market prices may serve to inform other aspects of scheme analysis, as we will demonstrate later.

⁷ This is a variant of Jensen’s inequality that $E(F(x)) \neq F(E(x))$. It is discussed more fully later.



When these cash flows are evaluated at the IGR, the valuation result is unbiased. In practice, it also exhibits great stability in valuation results. This is expected of a process where only marginal change occurs. Application of the proposed IGR method to the cash flows of the illustrative scheme is shown in Figure 4.

Figure 4: Valuation at the IGR of asset and liability cash flows for the illustrative scheme



For clarity of exposition, this figure shows asset cash flows to the left of the valuation date and liabilities to the right. Though we will return to this later, this figure shows that the value of asset cash flows in defeasing or offsetting liabilities is markedly lower than their market price, but still more than adequate to discharge all liabilities. The discounted cash flow approach (dashed lines) indicates that, ceteris paribus, the scheme will have no future solvency problems.

This approach relates to the input-output methodology outlined in Boulding's earlier rhyme. The inputs are total contributions and the outputs total pensions, which are related by a technology, the IGR. The parameters of this technology are determined by the timing of scheme members when making their contributions and drawing their pensions, and by the respective size of these flows. This allows us to determine uniquely and accurately the current state, the funding status, by comparison of the cash flows of income and expense at the IGR or cost of award. This is entirely an endogenous process, not reliant in any way upon exogenous variables.

The efficiency of any 'new' accounting should be evaluated by its logical aspects – if it provides better economic information in different circumstances and by its potential to reduce volatility in the ratio of assets over liabilities, it is to be preferred. The proposal here is that a correct method of pension scheme evaluation should be adopted which meets these requirements. It involves the projection of cash flows, of income and expense, and their comparison at the internal growth rate implicit in the terms of their award, including any subsequent revisions made at or before the valuation date. This is both accurate, and therefore economically informative, and volatile only to the extent that the scheme terms and conditions and trustees expectations of determinant parameters make it so, making it useful in predictive and management roles.

Objective and Preamble

The primary objective of this paper is to present, in some detail, a method by which pension scheme assets and liabilities may be accurately and correctly valued. From the perspective of an analyst, a method of valuation that is unbiased, and volatile only in reflection of change to the real circumstances of the scheme, is a sine qua non. A secondary objective is to inform the debates surrounding proposals for smoothing, including the forthcoming DWP⁸ consultation. This extends to questions of member security, insolvency and optimal funding.

While it is often appropriate to use different methods according to the perspective taken, or purpose of the analysis, it is important, and often critical, to have an accurate baseline from which to gauge the extent of bias and variability in these different methods. By way of illustration, it is meaningless to operate a ‘prudent’ funding standard if we cannot establish accurately the technical best estimate of liabilities.

There are several motivations for EFFAS and Long Finance publishing this paper beyond their ‘pro bono publico’ ambition and objective of raising the standard of professional and academic financial analysis.

Firstly, the self-interest that the current standards are producing accounts that are extremely difficult to interpret, with the corrections necessary for recasting figures being both complex and often impossible to make. Pension fund management, under the current standards, exhibits related behavioural issues, which are difficult to understand and appear to an analyst to be often unwarranted and costly to all principals concerned, carrying with them harmful externalities.

We are particularly concerned that current practice leads to the ‘funding trumps covenant’ arguments, where the emphasis is misplaced. Segregated funding cannot replace the sponsor covenant in any manner that is equitable to all stakeholders.

Secondly, as the pricing and valuation debate has been extended, many have taken entrenched positions. We hope to inform that debate.

This paper was in preparation prior to the announcement of the Department of Work and Pensions’ consultation on the subject of ‘smoothing’ in pension scheme valuation. The consultation is the result of the widespread dissatisfaction with existing valuation methods, as evidenced by the calls for smoothing from, among others, the National Association of Pension Funds, The Association of Member Nominated Trustees and the Confederation of British Industry.

It will become clear that the current methods in use are incorrect and introduce spurious volatility and arbitrary bias into valuations. It is also clear that the ‘flexibility’ afforded by the Occupational Pension Schemes (Scheme Funding) Regulations 2005 cannot resolve the important issues in valuation. These regulations specify the discount rate for liabilities as:

“(4) (b) the rates of interest used to discount future payments of benefits must be chosen prudently, taking into account either or both -

(i) the yield on assets held by the scheme to fund future benefits and the anticipated future

⁸ Department of Work and Pensions

investment returns, and

(ii) the market redemption yields on government or other high-quality bonds;”

This is very similar to the UK pension accounting standard, FRS 17, which specifies: “*The average rate of return on the actual assets held by the scheme, including both income and changes in fair value but after deducting scheme expenses, expected over the remaining life of the related obligation.*” Scheme assets are valued at market prices under all regimes. It is also possible that the forthcoming FRS102 will prove relevant.

In the long term, investment performance is dominated by the cash flows generated by these investments. In the case of a conventional nominal bond this is obvious, the receipt of coupons and principal when due. Interim reinvestments of any excess cash flow from investments will have only a small and marginal effect on the total performance. Empirical studies⁹ of equities over the long term show that dividends and dividend growth are responsible for more than 98% of their total real return. Equity prices, by contrast, do little more than keep pace in real terms.

Pensions are incomes in retirement, sequences of payments, not capital sums¹⁰. For pensions, the purpose of any investment assets held is to generate income to meet and defuse pension payments. Accordingly, we should be interested in comparing the projected income receipts from investments with the pension expenses promised, rather than comparing assessed capital values. It is current practice to project the cash outflows expected as pension payments. Projecting the cash flows from investments is econometrically well-trodden ground, though not apparently widely practised by actuaries. It is notable that equity dividend sequences are an order of magnitude less volatile than equity price sequences. It is extremely difficult to project equity prices reliably and draw inferences from their subsequent performance. It is far less difficult for dividends – dividend projections are in this sense auditable, ex post.

The incentives for DB pension provision by a sponsor also merit examination. When the contributions are segregated and the scheme funded, the sponsor bears the cost of provision fully. When we require full funding at all times, at the level of technical best estimate of liabilities, there is, at best, no financial incentive for the sponsor to provide this form of remuneration and considerable disincentives, in that the sponsor is exposed to the performance and volatility of market prices and rates. This exposure is both immediate and over time; it is as much, and probably more, an artefact of the current valuation standards as endogenous scheme changes. In this context, it is, perhaps, not surprising that asset allocation strategies, such as liability driven investment, have developed to hedge or mitigate the transmission of these spurious valuation effects to the sponsor balance sheet.

When the liability estimates are inflated to reflect prudential considerations, the immediate cost of provision by the sponsor is raised, creating financial disincentives for provision. In fact, funding provision is a very ineffective manner in which to assure the security of member pensions. If a scheme is fully funded at the level of technical best estimate on the event of sponsor insolvency, the scheme has a 50% likelihood of being unable to meet liabilities on time and in full before the

⁹ Such as “Triumph of the Optimists” Dimson, Marsh and Staunton

¹⁰ We recognise that this is not true of lump sum cash commutations, but these apply only to the retiring member’s entitlement and are allowed for in the liability cash flow projections.

discharge of the final liability. It is all-important that these issues are not compounded by inappropriate accounting and valuation methods.

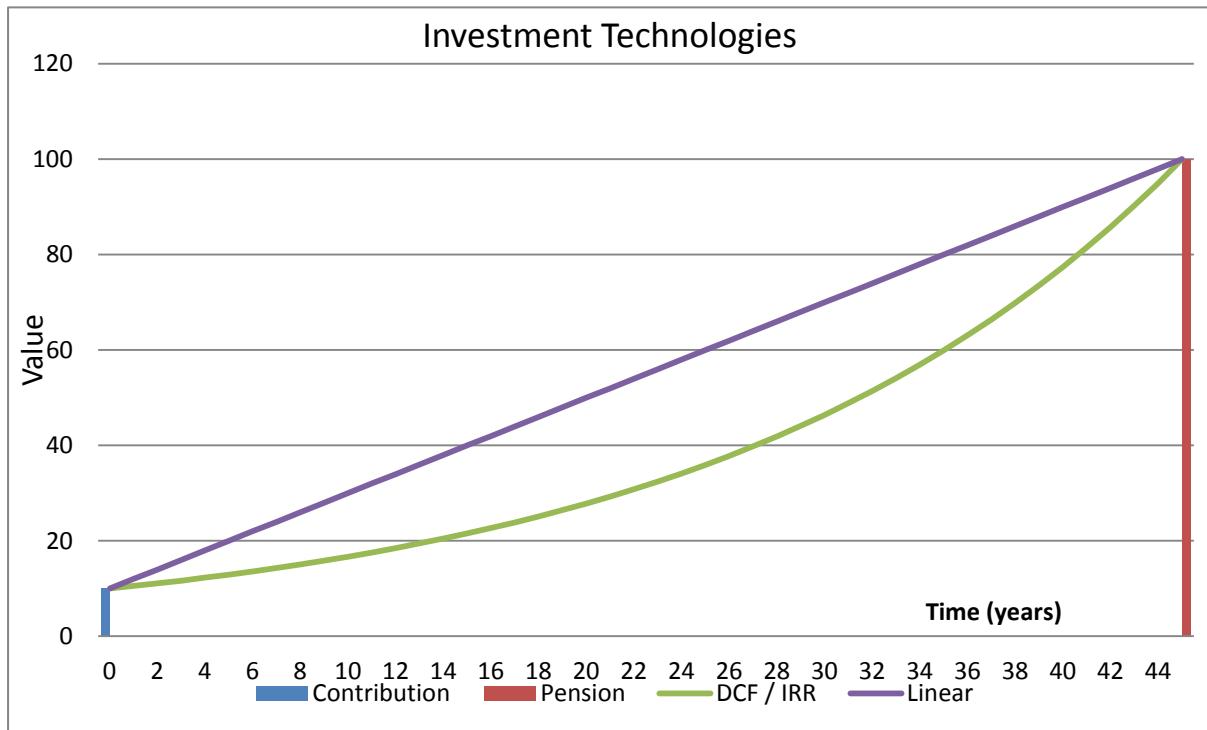
In summary, the cost of pension provision is fixed by the terms of award and falls upon the sponsor. This cost will vary only with real variables, which include changes in the assumptions determining the technical best estimate of liabilities.

A Graphical Representation

For the readers not comfortable with mathematical abstractions or the written explanations used above, we illustrate the issues and proposed solution graphically below, commencing with Figure 5. This figure shows the amount of a single contribution and a single lump sum pension benefit, together with their separation in time as previously. These uniquely determine a value for the discount function and trajectory of values between contribution and pension at intermediate times.

