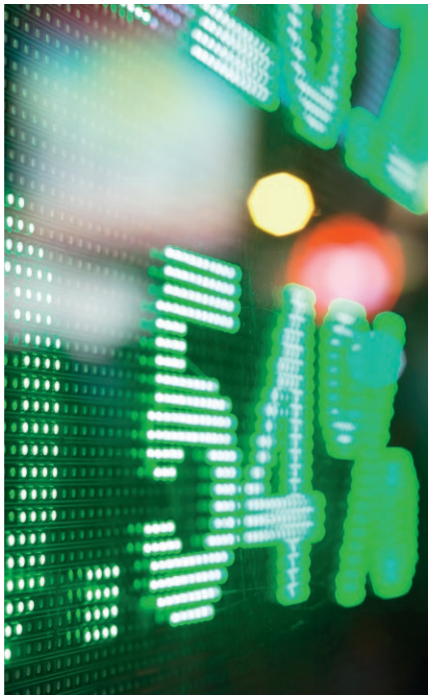
The ongoing influence of DB pensions on the market valuation of the Pension Plan Sponsor

Pension deficits and liabilities continue to bear heavily on the market values of FTSE 100 companies

Update: October 2016



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The ongoing influence of DB pensions on the market valuation of the Pension Plan Sponsor

Pension deficits and liabilities continue to bear heavily on the market values of FTSE 100 companies

Executive Summary

UK plc's defined benefit (DB) pension funds, and in particular their ever-widening deficits, currently dominate the political and social agenda. With approximately 11 million members and such high profile cases as the British Steel Pension Scheme and BHS, this is not surprising.

However, they now also dominate the business agenda, with increasing recognition that DB pension schemes continue to be large and extremely volatile elements in company balance sheets. With c.£3 trillion of liabilities compared to c.£1.5 trillion of assets,[1] on the insurance measure, they now potentially threaten the payment of dividends and, as this research shows, have significant negative effects on the market values of FTSE 100 companies.

This new study, by Llewellyn Consulting on behalf of Pension Insurance Corporation, updates the previous analysis of the impact of DB pension schemes on the share price of the FTSE 100 sponsoring company,[2] extending the analysis to the beginning of FY 2014.

The findings provide further robust evidence of the significant and ongoing downward pressure that DB pension liabilities, and pension deficits, exert on the market values of FTSE 100 companies.

The report's key conclusions include:

- The study confirms the findings of the earlier report of a broadly one-for-one effect of pension deficits on the market value of companies, when measured on a consistent 'risk free' basis, also consistent with the market attaching an additional risk premium equivalent to an average 20% of disclosed pension obligations.[3]
- It therefore shows that companies with larger pension liabilities are likely to be penalised the most by investors, even relative to those with similar percentage deficits, but which are based off lower overall total pension liabilities.
- Even those FTSE 100 companies that report a pension fund close to being fully funded, or even in surplus, are likely to be subject to a higher cost of capital directly correlated with the total size of their pension liabilities.
- By the end of FY 2013, DB liabilities for the FTSE 100 companies were some 50% higher than their pre-recession levels, averaging some 30% of market capitalisations, and have since ballooned with the fall in investment grade corporate bond rates.[4]
- Corresponding DB fund deficits, as reported in the company accounts, represented some 2% to 3% of market capitalisations at the end of FY2013, somewhat lower than at the recession peak of 4% to 5%, but still considerably higher in absolute terms than pre-recession levels. Estimates from other sources indicate that the accounting deficits have since increased substantially following the plunge in discount rates. These deficits are even higher if computed on a risk-free basis.
- Taking into account such risk premia, the negative impact of DB pension liabilities and deficits on FTSE 100 market valuations is estimated to have been around 7% to 9% by the end of FY 2013, considerably higher than might be suggested by reported pension net deficits alone and higher than their pre-crisis levels. These impacts are now likely to be considerably higher given the direct effects of continuing low and falling interest rates/yields on estimated liabilities.

1. Data from PwC's Skyval Index, August 2016.
2. See Richardson P. and L. Larcher, 2014.
3. Extrapolating this finding on the basis of DB pension liability data (from JLT Employee Benefits as at 31 August 2016) would imply that the market valuations of FTSE 100 companies were depressed by up to £340 billion at that point, incorporating both the reported deficit of £180bn and a further £160bn reflecting an additional 20%-odd risk premium associated with reported underlying pension liabilities of £795bn. Such estimates are of course subject to the usual margins of statistical error, and assume stability in the underlying relationships.
4. All figures cited are based on size-weighted averages across the FTSE 100 companies, using the available published accounts up to the end of fiscal year 2013.