The proposal simply extends this basic insight to the sequences of multiple years of contributions and awarded benefits; the portfolio of pension benefits that constitute a pension scheme. We begin by considering some alternatives to discount functions of the IGR type.

Figure 5: Investment Technologies



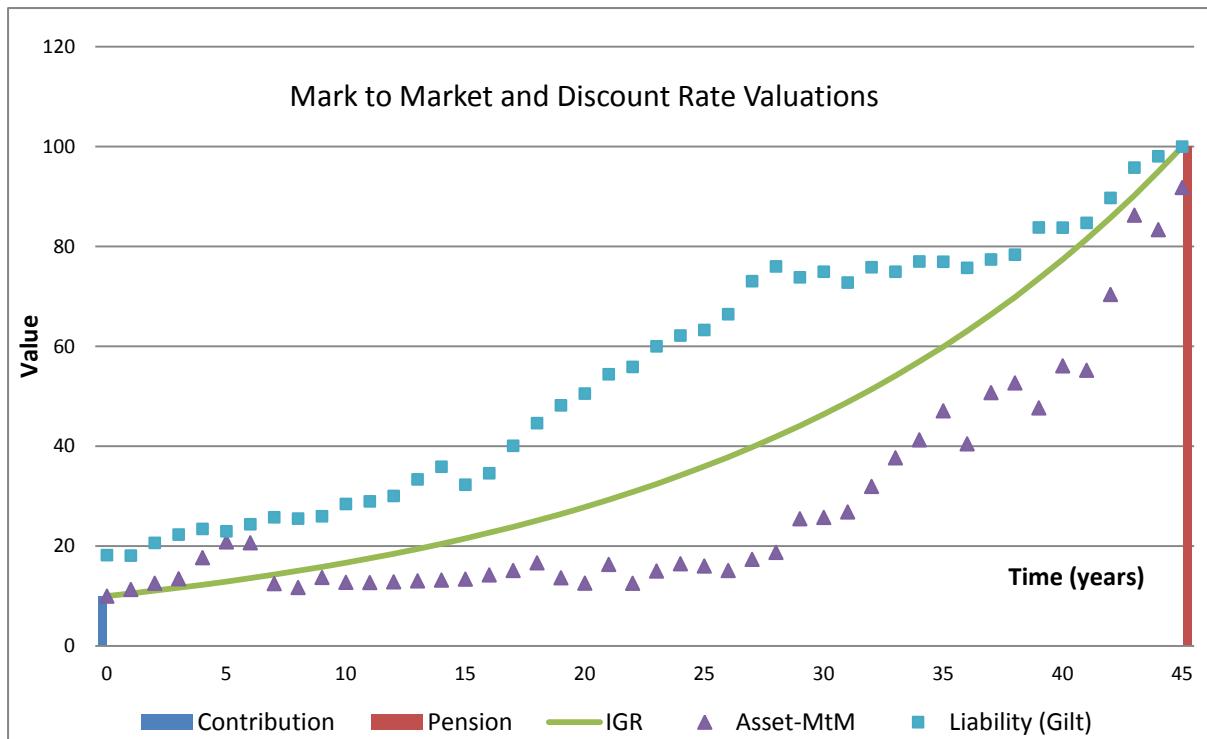
In abstract terms, we are merely saying that we have an input, a contribution, and an output (a pension) and between these, separated in time, we have a technology – investment. In this proposal, we are using an IGR (or Discounted Cash Flow) technology as this is usual in investment analysis and the matter under consideration is the investment of the contribution.

Other classes of technology may be utilised, such as linear amortisation or accretion. This is also illustrated in Figure 5. The difference between these two techniques is that under the IGR approach the proportional increase in value over time is constant while with the linear approach it is the amount that is constant. The shortest path between contribution and pension values is the most

efficient. This would suggest that a linear technology was optimal. However, that is impractical in an investment setting. The rate of growth is constant under IGR but declines with the passage of time under linear. Pay-as-you-go systems, such as the Swedish state system, where there is no investment, in fact, do utilise linear constant-amount technology. Any technology (or valuation standard) which meanders across the space between contribution and pension will be highly inefficient. In Figure 6, we illustrate the application of current standards to the contribution and lump-sum pension used earlier.

This illustrates a ‘mixed attribute’ standard, which uses market prices for assets and market based discount rates for this pension award. For this illustration, we have assumed a yield of 5.25% for both asset price changes and liability discount rate, with volatility of 15% for assets and 5% for yields and show two arbitrary realisations of these processes. 5.25% was chosen as the yield as this is the IGR under the proposed and correct cost of award basis for this illustration. These choices should not be taken to convey any predictive meaning; this is purely a pedagogic illustration. However, they do serve to illustrate the problem of prediction, and pension valuations are inherently partly predictive.

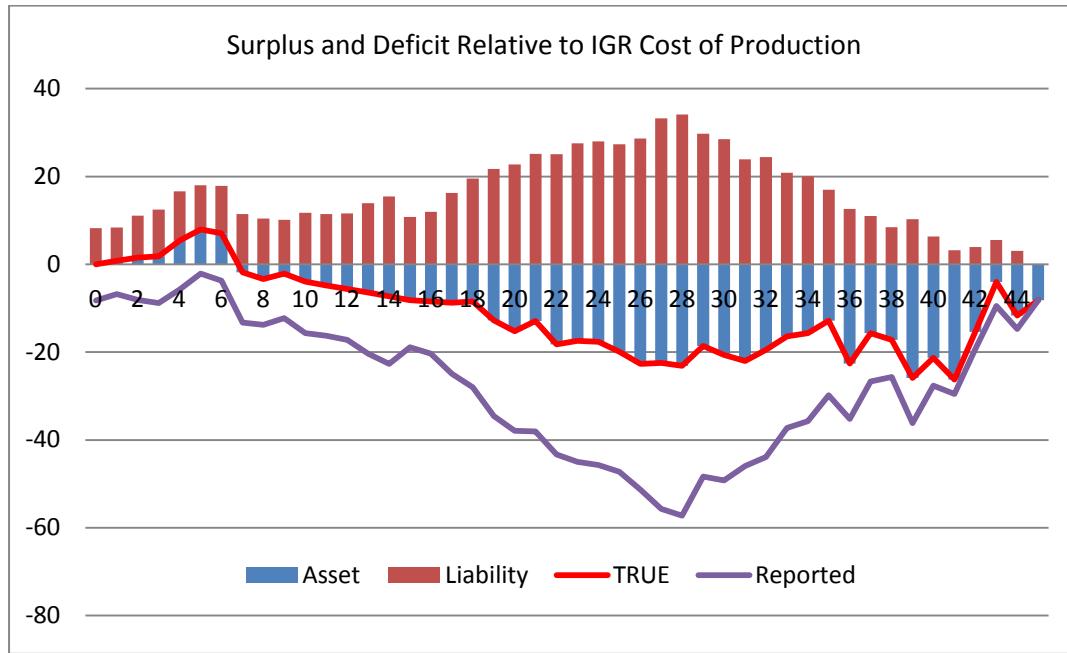
Figure 6: Modelled evolution under current standards



These particular realisations do bear a passing similarity to circumstances as they have developed in recent times. Liabilities at market rates are consistently over-valued relative to the IGR cost trajectory, even though both share a common expected return. In fact, at initiation this method suggests that contributions need to be 82% higher than they are. Assets fail to achieve the sum ultimately required to meet pensions by a relatively small amount, 8.17%. In the interim the asset value is almost everywhere below that required to meet the pension promise and highly volatile. These values clearly have little or no predictive power. At the very least, it is clear, from their meanderings, that this valuation method is highly inefficient. This, in turn, implies that it is costly.

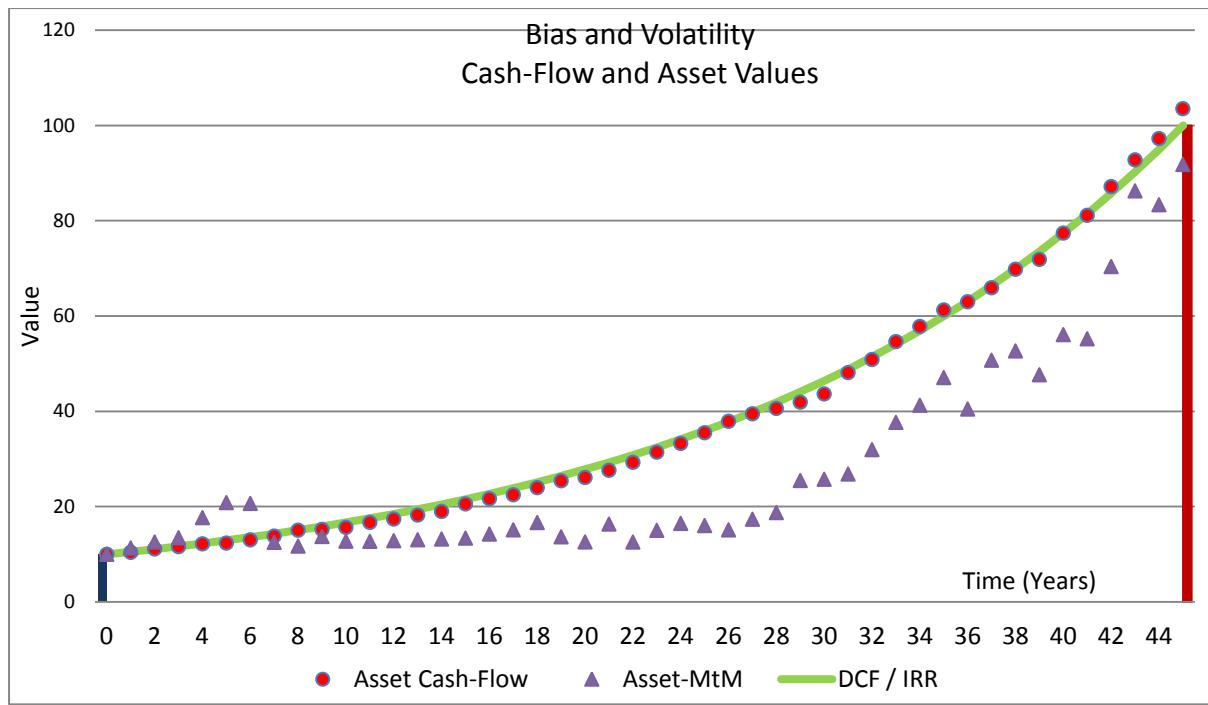
The extent of the resultant biases is shown in Figure 7. If we were to accept that market prices correctly reflect value (which we don't) then we can illustrate the bias induced by the use of market yields as the discount function. We designate this market price of assets value as 'TRUE'. The bias due to the use of a market discount function is shown in Figure 7 as the liability bars and as the difference between the 'TRUE' and reported funding status.