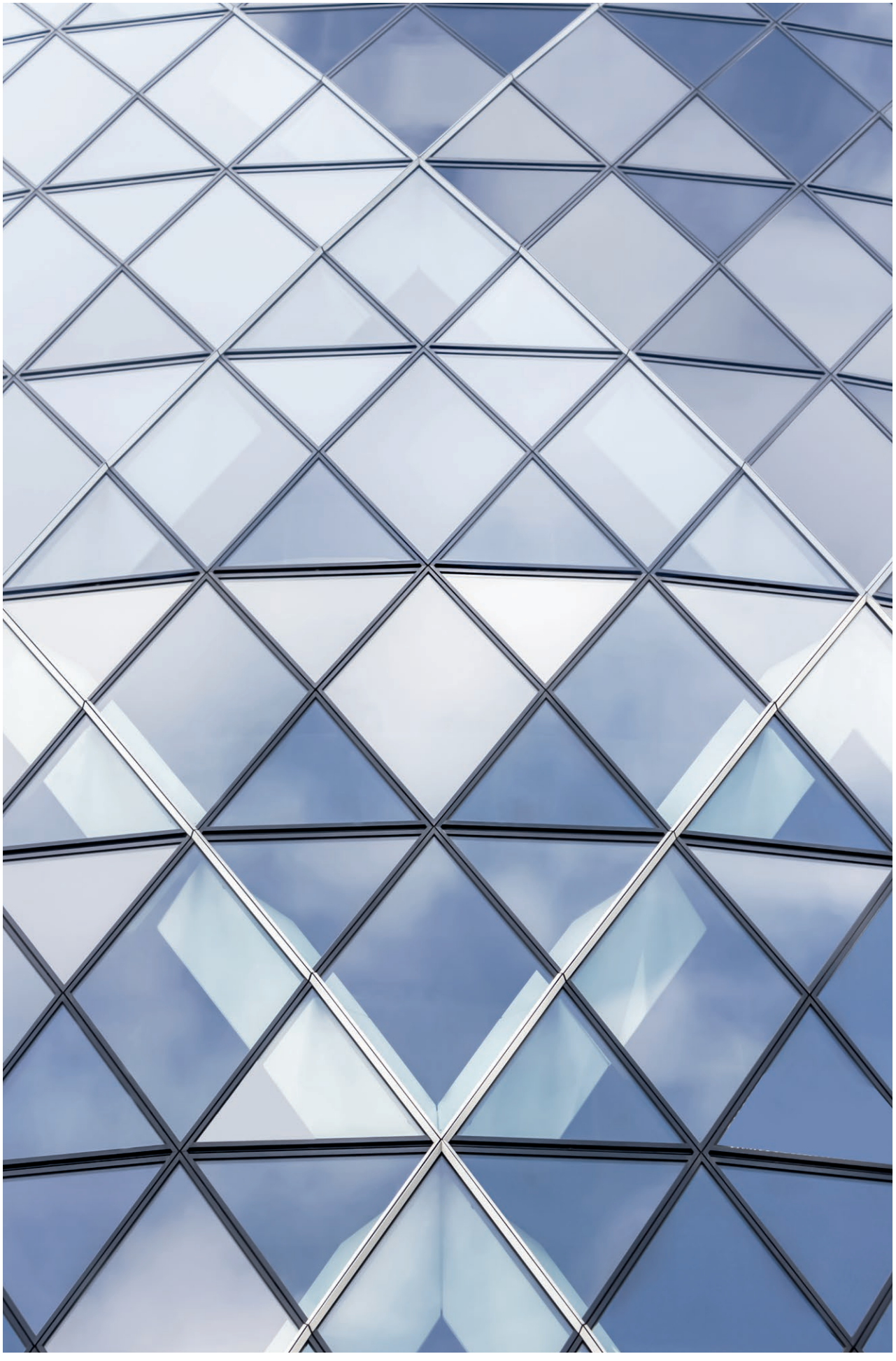
Analysis across broad macro sectors suggests that:

- The estimated relationships appear to be most well-defined for companies in the non-financial sectors compared with those in the financial sector, which were subject to greater volatility and risks during the financial crisis.
- Within the non-financial sector, companies in the industrial sector appear to have been more adversely affected than those in the consumer sector, reflecting generally higher pension liabilities built up during Britain's industrial heyday.
- The data also seem to suggest that the market capitalisations of companies in the financial sector have been impacted most heavily. However, this finding is not conclusive, being greatly influenced by the volatilities and uncertainties surrounding financial companies during the period of the financial crisis.
- Pension risks and their impacts are largely independent of company size as measured by total company assets.

The study also examines the implications of the recent revisions to the IAS19 pensions reporting requirements. Main findings here are that:

- Newly-disclosed information on the duration of pension obligations confirms previous estimates of an average 18-year duration used in the earlier study.
- For 2012, the recent changes in reporting standards[5] show a large impact on reported pension earnings – lower by an average 40%, equivalent to an approximate 2% reduction in total company earnings – implying possible further negative influences on market values.

5. In particular, IAS19 requires that estimated rates of return on pension assets be equated with those used in discount corresponding liabilities. As a result estimated rates of return from 2012 on are typically revised significantly downwards.



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The whole was edited by Preston Llewellyn, and approved for publication by John Llewellyn and Preston Llewellyn.

Authors' note

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The views expressed in the study are those of the authors, who remain responsible for any errors or omissions.

I. Introduction and scope of the study

Pension liabilities and deficits remain a concern for markets

Notwithstanding the systematic shift in company pension schemes from DB to Defined Contribution (DC) bases, DB pension liabilities and deficits continue to be large and volatile elements in company balance sheets, with potentially large and significant negative effects on the market values of the FTSE 100 companies.

The present study extends previous analysis of their influence ...

Following up the previous study on the influence of DB pension deficits on FTSE 100 companies,[6] the present study extends the analysis by a year to the accounting period ending in March 2014. In doing so it takes on board new information available as part of recent revisions in pension disclosure rules (as embodied in IAS19R), and looks more deeply at the implications for FTSE 100 market valuations by broad macro sector and by the size of company and pension scheme.

... on FTSE 100 company market values

The previous study examined the relationship between market valuations for the FTSE 100 companies and their DB pension deficits and obligations over the period 2006 to 2012, based on the information available from their published financial statements and associated pension notes. In doing so, a number of simple valuation models were estimated, relating the market valuations of each company to its non-pension book value and earnings, and its corresponding pension liabilities, deficits and costs (see the Box: The underlying model). From this analysis, three main conclusions emerged:

- In contrast to earlier U.S. studies[7] for US companies, for the UK FTSE 100 companies there is evidence of a well-defined and significant relationship between market valuations and DB pension deficits. Taken at face value, the influence of the pension deficit could appear to be disproportionate, implying that market values were reduced by considerably more than £1 per £1 of pension deficit. But this result appears to reflect the insufficiency of published pension deficits in representing the underlying structural factors, either because of risk premia which the market attaches to the scale of disclosed pension obligations or inconsistencies and uncertainties in their measurement.
- Allowing for such risk premia suggests a more or less one-for-one relationship between market valuation and the pension deficit, but subject to an additional 20% risk premium attached to the values of disclosed pension liabilities.
- Overall however, a more satisfactory relationship is obtained by putting pension liability estimates on a consistent 'fair value' or 'risk free' basis, using standardised gilt rates instead of corporate bond rates in calculating their net present values.[8] On this basis, a more stable one-for-one relationship is identified between market valuations and the corresponding 'risk free' pension deficits.[9]

An important implication of these results is that the market values of companies with larger pension liabilities are likely to be penalised relative to smaller schemes having otherwise similar net pension asset positions.

It examines robustness and impact by company sector and size

The main aim of the current study is to test the robustness of these results over a longer time period and to examine their implications for the market valuations of companies of specific types (by sector or size) in a systematic and more granular fashion.

6. See Richardson P. and L. Larcher (2014), The influence of DB pensions on the market valuation of the Pension Plan Sponsor: for the FTSE 100 companies, size really does matter, LlewellynConsulting, September 2014.
7. In particular, see the studies by Coronado and Sharpe (2003) and Coronado et al (2008).
8. For further details on the measurement of risk free pension deficits see Box: IAS19 and the choice of rates for discounting Defined Benefit pension obligations.
9. Although variable across the sample period, risk free adjustment also has the effect of increasing estimated pension obligations by an average 20%, close to the estimated average risk premia in the separate asset/liability model.

II. Key features of the extended data set

The data now include the 2013/14 accounts

The starting point for the study is the extension of the existing Defined Benefit Pensions Analytical Data Base for the FTSE 100 companies. This has involved the extraction of additional pension-note and associated financial data for the existing sample of companies, as defined by the 2009 composition of the FTSE 100 index, so as to produce a combined data set including information up and to the end of the 2013/14 accounting year.[10]

There have been some changes in reporting standards

Since the previous study, a number of important changes have been made to the information sets published within the company pension notes, reflecting revisions to the IAS19 reporting requirements. Those of special interest, and which complement the existing content of the study, concern the availability of information about the average duration of pension obligations and the way in which returns on pension assets are measured in company income statements.[11]

The duration of pension obligations

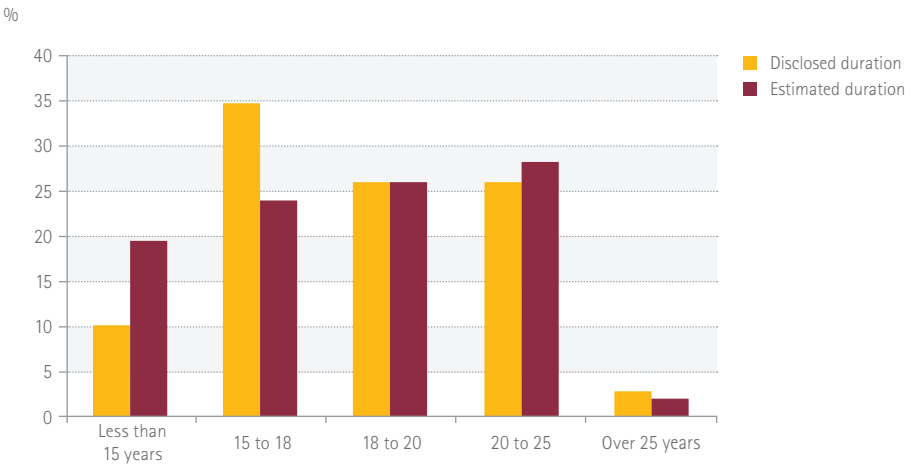
The duration of pension liabilities are now reported ...

Under the previous reporting requirements, the duration of pension liabilities were not directly disclosed. However, as noted in the Sources and Methods Annex 1, it was always possible to estimate approximate durations through interest rate sensitivity estimates published for most companies within the pension notes.[12]

In practice, sufficient information was available for the previous study to calculate implicit durations for over two-thirds of the FTSE 100 companies, providing estimates ranging from 12 to 25 years, with sample average and median values of around 18.2 years. For companies where discount rate sensitivities were not reported in the pension notes, the sample average duration was used in subsequent estimates. Experimentation also suggested that the resulting estimates of 'risk free' pension liabilities were relatively robust to variations in this assumption in the range of 15 to 20 years, reflecting perhaps the relatively flat yield curves for Gilts over the period.

Since the most recent IAS19 revisions, it is now possible to observe the relevant durations for 2012 and their distribution, and thereby check the relative accuracy of the previous estimates and any resulting errors in the calculation of 'risk free' pension obligations. The relevant information is reported in Figures A and B.