Figure 7: Bias and Volatility under Current Standards



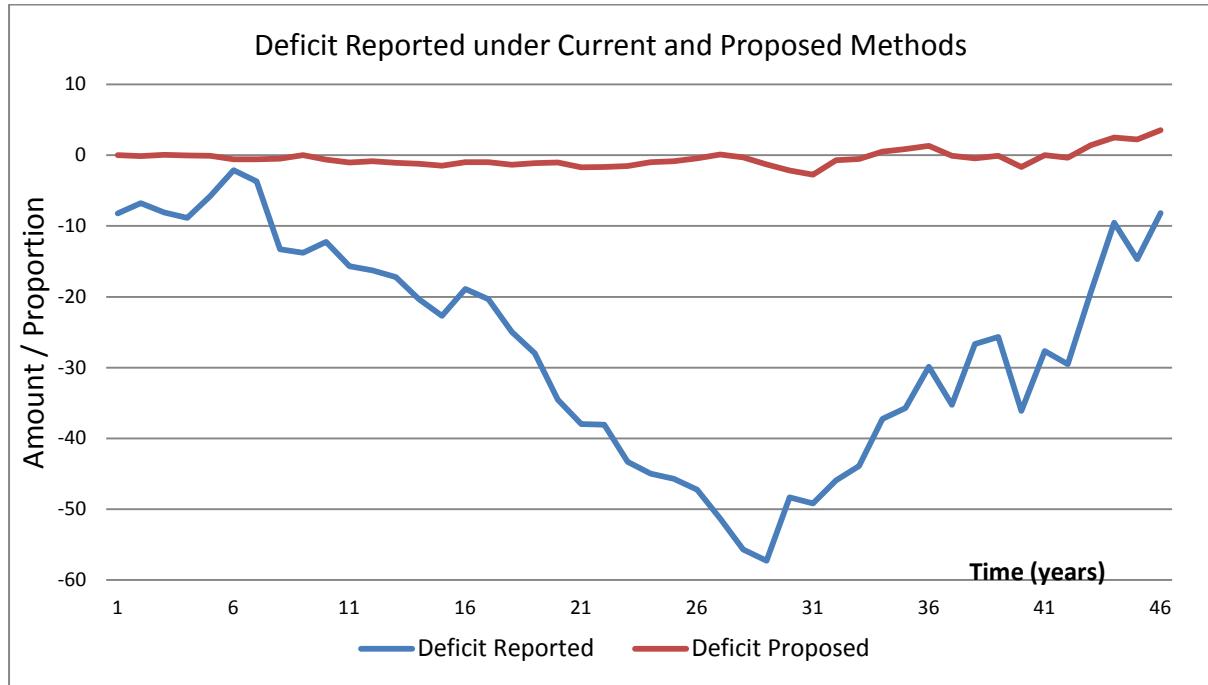
The outcome of the proposed method, together with the market price of assets, is shown in Figure 8. The proposed method does not use market prices as the basis for scheme valuation; it uses asset cash flows evaluated at the IGR. The cash flows from the invested contributions have a return of 5.25% and volatility of 2%. These parameters are consistent with those observed in markets over time for a portfolio allocated 60 / 40 to equity and bonds.

Figure 8: Bias and Volatility – Market Price versus Cash flow Projection under IGR



The lower variability of asset values under the proposed method is stark. The reported deficits or surpluses have an average value of 0.41% and an average volatility of 1.18%. Figure 9 compares currently reported deficits with those arising under the proposed cash flow standard.

Figure 9: Reported Deficit/Surplus under proposed and current standards



The maximum deficit reported under the proposed method is 2.75%, which compares with a maximum of 57.26% in the case of the market price and rates standard. It is clear from Figure 9 that reported deficits or surpluses are both smaller and much less volatile under the proposed standard than under the current; often massively so. The current standard does not return the contribution

made at the time of payment. It is apparent that the current mark-to-market standard is not an inconvenient truth, but a severely misleading and very costly fallacy.

As this is a purely academic illustration of our own construction, we shall next show some comparative results under current, and some possible, accounting and funding valuation standards for an illustrative scheme.

Current Practices

Pension scheme valuation may be conducted in different ways under current accounting standards and funding regulations. However, both utilise a market price for scheme assets and a discounted present value for liabilities. In this regard they are both ‘mixed attribute’ in nature. The international accounting standards are converging on the use of a gilt yield as the discount function for liabilities, while funding regulations allow the use of an expected return on assets. The legislation expresses this as: “*the yield on assets held by the scheme to fund future benefits and the anticipated future investment returns*”.

There is an obvious and immediate problem with the use of the expected rate of return on assets approach. This approach is valid only if the assets and their returns are sufficient to cover liabilities. To illustrate this point pathologically, suppose we have an asset of just one yielding 20% p.a. but liabilities of one hundred due in one year’s time. Then clearly the assets are insufficient. We would need to find another 82.333 units¹¹ of the asset, which may not be possible.

The present value of the liability as should be recorded in the scheme and sponsor company’s books will be incorrect in almost all circumstances when using this return on assets method for discount rate determination. This follows as the discount rate that equates contributions to estimated liabilities is unique. When we have asset prices varying, as they do in markets, the likelihood of coincidence of the implicit rate of return on assets, derived from those prices, with the IGR under which the obligation was incurred, is negligible. This is a source of considerable irrelevant volatility.

The most obvious illustration of the problem with the application of such a discount rate is that it will tend, if back-cast, to throw up a profit or loss at the initiation of an award. This point, the amount and time of contribution, is an observable fact. Here we are considering an analyst’s view rather than accountant’s treatment¹². Other than by chance, when the discount rate chosen in either manner is equal to the cost of the award, the account of scheme or sponsor will show a difference between the contribution and the discounted present value of the benefits. Flexibility in this choice will also do nothing to ameliorate the volatility of asset prices at market value and their transmission to scheme and sponsor accounts.

Many argue that this expected return on assets approach admits great flexibility and that no change is required or advisable. In this paper, we argue and illustrate that this is not in fact the case; that the ‘mixed attribute’ nature of valuation standards introduces arbitrary and unnecessary biases and

¹¹ This is calculated as $(100-1.2)/1.2 = 82.333$.

¹² One reviewer noted: “Where you suggest the application of such a discount rate will tend to throw up a profit or loss at the initiation of an award, regrettably accounting is less symmetrical. Future profits on an award are likely to be deferred or even allowed to go unrecognised, whereas estimated future losses are usually accrued in full along with a cash requirement to prefund.” This aspect of the formal accounting is outside of the scope of this paper.

volatility into valuations. We provide numerical indications of the extent of these biases using the illustrative scheme. These indications are deterministic in nature for the purposes of simple exposition, but they could be extended to a fully stochastic environment, with no great difficulty.

For the illustrative scheme, we are considering a Past Service Liability¹³ (PSL) valuation. Much of the discussion of pension valuation and regulation is concerned with the idea that this is ‘risk-based’. In everything that follows, we are concerned with comparative statics rather than risk dynamics. To consider scheme dynamics correctly, it would be necessary to move from a PSL to a Total Service Liability (TSL) basis for evaluation. The ‘risk-based’ evaluations of regulatory practice are deficient in this regard. Moreover, it would be necessary to utilise time-serial techniques for projections rather than the much-favoured ensemble methods as scheme funding arrangements are not ergodic¹⁴. These techniques would be time consistent, which is not true of the current standards.

The difference between the two current approaches may be shown for the illustrative scheme:

Table 1: Valuations under accounting and regulatory standards

	Assets	Liabilities	Surplus	Solvency %
Pensions Act	186,030,788	182,433,905	3,596,884	102.0%
Accounting	186,030,788	222,631,806	36,601,018	83.6%

In Table 1 the assets of the scheme, which consist solely of listed equity and bonds, are valued at market prices in both cases. Liabilities are discounted using the zero coupon gilt yield curve¹⁵ prevailing at the date of valuation in the accounting case. In the Pensions Act approach, the expected return on assets (4.25%) was arrived at as a premium of 1.75% to expected inflation¹⁶; this is a premium of 1.22% relative to the twenty-year conventional gilt at that time.

A gilt-relative comparison of discount rates has been compiled and reported by the Pensions Regulator¹⁷ for scheme funding valuation tranches, and though gilts were not used in its derivation, this suggests that this expected return on assets is quite aggressive relative to the expected returns chosen by other schemes. This publication, “The Defined Benefit Regime – Evidence and Analysis”, contains a diagram (reproduced below) which shows gilt-relative assumed out-performance for schemes undergoing valuation for the years 2006 – 2010. In 2010, this 1.22% premium would place the scheme at around the 75th percentile – only 25% of schemes are more aggressive.

¹³ The past service liability considers awards which have been made prior to the date of valuation. In this paper, the basis of this includes future increases in salary and related expectations of current members, such that these are current best estimates. Awards for future service and the future service liability (FSL) are not considered. We will make occasional reference to the total service liability (TSL), where the relation is: TSL = PSL + FSL.

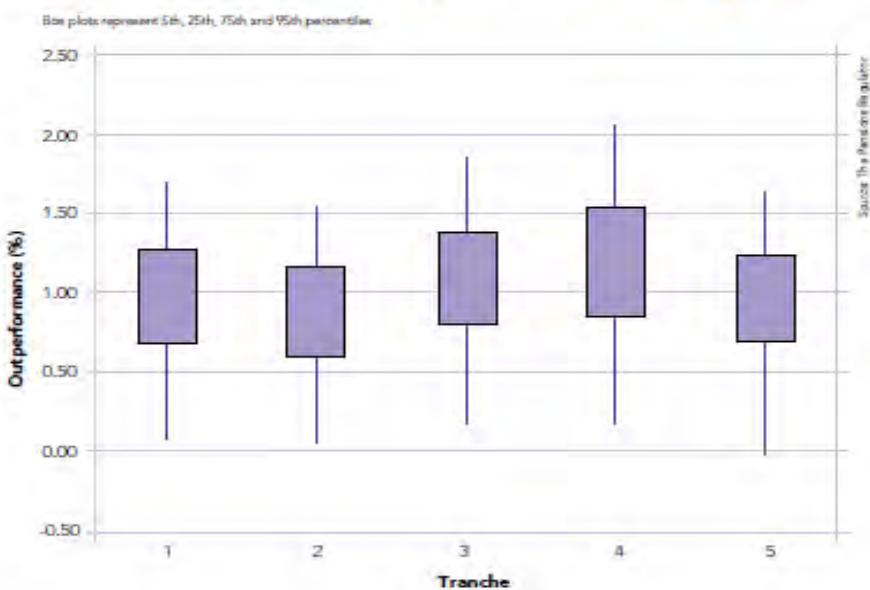
¹⁴ For an exposition of this point, see: Peters O., “The Time Resolution of the St Petersburg Paradox.”, Philosophical Transactions of the Royal Society A, 2011

¹⁵ The zero coupon (strip) yield curve was taken from the UK Debt Management Office’s website.

¹⁶ The current marginal IGR for the most recent year of contributions and awards was 4.53%.

¹⁷ “The Defined Benefit Regime – Evidence and Analysis”, Pensions Regulator 2012.

Distribution of assumed outperformance over gilts



Incidentally, it is argued in that publication and elsewhere that this gilt-relative spread is evidence of considerable flexibility. However, the high degree of overlap between the spread distributions, over the years, might also be interpreted as evidence that this flexibility is not being utilised. Note that the period covered is 2006 – 2010, when changes in financial markets and the macro-economy have been large and without precedent in modern times.

The first and most obvious question is: Which, if either, of these two liability valuations in Table 1 is correct?

Notwithstanding these issues, these accounting and regulatory standards will result in high volatility of valuations over time, in both cash and proportional terms. This will arise from the price variability of both equities and bonds, the scheme's assets, though there will be some damping of overall asset volatility due to portfolio diversification effects. In similar fashion, the discount rate will also be volatile.

It is common in investment management to assume volatilities in the ranges 7% - 15% for bonds and 12% - 25% for equities. In the case of the illustrative scheme, the scheme's assets have exhibited an annual volatility of 19.6% over the past five years and the gilt-based discount rate a volatility of 7.7% p.a.

The volatility of valuations and resultant additional funding requirements have resulted in many schemes pursuing investment strategies which seek to minimise volatility relative to the liability valuation. This ranges from the purchase of increasing proportions of bonds, using the proceeds of equity sales, to more complex strategies such as liability driven investment using derivatives. These strategies are costly, and the more so as they become more scheme specific. They can be seen as hedges of regulations rather than as hedges of real risks. There are direct and indirect costs to the scheme and its sponsor, as well as to industrial and other capital-consumers arising from the resultant loss of flexibility in pension scheme financing arrangements.

One of the problems here is the ‘mixed attribute’ nature of these standards. This is a breach of elementary measurement theory. The metrics used, discounted present values and market prices, are different. If we are to measure and compare things accurately, it is essential to use the same measure for both. It is evident that bond-derived discount rates and market prices do not satisfy this requirement. Indeed, diversification between bonds and equities is a central tenet of prudent investment management policy – this would be pointless if these measures were identical.

It is evident that, due to their exogenous nature, current approaches introduce both volatility and bias into scheme valuations. An approach such as smoothing of discount rates might possibly lower volatility, but it will not address or resolve the question of bias.

It is possible under current circumstances to remove the problem of inconsistency between asset and liability discount functions. This is a case of projecting cash flows for both pension expense and investment income and then applying the same discount rate to both expense and income. There are two obvious cases.

- 1) We may derive the discount rate which equates asset cash flow projections to the observed market price of those assets and then discount liabilities at this rate (Asset Implied)
- 2) We may discount the cash flow projections of assets using the same (gilt) rate(s) as was applied to liabilities (Gilt)

The results of these (Gilt and Asset Implied) are shown for the illustrative scheme in Table 2, together with the results under methods currently used in practice.

Table 2: Scheme Balance Sheets and Surplus under different approaches

	Assets	Liabilities	Surplus	Solvency %
Pensions Act	186,030,788	182,433,905	3,596,884	102.0%
Accounting (M-t-M)	186,030,788	222,631,806	36,601,018	83.6%
Gilt	341,353,967	222,631,806	118,722,161	153.3%
Asset Implied	186,030,788	153,468,329	32,562,459	121.2%

We will discuss the projection of asset cash flows later. The asset implied discount function, based on the projected income flows and current market prices, was 5.48%. Applying this discount function lowers the present value of liabilities to £153 million and increases the funding ratio. We now have three possible values for the present value of liabilities. By contrast, discounting the projected income cash flows of assets using the gilt curve returns a present value of assets which, at £341 million, is a multiple (>1.8 times) of their market value.

The problem with using either of these two new possible approaches is that though they may be unbiased, they are so in only a very narrow sense. They are not accurate. The liability value reported in the asset-implied case would only be accurate if that asset implied discount function were the employer-sponsor’s cost of capital under the terms of the award. Similarly, the asset value reported in the gilt case would only be accurate if that gilt yield were the employer-sponsor’s cost of provision under the terms of award. They retain the volatility of, respectively, asset prices and gilt yields, making changes in these asset prices and yields a substantial source of noise in valuations.

The extent of the volatility introduced by current methods can be directly observed from the Pension Protection Fund (PPF) 7800 index series. It is very substantial. We should note that neither market returns nor gilt yields form any part of the pension contract between employer and employee. In other words, most of the volatility in valuations is arising from the accounting and valuation methods in effect, not changes in their real pension factor costs. These two new methods and the earlier, current methods do not resolve the question of which discount rate is appropriate. It is very clear that all of these offer a poor basis for decision and management action.

It is notable that much of the opposition to the concept of smoothing treats results obtained under the current standards as if they are absolute truths. Expressions of concern over the amount of funding are among these – such as the idea that smoothing may result in lower funding requirements and that this is always detrimental to member security. The reality is that these objectors have no basis for such judgements under current standards, and for some schemes, lower segregated funding will result in improved member security, since it lowers the likelihood of sponsor insolvency.

We do not extensively examine variation from valuation to valuation under the different methods, focusing instead on the question of bias and interpretation of the various results that are illustrated. However, the year-to-year volatility under different methods may be indicated by the change in the assessed funding ratio of the illustrative scheme between the prior and the current year. Here, the proposed IGR, or weighted average cost of provision, declined from 7.74% to 7.68 % and the funding ratio, under the proposed method, declined from 118% to 112%¹⁸. By contrast, over this period the assessed funding ratio of the PPF 7800 index, which uses current standards, declined from 105.2% to 82.4%.

There is one further suggested approach, such as has been proposed by JP Morgan Asset Management¹⁹, which deserves mention. This has been described as an insurance ‘run-off’ model. Under this approach, asset prices are projected and liabilities deducted as they fall due from the projected values of assets. This sidesteps only the question of which discount rate to use in valuing liabilities. Assets are sold when income is insufficient to meet liabilities. Beyond the observation that it does not provide a liability valuation for the sponsor-employer’s balance sheet, the most important problem with this approach is that it contains a feed-forward mechanism, which means that it is an unstable model. In the event of a shortfall between asset income and pension expense in a year, it is necessary to sell some proportion of assets to make good the pension payments. Due to the high volatility of asset prices, the proportion required to be liquidated is very uncertain and this uncertainty in turn feeds into future income. The future income rapidly assumes the volatility, not merely of dividend income but of asset prices. Simply put, over the life of pension schemes, the model explodes and the whole process appears far riskier than it really is. This is an ergodic model and process, while the appropriate model and process are time-serial in nature²⁰.

¹⁸ This shift in funding ratio is the result after a number of changes to assumptions was made. Ordinarily, the decline in the IGR for this scheme would have resulted in an increase in funding ratio.

¹⁹ A more detailed discussion of this proposal is available on request.

²⁰ Ole Peters, of Kings College London and the London Mathematical Laboratory, has investigated these issues in detail.

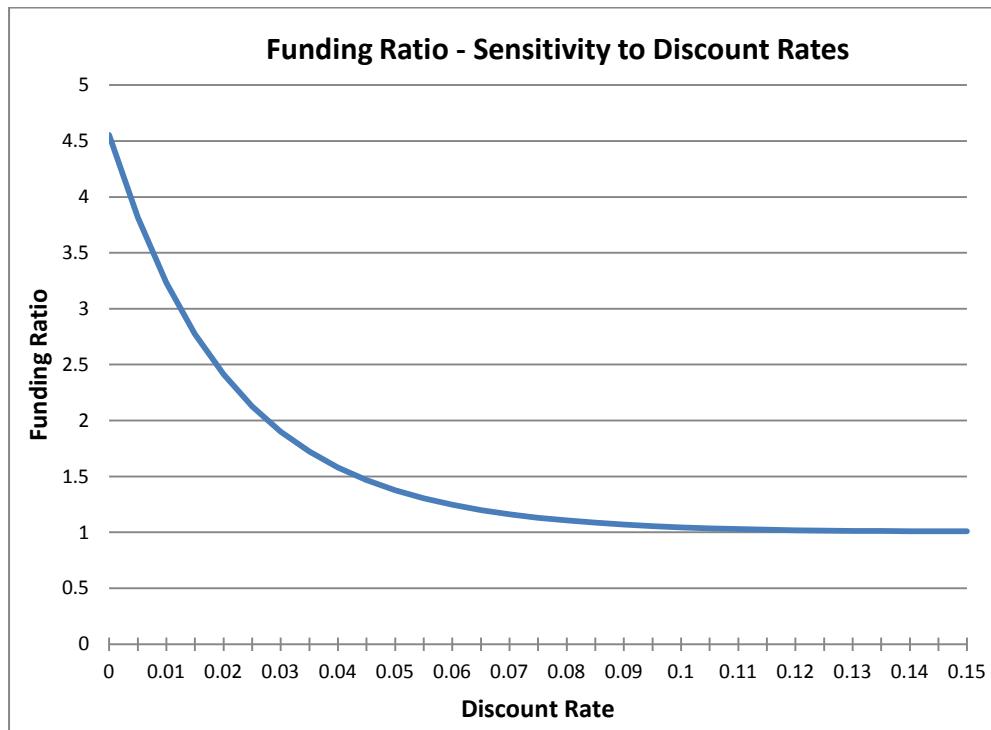
There is a further aspect to this issue with such models, volatility drag, which was well described by Hatchett, Hurd and Clacher²¹. We quote from that paper: "By volatility drag we mean the reduction in money-weighted returns experienced by a scheme that is a net disinvestor (sic) relative to time-weighted returns, due to volatility in asset prices. For example, a scheme is disinvesting £5 p.a. from an asset base of £100. If the markets drop 15% the scheme assets will drop to £85, then £5 is paid out leaving £80. Returns of 25% would then be required to return back up to £100 (or 18.75% to get back to £95). With a few bad years' performance, this effect is compounded. Similarly, upside experience can also be magnified. However, the median money-weighted return is typically lower than the median time-weighted return in this scenario. For pension schemes it is money-weighted returns that matter."