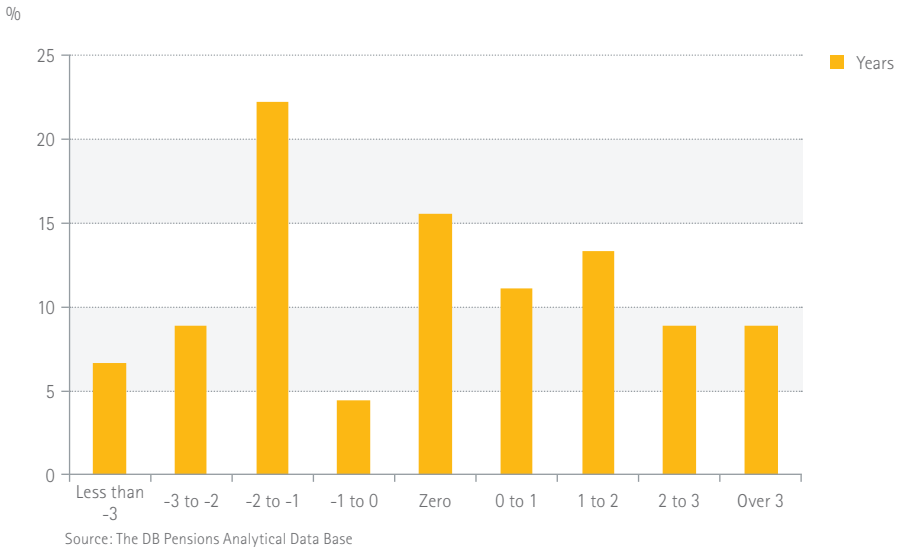
Figure A: The distribution of disclosed and estimated pension liability durations in 2012



Source: The DB Pensions Analytical Data Base

10. Full details of the DB pensions Data Base are given in Annexes 1 and 2 to this report.
11. A further notable change has been the abolition of the use of "corridor adjustments", whereby exceptional gains and losses from pension schemes could be deferred or smoothed over a period of years. The earlier study found such adjustments to have little or no effect on company valuations, supporting the view that the market essentially "sees through the veil" of cosmetic adjustments.
12. Specifically durations D are estimated as: D = - (dPL/PL) *(1+r)/dr
where D is, for a given company and year, the estimated duration and dPL/PL the proportionate change in the present value of DB liabilities reported in the pension notes for a given change (dr) in the discount rate (r) used in calculating the present value.

Figure B: Estimation errors for pension liability durations in 2012



Source: The DB Pensions Analytical Data Base

... confirming previous estimates of an average 18 year duration

Measured across companies in the sample, the average disclosed duration of 18 years is indeed very close to the estimated value of 18.2 years. From Figure A, the main source of overestimation is seen to lie in the slight over-estimation of the number companies with durations of 20 to 25 years, with an overestimation of companies with durations less than 15 years largely offset by the underestimation of companies with durations in the 15 to 18 year category. In absolute terms however, most estimation errors are seen in Figure B to be three years or less and broadly symmetric around zero, confirming the absence of any specific biases to risk-free liability estimates.

Interest costs and the returns on pension assets

Net interest cost and asset returns estimates are made consistently ...

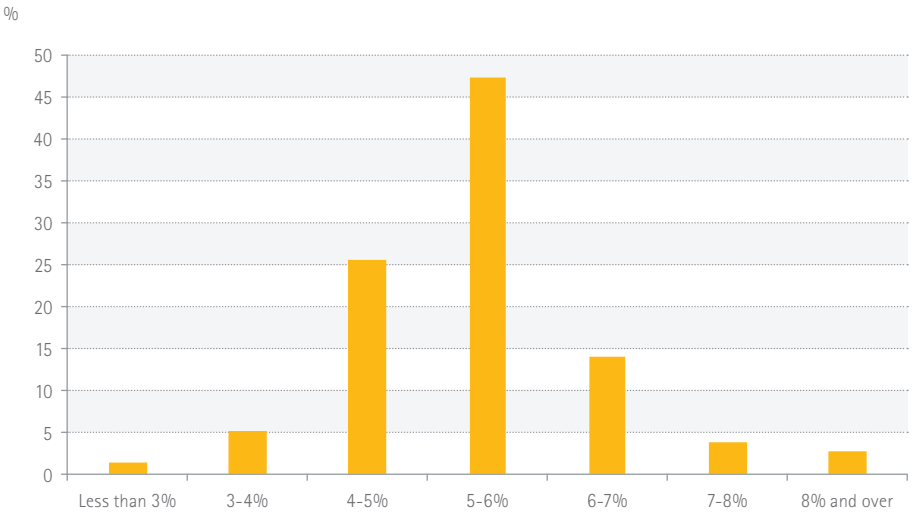
A second important change resulting from the revisions to IAS19 is that, for accounting periods starting on or after the 1st of January 2013, interest costs on the defined benefit obligation and the expected return on plan assets are replaced by net interest costs, calculated as the net position of the pension plan times the assumed discount rate. Companies were also required to restate their 2012 accounts according to the new rules, providing a useful basis for investigating the impact of the revision. Such a change is significant because the discount rates used in 2012, typically in the range of 4% to 5% were systematically lower than the expected rates of return on assets previously assumed, as illustrated in Figure C.