The Proposal Illustrated

When comparing cash flows for income and expense, the funding ratio²² is sensitive to the level of the discount rate. Figure 10 shows the sensitivity to interest rates of the funding ratio for these illustrative scheme cash flow projections. This is a concern even with methods such as the asset implied or gilt approaches where, though the discount rate is derived from market prices, this rate will tend to change from valuation to valuation as market prices or yields vary, even if the projected cash flows from assets are unchanged.

Here, one of the concerns may be considered as a form of backwards compatibility or time consistency. With the discount rate moving arbitrarily, there is no guarantee that prior results, even if they were accurate at the time, would remain so.

Figure 10: Funding ratio sensitivity to interest rates



²¹ Hatchett J., M. Hurd and I. Clacher, "Meeting defined benefit pension obligations: measurement, risk and flight paths", British Actuarial Journal, *Forthcoming*.

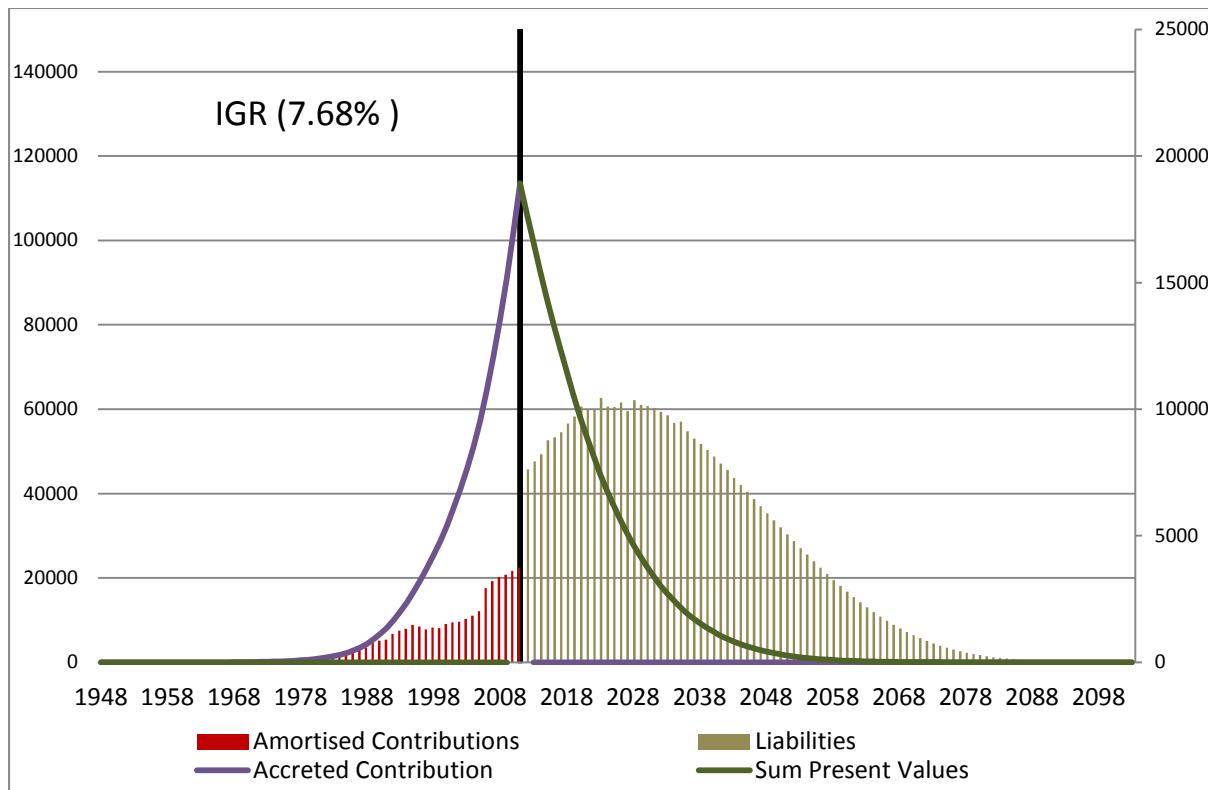
²² A separate study of the statistical properties of the funding ratio statistic is available on request.

This illustrative scheme is unusual in that the asset allocation was specifically created to benefit from declines in interest rates and was structured to be largely immune to substantial increases in rates. It is more normal for schemes, with low equity allocations and large bond portfolios that are shorter in duration than their liabilities, to exhibit greater funding weakness at low discount rates. This particular set of income and expense cash flows return a locally minimal funding ratio of 99.70% at a discount rate of 14.7%.

Our concern extends beyond whether the scheme funding is adequate to meet pension payments, which is a question of the extent to which asset income defeases pension payment obligations; it encompasses a requirement for liability values to be accurate. Without this, we cannot perform any meaningfully holistic analysis of company sponsor and scheme. In other words, the sponsor covenant could not be accurately assessed under any of the two current procedures or those advanced as possible currently. By comparing income and expense cash flows at the IGR, the cost of award discount rate, we are accurately reflecting the extent to which the expected income from the asset portfolio suffices in meeting pension obligations and providing accurate values for liabilities. Moreover, we are doing this time consistently.

The terms of this scheme are currently that for an annual contribution of 20% of pensionable salary (15% employer, 5% employee) the member will receive one sixtieth of his final salary for life in retirement, from age 65. In addition, there is a 50% survivor's pension. Death in service is covered by a life insurance policy. We revisit the question of death in service and the related question of the amortisation of contributions as pensions are discharged later. In the immediate post-war period, slightly over 25% of contributing members did not survive to collect any pension. This is currently a little under 10%. This was a source of considerable subsidy to contributions for members. Its decline has obviously increased the cost of provision. The current age of pensioners is omitted as it is not material in the calculations involved in the proposed method, though it would be relevant in the context of pay-as-you-go schemes. The practice adopted by this scheme for death in service of active members and the pre-retirement death of deferred members is that their contributions and benefits are removed from the total pensions and contributions sums, while the associated assets are left in the fund. We cover contribution amortisation in more detail later. The method of deriving the IGR is illustrated in Figure 11. It consists of no more than requiring that the present value of contributions equals the present value of benefits and solving for the common IGR.

Figure 11: Method of deriving the IGR



The IGR or weighted average cost of pension capital for this illustrative scheme is 7.68%. This is attractive to the sponsor employer and compares favourably for an employee where it is equivalent to a pre-tax return of 9.22% for a basic rate tax-payer and more for higher rate tax-payers. This would be the cost of scheme liabilities, which would fall upon the sponsor if all assets became valueless. This rate may seem high in the context of recent equity and bond market returns and yields, but this rate is the average of awards made sequentially over a long period. There is one beneficiary alive, who joined the scheme in 1948. There are many pensioners who were contributing in the 1970s and 1980s, when such investment rates would have seemed paltry. The most recent year's marginal cost of award has an IGR of just 4.53%. We illustrate later the amortisation of contributions due to death and pension discharge.

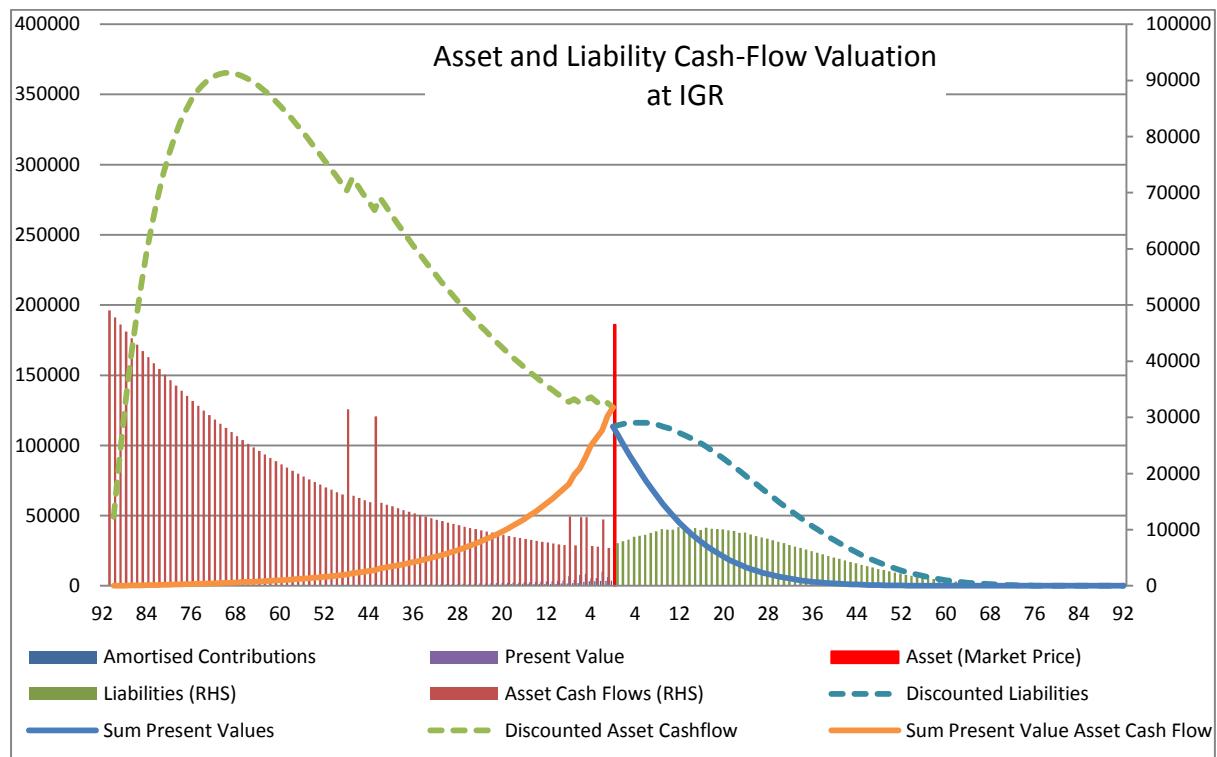
The present value of assets and liabilities, together with these figures under the previously discussed methods, are presented in Table 3 below:

Table 3: Balance Sheets and Funding Status under differing approaches

	Assets	Liabilities	Surplus	Solvency %
Illustrative Scheme	132,017,010	117,735,917	14,218,094	112%
Pensions Act	186,030,788	182,433,905	3,596,884	102%
Accounting	186,030,788	222,631,806	36,601,018	84%
Gilt	341,353,967	222,631,806	118,722,161	153%
Asset Implied	186,030,788	153,468,329	32,562,459	121%

We reproduce below Figure 4, which shows the valuation graphically.