... reducing total company earnings by an average 2%

For 2012, for which overlapping information is available for most companies, the resulting reductions in earnings on pension assets for the FTSE 100 companies are large, on average approximately 40%, broadly equivalent to an average 2% reduction in total company earnings as a whole (See Figure D).[13]

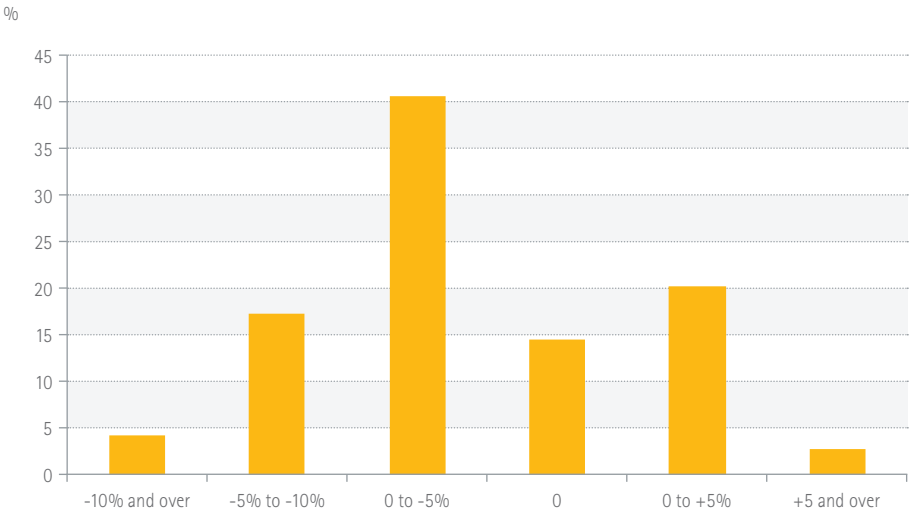
13. This average excludes the reported impact on earnings for TESCO PLC, for which the change in reported earnings was close to 100%.

Figure C: Expected rates of return on DB pension assets in 2012



Source: The DB Pensions Analytical Data Base

Figure D: The impact of IAS19 revisions on total company earnings in 2012



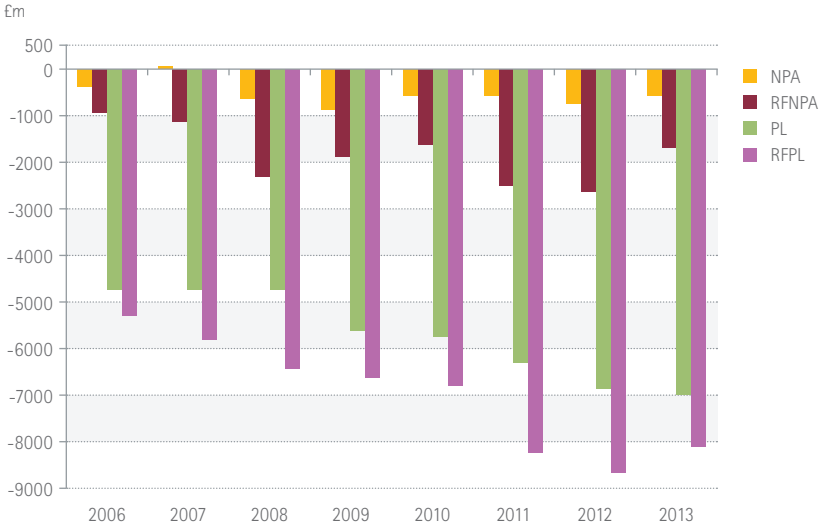
Source: The DB Pensions Analytical Data Base

Recent trends in DB liabilities and deficits and the impact of risk free adjustments

Liability shares have fallen but remain higher than pre-crisis levels

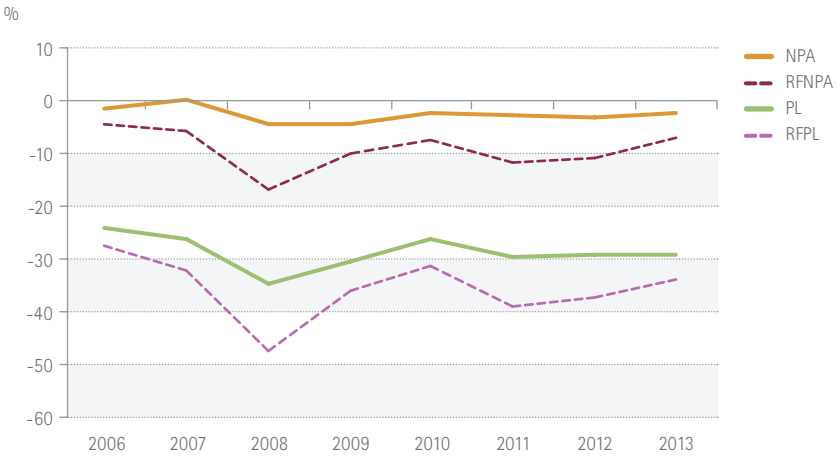
The broad movements in DB liabilities and net asset positions and as shares of market capitalisations for the FTSE 100 companies are illustrated in Figures E and F. Having peaked at around 35% at the height of the financial crisis, reported liabilities as a share of company values have moved back steadily since 2008, as markets recovered, towards 30% of company values. But they are still quite significantly higher (by almost 50%) in absolute terms than pre-crisis levels. Over the same period, pension deficits as a share of market capitalisations have also fallen significantly, averaging a little over 3% and 2% respectively in 2012 and 2013, but are still somewhat higher than their pre-crisis rates, significantly so in absolute terms.[14]

Figure E: Disclosed and 'risk free' DB pension liabilities and net assets, £m.



Source: The DB Pensions Analytical Data Base
Notes: Average values across the FTSE 100 companies in the full sample.
The yellow and green bars represent the reported values, the red and purple bars correspond to the 'risk free' adjusted values.

Figure F: Disclosed and 'risk free' DB pension liabilities and net assets, shares of market capitalisations



Source: The DB Pensions Analytical Data Base
Notes: Average values across the FTSE 100 companies in the full sample
The solid lines represent the shares based on reported data, the dashed lines correspond to 'risk free' adjusted values

14. Note that much of these improvements over the period reflect the steady recovery in company values movements in market values rather than any major falls in liabilities. As a share of total company assets, DB pension liabilities are at more or less the same as in 2008/9.

Risk adjusted liability shares at 8% are much higher

The overall picture is somewhat less sanguine in terms of liability and net asset positions when 'risk free' adjustments are taken into account - as indicated by the dashed lines in Figure F. On a risk-free basis, much of the large gap in deficit estimates, which opened up in 2008/2009, has subsequently abated, but risk-free deficits have remained at around 8% of market capitalisations in 2012/13, significantly above their pre-crisis levels.

Box: IAS19 and the choice of rates for discounting Defined Benefit pension obligations

The current provisions of the IAS19 guidelines require that pension obligations be discounted using the yield on high-quality corporate bonds, or government debt when there is no deep market in high-quality corporate bonds. Most companies interpret this provision as a recommendation for the use of AA-rated corporate bond yields of currency and duration matching those of the pension obligations. As a result, there can be considerable variability in discount rate assumptions across companies according to the chosen bond rate. There is nonetheless a long-standing academic debate about the choice of discount rate for such an exercise, summarized most recently by Napier (2009).[15]

Financial theory suggests that the determination of the pension obligation is a two-step process. The first is the estimation proper, where the schedule of future pension payments is computed using a range of actuarial assumptions that depend upon the specific situation of each DB scheme and the demographics of its participants. In the second step, once the future cash outflows of the pension fund have been estimated, they need to be discounted to compute the net present value of the projected benefit obligation (PBO) that the sponsoring company has to fund and disclose in its financial statements.

The discount rate used in such an exercise should be determined considering the risk of these future payments from the sponsor's standpoint. From such a perspective, however, the future benefit payments are certain, at least with regard to credit risk. The only way in which a sponsor can escape such payments is to file for bankruptcy or negotiate a reduction of pension benefits with the scheme's participants (in effect a salary cut). The results of the study imply that the market is taking account of DB pension liabilities with no allowance for credit risk in the discount rate, i.e. is allowing for a discount rate that is equivalent to a government bond yield. [16]

15. See Napier (2009), the logic of pension accounting. Accounting and Business Research.
16. For a wider discussion of the theoretical and practical issues relevant to the choice of discount rates for estimating pension liabilities, see Blake et al. (2008), Brown & Pennacchi (2015) Brown & Wilcox (2009), the UK Accounting Standards Board (2008) and The Purple Book, DB Pensions Universe Risk Profile, published annually by the UK Pensions Regulator and the UK Pensions Protection Fund.

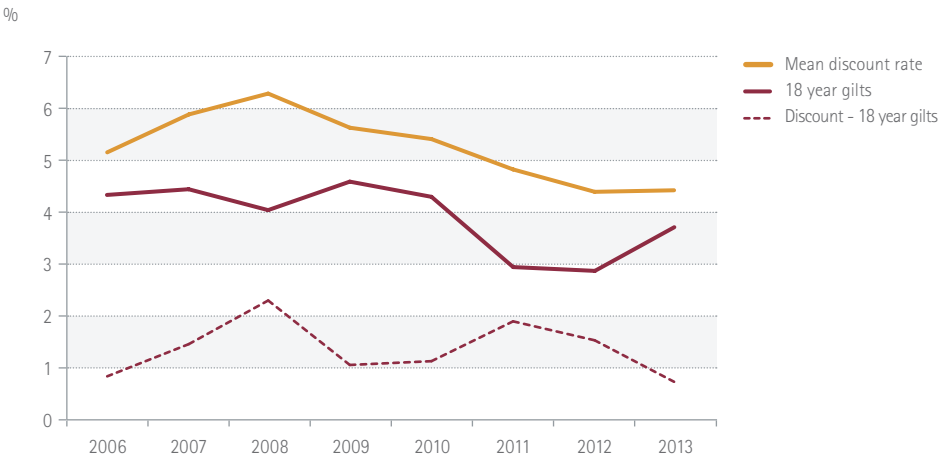
Risk adjustments are quite uniform across sectors

For the period as a whole, the average risk adjustment to pension liabilities is of the order of 22%, although the scale and distribution of these effects have varied significantly over time. As illustrated in Figure G, the broad impacts of the risk free adjustments are fairly uniform across sectors, following the same general paths over time, with the mean adjustment for the financial sector being marginally higher until the most recent period. The broad profile of adjustments over time, peaking in 2008 and 2011, closely follows the gaps between the average discount rates and prevailing gilt rates, as illustrated in Figure H. In 2008, the scale of the gap is a reflection of the general increase in risk premia as investors looked for safe havens amid market turmoil. Although corporate bond rates were declining steadily in 2010, 18-year gilts fell by a full 150 basis points, opening up a wider gap closing only in 2013 as bond rates levelled off and gilts recovered.