Figure 4: Valuation at the IGR of asset and liability cash flows for the illustrative scheme



Some interpretation and discussion of these various figures and their biases is appropriate. For the illustrative scheme the liabilities are correctly stated; they will throw up no surplus or deficit relative to contributions received at initiation of an award. The value of assets reported lies below the market value of those assets. This arises because the projected income yield of those assets is substantially below the IGR of the fund. Of course, it is also possible that the asset value returned under this method would lie above the market value; that would require the projected income yield on assets to be above the IGR. However, an important policy conclusion may be drawn here. As income yields from assets fall below the IGR so additional contributions become increasingly less efficient. It is a mistake to require additional contributions in times of low yields and returns, unless these are absolutely necessary. This resonates well with common intuition.

This asset-implied yield method would serve to damp the effects of stock market bubbles. In these circumstances equity market prices are very high relative to the income produced, which results in low implied discount rates at those times. Then the tendency is for the stated value of liabilities to be higher than the true. In pathological ‘bubble’ situations, when market asset values are grossly inflated, it is actually possible that the asset-implied discount rate of future cash flows is negative, which is clearly nonsensical. This asset-implied approach will reduce scheme valuation volatility only marginally and will retain substantial and variable biases. In the case in point, the bias in liabilities is some £36 million or 30.3% of the true. There are also biases associated with the use of market prices for assets.

The gilt derived value of liabilities is very high by comparison with the true cost of capital calculation. This approach will indicate spuriously that contributions are insufficient at time of award and result

in a loss posting. The bias is extremely large in these times of extremely low gilt yields - £105 million or 89% of the IGR true. The approach indicates that the cash flows of equities are massively more valuable than their market price - £341 million in place of a market price of £186 million. The scheme appears on this basis to be better funded than is the case. The sponsor covenant is distorted by the high liability values returned. With asset values so overstated, pressure to return assets to the sponsor should be expected.

Current Pensions Act regulations result in an overstatement of the present value of liabilities relative to the IGR true and will throw up losses at the time of award and contribution receipts. The liability bias is £64 million or 55%. This is a mixed attribute standard. While this approach may be informative as to the ability of the assets to meet liabilities, it distorts, negatively, the cost of provision and the assessment of the quality of the sponsor covenant.

The accounting standard is also mixed attribute; it reports the worst funding status of all possible.

Many contest the use of anything other than market prices for the valuation of pension scheme assets. We will discuss this issue more fully later. Here the valuation of the scheme's asset cash flows should not be confused with a market-price; it is the present value of the cash flows of these assets in defeasance, or off-setting, of the pension expense obligations. It is a value in use to the sponsor employer in offsetting its contracted pension obligations.

It should be noted that this value in use is not specific to the employer sponsor in question; it applies equally to valuations for transfers to other qualifying schemes and employers. The transfer of both assets and liabilities would ensure this. As transfers are usually individual in nature, the amounts involved are small and cash rather than proportional shares of asset portfolios usually accompany the liability transfer. Arguably, this transfer of cash is riskier for both schemes. Indeed, with bulk transfers of pensions, transfer of asset portfolios is far from uncommon. Of course, transfers to others who are using different valuation techniques, such as bulk annuity insurers, would throw up accounting differences – even though the real position as reported under the proposed method was correct.

We may offer independent confirmation that the scheme is currently well funded. We do this by considering what rate of return is required of current assets, at market prices, to achieve full payment of pension liabilities as they fall due. This rate is 3.99% substantially below the IGR of 7.68%. Hence, it follows that the scheme is more than adequately funded. The historic rate of return on contributions is 10.94%. This is not the return on assets usually reported. It is also inflated by death in service, among other things.

Cash flow Projection

The practices for pension payment projection are well-established in the actuarial profession and already form part of current valuation methods. The liability expense projections for the illustrative scheme include allowances for administrative and other expenses. No change is suggested. The econometric practices for cash flow projections for assets are also well established. However, it is evident that they are not widely practised in the actuarial profession. One reviewer of this paper noted: "In all my years as a trustee, I have seldom seen such cash flow projections from most actuaries or investment consultants. It tends to happen with smaller schemes, where frankly you

could label each cash flow by manager name (for assets) and by member name (for pension payments), but larger schemes allow themselves to be fobbed off with stochastic modelling of net funding levels. If you dig into asset modelling you find total returns treated as if income is identical in nature in terms of its straight-line or volatility, which ... it is not.”

Here we are projecting cash flows, that is, dividends and coupons rather than asset prices. These are an order of magnitude less volatile than asset prices and accordingly may be projected with far greater confidence than the market prices of assets. These projections are, in consequence, auditible at short-term interim horizons. When asset income cash flow models are time-serial in nature, they are self-correcting and do not propagate prior model errors, which greatly facilitates the audit process.

The asset cash flow projections for the illustrative scheme are simple. Bonds are the contractual flows of coupons and principal. Default on corporate bonds is not a material issue here. Equity dividends are modelled conservatively as increasing solely at the rate of inflation – that same rate (2.5% p.a.) as is used for liability growth projections. The current yield on this equity portfolio, at market prices, is 3.9% in line with UK market indices²³.

This projection is extremely conservative by historic comparison where, since 1900, equities have returned 5.5% in real terms, of which 4.8% was attributable to dividends and 0.6% to dividend growth. This caution was motivated, in part, by the increased use of share ‘buy-backs’²⁴ as a means of distributing funds to investors.

There are further issues, not discussed here for brevity, to be considered with more complex asset allocation strategies such as those involving defaultable corporate bonds, real estate, hedge funds and derivatives. However, it is clear that under a cash flow approach there is an incentive to avoid speculative investment, where future capital sums (sales in financial markets) are the source of return. We shall return later to the question of incentives.

The cash flow projections of pension payments and asset income for the illustrative scheme are shown earlier in Figure 3, together with the annual surplus or shortfall. The spikes in income are repayments of the principal of bonds held. The deficit and surplus presentation offers us a very simple risk metric – we can see exactly when further cash will be needed to pay pensions. There is, in this illustrative case, an immediate shortfall, but as the scheme is open to new members and future accrual, there is an expected cash contribution of £3.8 million annually in respect of currently active members and the shortfall is well-covered.

In the absence of future contributions arising from new awards, this scheme would need either additional sponsor contributions, or borrowing, or some sales of assets to cover these shortfalls. Sound risk management would tend to favour asset re-allocations that produce adequate asset

²³ The equity portfolio has a market value of £107.7 million. It does not reflect the overall market index as it excludes foreign stocks, many small stocks and companies which compete with the sponsor. The policy allocation among bonds and equities is 60% equity – 40% bonds and cash. As a result of market movements, it is actually 58% equity and 42% bonds and cash. The bond portfolio has a long duration, and includes a holding of Consolidated 4%, which is undated.

²⁴ For a succinct description and discussion of the differences between distribution by way of share buy-back and dividend, readers are referred to Cedar Rock Capital’s 2010 Annual Review, or to Long Finance’s 2009 paper “Don’t Stop Believing: The state and future of UK occupational pensions”.

income cash flows to meet near-term liability payments²⁵, rather than borrowing or immediate sale of assets.

This takes us back again to the question of risk management in pension schemes - as this is outside of the direct scope of this paper, we have confined our comments on risk management to an appendix. Where the scheme is open to either new members or to future accrual (or both), then it really is necessary to consider future contributions and awards. Risk management is concerned with the time variation of the scheme rather than its comparative statics or sensitivity to changes in the current status quo. This is a shift to a TSL rather than PSL framework. It also relates to the earlier-mentioned question of time serial rather than ensemble projections.

We have, in the scheme valuation, shown only those cash flows which occur within the term of liabilities. Obviously, in the case where assets include equities and perpetual (or undated) bonds, as this scheme does, there is a residual future value associated with cash flows beyond this term which is not considered at this point.

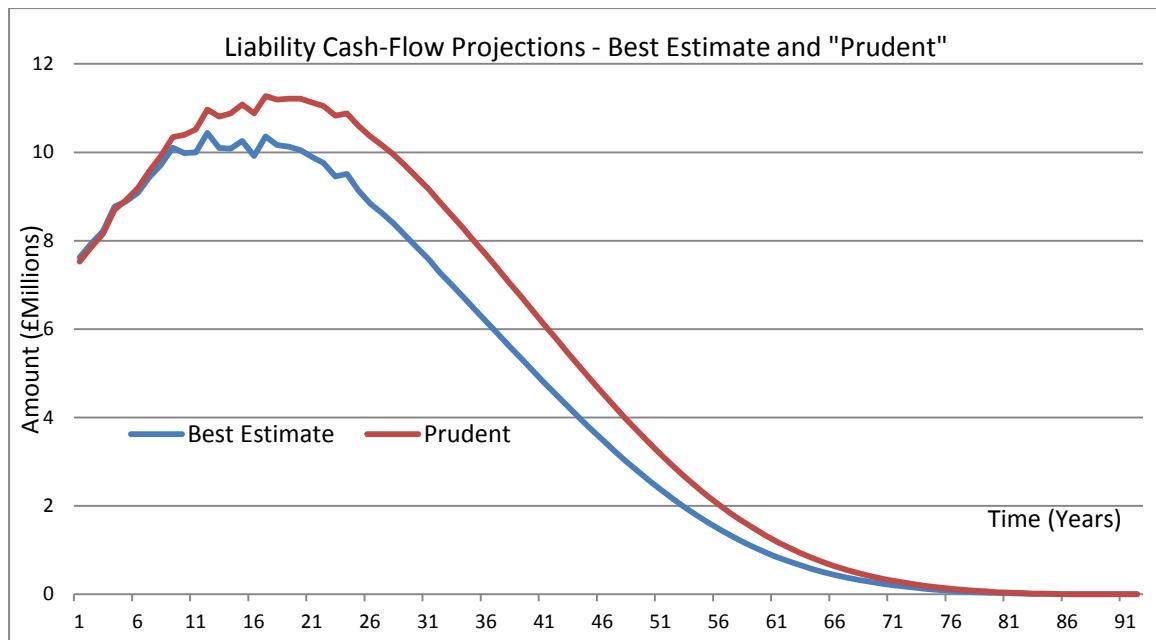
As noted earlier these calculations (in Table 3) consider only income arising within the term of liabilities, but there is also clearly income arising beyond this term as the scheme holds equities and undated government bonds. If we include the present value of the future value of these cash flows, the present value of assets is augmented by £4,117,315 and the scheme is seen as 115.6% funded.

A Stress Analysis - Prudence

The pension liability cash flow estimates used this far have been technical provision best estimates. As this may be considered incomplete, we shall perform a small exercise in comparative statics. If we move to a set of 'prudential assumptions', such as a one year increase in life expectation, a 0.25% increase in inflation expectations, a 5% lower cash commutation take-up and some other minor conservative adjustments, we see the total pension payable over the life of the scheme rise to £460 million from £402 million. The money-weighted life expectation rises to 89.53 years. These liability cash flow projections are shown in Figure 12.

Figure 12: Liability Cash flows under Best Estimate and 'Prudent' Assumptions

²⁵ A separate study of this is available on request from the corresponding author



The IGR under the proposed method rises from 7.68% to 7.91%. Note that this is slightly smaller than the 0.25% increase in the expected inflation assumption. The balance sheets for the illustrative scheme under the earlier technical and 'Prudent' assumptions together with surplus and funding ratio are shown in Table 4.

The present value of assets increases because the nominal dividends of equity increase, maintaining pace with inflation. The increase in the present value of liabilities is due to the more conservative assumptions. It is notable that the scheme funding ratio declines by a rather small proportion, 7.2%.

Table 4: Balance sheet, surplus and funding ratio for technical and 'Prudent' assumptions

	Assets	Liabilities	Surplus	Solvency %
Prudent	127,561,628.4	121,645,024	5,916,604	105%
Illustrative	132,017,010	117,735,917	14,218,094	112%

On a full asset basis, including the present value of cash flows beyond the term of liabilities, the funding ratio declines from the earlier 115% coverage to 107.7%.

The results of applying the two current methods to the illustrative scheme are shown in Table 5 together with the proposed cash flow IRR method. The use of market prices for assets under current standards leaves these unchanged, while liabilities increase by differing amounts. It is notable that the accounting standard again produces the worst result.

Table 5: Valuations of the 'prudent' assumptions under proposed and current methods

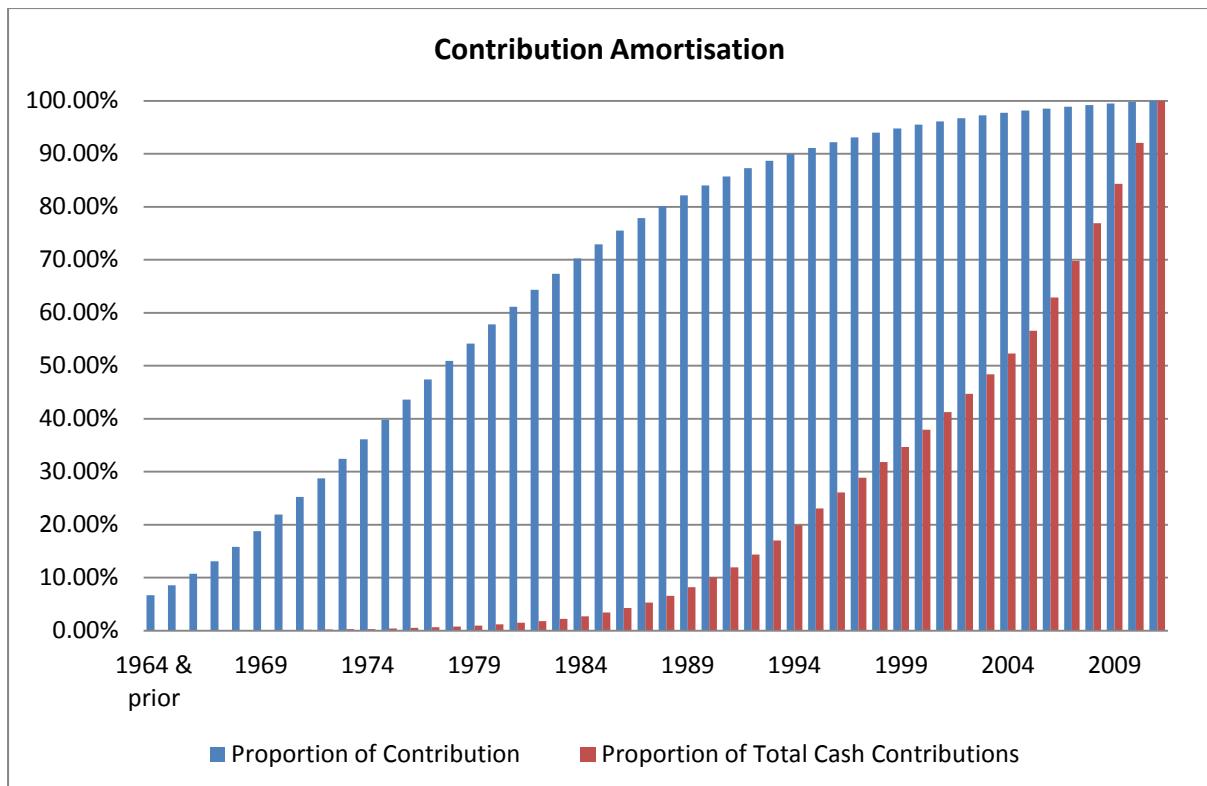
	Assets	Liabilities	Surplus	Solvency %	Change
Prudent	127,561.628	121,645,024	5,916,604	105%	-7.2%

Accounting	186,030,788	243,271,438	57,240,649	76.5%	-7.1%
Pensions Act	186,030,788	190,981,598	4,950,809	97.4%	-4.6%

Contributions

In the calculation of the IGR, it would be misleading to use the sum of the simple historic amounts of contributions made. It is necessary to reduce the historic amounts paid to reflect pensions that have been paid and members who have died – these are no longer elements of the projected pension liability flows. This amortisation of historic contribution amounts is shown for the illustrative scheme in figure 13.

Figure 13: Contribution Amortisation



Here we see the declining residual value of annual contributions, their amortisation. For 1964 and years prior, these lie below 6% of the initial payment made in that year. In fact, for the year 1947, there are no surviving member beneficiaries. By contrast, in terms of their cash value, that is to say, value as a proportion of the total contributions made, contributions prior to 1988 are 6.5% of the total. This is in large part a product of wage inflation.

The IGR is a very smooth and slowly changing function because it is a compound average. The pensions discharged in any year are of the order of 2% of the total pension liability. This is spread as amortisation of contributions over the entire term of contributions, some 50 to 60 years. It is approximately £1 million annually of amortisation for the illustrative scheme. New contributions are high at approximately 7% of the total contributions, but less than 1% of total pension liabilities. Of course, radical revisions to the expectations driving pension liability projections may induce significant changes in the IGR, but, as we saw earlier, a 15% increase in liabilities resulted in an increase of the IGR of just 23 basis points. It is absolutely clear that the volatility in practice of the IGR is far lower than the volatility of bond market yields. In this, perhaps there lies an argument for the use of smoothing as an interim measure.

Market Prices

This section concerns the appropriateness of the use of market prices for the valuation of assets. This is a highly contentious area. We observed in the opening section to this paper, that the one condition introduced in this paper is the fair value condition, that the present values of contributions should equal the present value of liabilities. The accounting standard is claimed to be fair value in nature. However, this paper has shown that the standards are not congruent with the elementary concept of fair value proposed, producing results that are volatile and biased relative to the fundamental IGR, or cost of award concept.

The IGR approach is endogenous to the pension scheme. The market price standard introduces exogenous variables. It appears that these prices carry much extraneous and irrelevant baggage with them.

Market prices arise from a mixed game; markets are partly games against nature, where risk is exogenous to the market, and partly games against others, where risk is endogenous. Price movement motivates most activity in this world. Recent work by Didier Sornette at ETH, Zurich suggests that 85% of equity market price movement in Europe is unrelated to news. It is clear that the volatility of market prices is predominantly sourced endogenously, from the game against others. These prices are highly volatile, with the majority of this volatility arising from the inside game among intermediaries rather than the fundamentals that drive productive investment returns.

As the holding or investment term increases so the fundamental comes to dominate. The variability of these fundamental productive returns is low, as is evident from the ONS reports of corporate profitability over time. The empirically observed decline in volatility of financial assets with holding period is a reflection of the increasing importance of income rather than some form of mean-reversion in asset prices. Using the current market price of assets introduces this speculative volatility rather than fundamental volatility into scheme valuations, which is highly inappropriate when these institutions are long-term in nature.

Occupational pension contracts are non-negotiable in the sense that the member-owner cannot freely liquidate them, though transfer to other qualifying schemes is possible²⁶. This is sound public policy²⁷. No market prices or rates are used in setting their terms – the contributions and associated benefits. It is unnecessary to introduce dependence upon such prices and rates into valuations, as has been shown by the method proposed in this paper. The contracts written by both long-term insurers and pension schemes are not negotiable; they lack the option on market liquidity of traded negotiable instruments. It should be realised that liquidity is costly; if it were not, all assets would be liquid. To introduce dependence on market prices and interest rates in the valuation of pensions schemes requires justification.

Markets are not consistent among themselves; if they were, diversification would not be feasible. The question is not so much which market should we require these institutions to be consistent

²⁶ Even this transfer need not be conducted in cash terms; payment by asset transfer could be effected.

²⁷ The non-negotiability of pension savings prior to retirement avoids the moral hazard that if allowed a scheme member might draw and squander their pension savings, knowing that they can fall back on state provision. There are some cases where scheme organisation as a provident fund is superior, to the entirely unavailable before retirement form. A provident fund allows early access for some qualifying purposes.

with, but rather why should we shoehorn these institutions into a framework where they are not naturally members at all?

Many cite academic ‘theory’ in support of their demands for the use of market prices and rates. It should be realised that this is in fact the efficient markets hypothesis; it does not warrant the description ‘theory’ as it does not and cannot produce any testable predictions. It is, in fact, arguable that this is, as Bachelier originally described it in 1900 a *theorie de la speculation*. As became obvious during the recent financial crisis and its aftermath, it is deficient in that liquidity is not expressly considered within it. The whole point of traded securities is that the market offers an option on liquidity, that is to say negotiability. In the approach to valuation suggested in this paper where assets are held to fund or defuse pensions expenses for the sponsor there is absolutely no reliance upon sale in any market. It should be noted, as above, that the option on liquidity contained within market prices and yields is costly to the investor. If liquidity did not have a cost, all assets would be perfectly liquid and the option valueless; this perfect liquidity is an unstated and unreasonable assumption contained within the academic hypothesis. It is also necessary for such an approach to be time-consistent.