Structurally too there are major differences in the distribution of pension deficits across companies and over time on pre- and post-risk adjusted bases. The main movement in

Figure G: Percentage impacts of 'risk free' adjustment on pension liabilities by sector

Figure H: Average pension liability discount rates compared with 18 year gilt rates



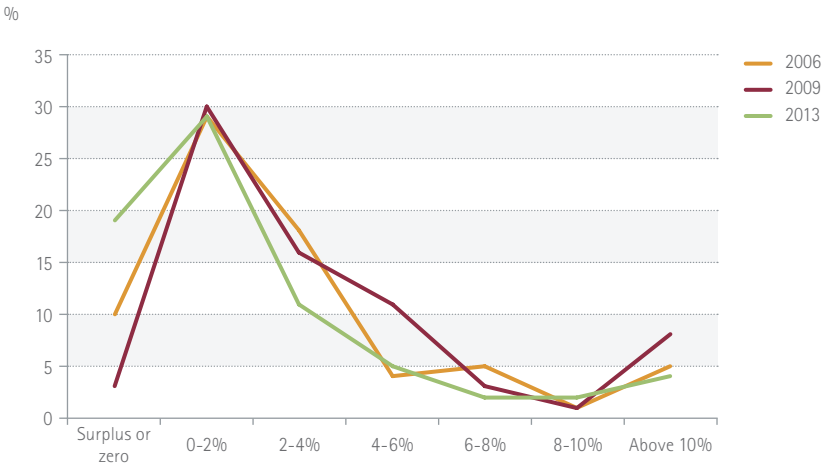
Source: The DB Pensions Analytical Data Base, Bank of England
Notes: The discount rate is the unweighted average of rates used in calculating net present values of DB pension obligations for the FTSE 100 companies.
The gilts rates are the end year values corresponding to the relevant accounting periods

reported net assets as a share of total company assets (Figure I) has been a rise in the proportion of companies reporting surpluses or near zero balances, to around 20% since the crisis. On a risk-adjusted basis (Figure J) however, the major shifts have been the rise in the share of estimated deficits in the 4% to 6% range, and the substantial fall in the proportion of companies with deficits exceeding 100% of total company assets (which rose quite dramatically during the crisis period). There are also significant differences in the shares of companies having pension deficits of 2% or below as between reported and risk-adjusted bases. On a reported basis these account for approximately half of the FTSE 100 companies in 2013, compared with less than one-third on a risk-free basis, with relatively few (if any) of the latter having significant surpluses.[17]

Pension deficits are still likely to be having significant negative effects

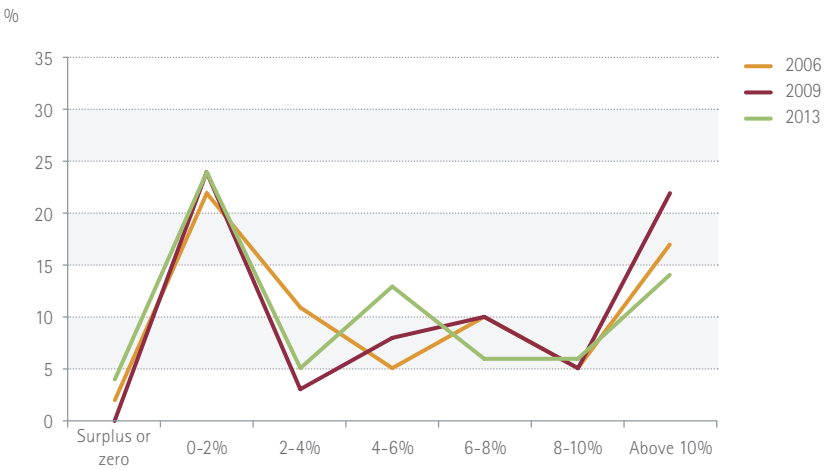
The overall conclusion is that DB pension deficits have varied considerably across companies and over time and, on a risk-adjusted basis, are still likely to be exerting significant negative influence on market valuations.

Figure I: The distribution of pension net assets, share of total company assets



Source: The DB Pensions Analytical Data Base

Figure J: The distribution of 'risk free' pension net assets, share of total company assets



Source: The DB Pensions Analytical Data Base

17. See Box: The significance of DB pension surpluses.

Box: The significance of DB pension surpluses

From time to time, a number of individual DB pension schemes and their sponsors have attracted market attention as they have declared or moved closer towards surplus positions. In the context of the present study, this raises the question of how much significance should be attached to having such surpluses.

In general, it is evident that moving towards apparent surplus or undertaking associated pension de-risking should, other things being equal, have a positive influence on share prices in reducing risk premia and risk-free deficits. The general impact of such changes would be expected to be to raise market valuations on a near one-to-one basis, with the percentage effects depending on the size of the change in relation to the overall market capitalisation.

Nonetheless, simply having a surplus does not mean per se that the market does not attach specific risks to the pension plan in question because of:

- Possible mis-valuation of liabilities, for example by the choice of discount rate;
- Exposure of both assets and liabilities to related risks, for example arising from prevailing uncertainties about interest rates, equity prices or longevity risks;
- Short-term market volatility, for example because the move towards zero or surplus balances arises through temporary circumstances or market fluctuations that are likely to unwind over time.

In such instances, the market would need additionally to factor into its evaluation the specific circumstances and causes of any temporary or underlying structural change.