Notwithstanding the fact that funding cannot completely resolve the issue of sponsor insolvency, the idea has become prevalent (and been promoted by the PPF and Pensions Regulator) that funding is more important than the sponsor covenant and the primary risk management concern. This has found expression as: “Funding trumps covenant”²⁸. This may be compared with the idea that seatbelts trump brakes in our cars. It fails to recognise that prevention of the accident is superior and more efficient than mitigating its effects.

The Pensions Regulator should have a primary requirement to consider the status of the sponsor employer rather than merely the scheme and fund. It is possible to argue that the Pensions Regulator should have an additional power to authorise, in conjunction with HMRC, the creation of new pension schemes based upon the status of the sponsor employer. It is also possible to envisage the Pensions Regulator having input in asset cash flow projection techniques and parameters when the proposed method is utilised. However, the most important and urgent revision needed is to the accounting basis; without this, the Regulator’s position would be unenviable as it would be operating with incorrect inputs to these functions.

Conclusion

Arbitrary smoothing of discount rates may be without any sound intellectual support. However, as has been shown in this paper, the variability of estimated pensions funding costs is small in reality, changing only with changes in the real situation or trustee expectations of the future. These discount rates (IGR) are far smoother over time than the current practice admits. The current methods introduce both bias and volatility to scheme valuations. They are not time consistent. These are doing considerable harm. DB provision has declined because these methods have overstated the cost and risk of DB provision. For many, these costs now far exceed the value of the tax concessions associated with authorised pension schemes. The idea that both of these bias and variability issues can be resolved solely through the flexibility inherent in the choice of discount rate in current regulations is without merit. This extends to other approaches that might be considered as possible

²⁸ Alan Rubenstein, CEO, Pension Protection Fund

under existing regulations and standards. Even if the correct discount rate were magically chosen, this would still leave the assets determined by market prices. The method of valuation proposed in this paper is independent of market prices or rates, as is the pension contract itself. It is unbiased and produces variation only when this is rooted in changes in the scheme itself.

Applying correct valuation techniques, as proposed in this paper, would reduce the cost of pension scheme funding to the tax-payer materially. Because of the biases inherent in the current methods, the majority of current special contributions would be unnecessary, and, *ceteris paribus*, tax receipts increased. Indeed, even in the event that these sums were instead spent on corporate investments, government policy would still be furthered. The introduction of smoothing and the proposed method are both likely to produce one-off windfall gains and ongoing lower tax costs.

Valuation as proposed is also a necessary precursor to the sound evaluation of the effects of pension scheme funding on sponsor financial strength and scheme security. As sponsor solvency is, in the absence of pension indemnity assurance, the prime determinant of the security of UK DB pension schemes, the effects of actions required of sponsors in support of schemes should clearly be a concern for the Pensions Regulator. Arguably, this should take precedence over its obligation to protect the Pension Protection Fund. Such a responsibility would merely be recognition that a solvent sponsor is the best and primary security for members' benefits. Indeed, it is not necessarily incompatible with that PPF protection obligation, since it should result in fewer sponsor insolvencies, if properly pursued.

Many contend that prudence and caution should dominate in pension valuation in pursuit of member security as protection or mitigation of the risk of sponsor insolvency. There is a question of proportion here. Firstly, the efficient solution to sponsor insolvency is insurance, not funding. At numerous points in this paper, we have indicated the incompleteness of excessive cost of funding as a security device. Secondly, the scale of insolvency is simply not great enough – even in recent troubled times not exceeding 0.7% of all active companies, and better on average than that in companies with DB pension schemes. To justify imposing extra funding requirements on all schemes on the scale evidently desired is not possible. Additional funding, whether deliberate or an unintended consequence of the accounting basis, has two effects – it raises the cost of provision and it leads to scheme closure – which is, by far, the greater harm.

There is an argument for the introduction of smoothing which lies in the immediate relief that this would provide for sponsors, and the value of this action as a signal of the intention of government to see past errors in practice corrected. This is simply recognition that the best is indeed sometimes the enemy of the good. Smoothing would be good for schemes and the government, but the best would take time to introduce and implement.

It is clear that in the absence of change, voluntary occupational defined benefit pension schemes, which are economically the most efficient of current pension arrangements, are destined to cease to exist and will do so in a manner which is extremely costly to society in general and the tax-payer in particular.

Appendix A: IGR Evaluation

The Internal Growth Rate of a scheme is simply the rate that satisfies condition that the present value of contributions should equal the present value of projected benefits payable. This is a fair value condition, which is widely used in financial analysis, including the pricing of assets, liabilities and derivatives. Mathematically, this might be expressed as:

$$\sum_M C^{(1+IGR)^t} = \sum_M E(P)^{-(1+IGR)^\tau} \quad \{1\}$$

Where C and P are respectively the amortised contributions and projected pensions reflecting the current membership, M, which also defines the times t and τ over which the summations should be taken.

Other methods of estimating the IGR may be utilised, such as considering the average age at contribution and the average age at pension receipt and the total amount of amortised contributions and pensions payable. These are omitted for simplicity. Appendix C illustrates the relation between the IGR function and points in time valuations.

Appendix B: Risk Management

Present financial regulatory practice is to require risk buffers to be present currently. In fact, it is clear that these need to be present in the future. The requirement for prudence is to have some surplus at times beyond the discharge of the ultimate liability. One of the behavioural problems associated with currently held risk buffers is that these will tend to be invested in risky assets, and perhaps not available when needed.

Standard risk management regulation, such as Solvency 2, requires the maintenance, currently and over time, of additional capital resources to cover such variability. The natural tendency is for these risk buffers to be invested in risky assets, making their availability when needed suspect. There is a genuine issue, here, for funding as a solution to pension security. If a scheme is funded at the level of technical best estimate at the time of sponsor support withdrawal, through insolvency or otherwise, then the scheme has a 50% chance of failure before the discharge of all pensions. Funding is an incomplete solution to the problem of member security. Making funding demands in excess of this 100% level is costly, and will tend to make the pension an inefficient form of employee remuneration, and therefore unattractive to sponsor employers as a form of employee remuneration. Making demands in excess of the technical best estimate is also inequitable to other employer stakeholders.

This is risk management in the short-term. As such, exactly as with speculation, market price is the dominant concern. However, pension schemes are long-term institutions – in the case of the illustrative scheme earlier, the present liabilities extend for 91 years²⁹. They really cannot crystallise at shorter horizons – a pensioner ‘run’ would only be a transfer process to other schemes. As noted earlier, at large scale, bulk transfers can be effected by asset transfer rather than cash, removing or lowering market dependence at these times. At the long timescales of pension schemes, income and income growth are the dominant concerns. Moreover, it is obvious that risk provision today for everything that may occur over all possible futures is inefficient. One of the few things that we know, with certainty, about risk is that it means more things may occur than will. Provisions, which may be realised, are needed in the future not immediately. The proposed method has precisely such buffers at the maturity of the scheme, and these are buffers which rise in value as time passes.

The magnitude of required risk buffers is also related to the manner in which the balance sheet is estimated. Using current valuation standards, a risk buffer of two standard deviations would be of the order of 30% of scheme value while under the proposed it would be closer to 4% for a scheme reporting 100% solvency.

Adopting an accounting standard and regulatory practices which correctly reflect the present value and cost of pension liabilities is a minimum requirement if the broader situation of the joint consideration of sponsor and scheme are to be effected accurately. If any holistic balance sheet of sponsor and scheme is to be constructed, this is necessary.

Using this proposed form of accounting and valuation provides incentives for a pension scheme to be managed for the long term, which includes sustainability and sound governance in investments. It

²⁹ Coincidentally, the oldest member of the illustrative scheme is currently 91, having joined the scheme in 1946 as a 25 year old.

also makes these explicit and visible. In the case of the simple dividend model used for the illustrative scheme, the expected return of the illustrative scheme is 4% at a one-year horizon but rises to 5.48% over the life of the scheme – and more on discharge of the final liability. This incentive is a property of all growth models. There are also usually incentives for the purchase of long-dated bonds, which arise from the shape of the yield curve, which are, incidentally, currently very strong, as the curve from one month to thirty years or more is very steep.

This does not preclude strategic management; the asset allocation of the illustrative scheme was constructed five years ago to profit from declining interest rates and changing this to profit from rising bond yields is now under active consideration. However, it does discourage the hyperactive trading, and the associated frictional expenses, that are characteristic of speculation.

The most common question asked in reviews of this paper concerned the strategy of buying junk bonds that offer high current yields but are likely to default, which at first sight might frustrate an income related valuation. The short answer to this is that they might but they would certainly not do it twice given the consequence for future income projections and the pressure that this would then bring onto the sponsor employer. Recall that people learn not just from their own experience, but also that of others. The longer answer is that a stochastic model is needed to derive the expected income flows from defaultable bonds; these are most unlikely to produce results that show low quality bonds to be very attractive in a sustainable, long-term manner.

It is also noticeable, in the earlier figure copied from the Pensions Regulators paper, that pension trustees do not appear to exploit or abuse the flexibility presently available to them, which suggests that such behaviour would be extremely marginal. Moreover, shareholders would likely have much to say as the costs of failure of abusive strategies fall upon them.

Finally, the strategy of paying inadequate contributions for an award of benefits would be immediately visible in the value of the IGR. It would also be self-defeating. This abuse might reduce liabilities substantially but it would reduce reported asset values by even more.

Appendix C: An Illustration of the IGR function and scheme valuation

It is perhaps helpful to show the relation between the IGR function and a scheme valuation conducted using the IGR in point in time valuation in a single graphic. Figure A1 shows the valuation of liabilities for the representative scheme using the present value equality method shown earlier. It also shows the IGR function over the range between contributions. This is the IGR trajectory of values.

This utilises one of the more complex methods for IGR estimation; taking contributions and pensions totals and the average timing of these to derive the IGR function or trajectory. This is a non-trivial exercise as it is necessary to correct for the non-linearity of the cash flow sequences and the problems associated with Jensen's inequality. For those interested in investigating this aspect further, we will just offer the clue that corrections for convexity may be made through adjustments to either or both the timing or the amount of total contributions of pensions. This can also be related to approaches such as the Swedish pay-as-you-go turnover duration (TD) approach.

The IGR trajectory is shown as the red line between contribution total and the pension total. Obviously though not shown in this diagram the IGR extends beyond this range of support. Clearly, the IGR function is smooth – its proportional first derivative is a constant. In fact, it will vary only with revisions to contributions, pensions or their timing.

It is in no way dependent upon any exogenous variables, such as market prices or rates.

Figure A1: Illustration of the IGR function and scheme liability valuation