III. New model estimates

Revised model estimates are made

The general approach for the empirical analysis using the revised data set is broadly the same as that adopted in the previous study, Richardson and Larcher (2014), estimating a set of market valuation models for the FTSE 100 companies over the extended sample period including data for 2006 to 2013. As described in the Box: The underlying model, three different forms of model have been used to test the relative importance of alternative measures of pension liabilities and deficits:

- A basic model featuring published pension net assets,
- A more generalised version giving separate weight to reported pension assets and liabilities, and
- A 'risk free' model using the alternative gilt-based risk free deficits and liabilities instead of the published statistics.

The key estimation results for these models are reported in Table 1.

Table 1: Summary model estimates

Dependent variable: MCAPA, the ratio of the market value of company to total company assets.
Equations as described in Box: The underlying model.
Sample: 2006-2013, companies as per notes.

Equation	1.1	1.2	1.2b	1.3	1.3b
Dependent Variable MCAPA	Net asset model N=618	Asset/liability model N=618	Net assets model with liability term N=618	Risk Free model N=618	Risk Free model with liability term N=618
BVCA	0.4354*** (.14)	0.4084*** (.14)	0.4077*** (.15)	0.4047*** (.14)	0.4099*** (.15)
NPAA	1.8577*** (.52)		0.9402* (.56)		
RFNPA				1.1175*** (.22)	1.3324*** (.50)
PLA		1.1827** (.54)	0.2191*** (.08)		
RFPLA					-0.0601 (.13)
PAA		0.9639* (.57)			
EA	3.9668*** (0.78)	4.0619*** (0.79)	4.0631*** (0.79)	4.0421*** (0.78)	4.02522*** (.78)
NPPCA	-0.6943 (6.74)	-3.4276 (6.68)	-3.3955 (6.68)	-3.9525 (6.45)	-3.8667 (6.592)
CON	0.87101*** (.11)	0.9033*** (.11)	0.9031*** (.11)	0.8918*** (.11)	0.8872*** (.11)
R2	0.5704	0.5765	0.5764	0.5807	0.5809
RMSE	0.4998	0.4966	0.4967	0.4938	0.4941

Notes: Year and sector fixed-effects variables are also included in all equations, but not reported here. Coefficient significance levels are indicated * p<.05 ** p<.01 *** p<.001 (equivalent to 90%, 98% and 99.8% confidence)

MCAPA = Market value of company/Total Assets
BVCA = Book Value of Company (ex Pensions)/Total Assets
EA = Company (Non-Pensions) Earnings/Total Assets
NPAA = Net DB Pension Assets/Total Assets
PLA = Pension Liabilities/Total Assets
PAA = Pension Assets/Total Assets
NPPCA = Net Periodic DB Pension Costs/Total Assets
RFNPA = Risk Free DB Pension Net Assets/Total Assets
RFPLA = Risk Free Pension Liabilities/Total Assets

Box: The underlying model

The broad approach for the empirical analysis used in this study is the same as that of the previous study, Richardson and Larcher (2014), estimating a set of simple market valuation models for the FTSE 100 companies over the period 2006 to 2013.[18] In essence, three different forms of model are used.

1. The basic pension net assets model

This model uses a simple residual income approach, relating the market value of each company to the book values of its pension and non-pension net assets and corresponding pension and non-pension earnings and costs, using an equation of the following form:

Equation (1) $MCAPA = b0 + b1 * BVCA + b2 * EA + b3 * NPCCA + b4 * NPAA + fixed\ factors$

where:

MCAPA = Market value of company/total assets
BVCA = Book value of company (ex-pensions)/total assets
NPAA = DB pension net assets/total assets
EA = Company (non-pensions) earnings/total assets
NPPCA = Net periodic pension costs/total assets
Fixed factor effects are included by both sector and year

In equation (1), all relevant variables are normalised by the book value of total company assets, to allow for the possibility of heteroskedasticity and non-stationarity and associated estimation biases. Econometrically, there are good reasons to believe that such model is more likely to be stable, particularly during a period of share price volatility, which may otherwise mask the underlying economic relationship.[19] Individual sector and time variables are also included to pick up sector and time-specific factors common to the companies in the sample, including the economic cycle and related secular trends.

Within this framework, two underlying valuation models can be distinguished. The first is a "transparent" model, in which market investors, when valuing a company, focus simply on the value of pension and non-pension net assets, rather than the associated flows of net financing accruals i.e. one in which b1, b4<1 and b3=0. The polar alternative, the "opaque" model, is one where investors take no explicit account of pension net assets as opposed to the stream of associated pension-related accruals, that is, b3> 0 and b4 = 0.

In the previous study, the estimation results for the FTSE 100 companies over the sample period 2006 to 2012 are consistent with a model in which both pension and non-pension net assets and earnings variables are found to be statistically significant.[20]

18. See Richardson and Larcher (2014), "The influence of DB pensions on the market valuation of the Pension Plan Sponsor". The approach is similar to that used by Coronado and Sharpe (2003) and Coronado et al (2008) in the study of U.S. companies.
19. Clearly the sample from 2006 to 2013, includes a period of major financial volatility and the preliminary screening of the raw data confirmed its non-stationarity with high degrees of co-linearity. Corresponding tests on the model in normalised form confirm general stability and stationarity of the variables involved.
20. This result contrasts with previous findings for the US in which pension net assets are not found to be statistically significant and with pension related effects being mainly reflected by expected pension earnings. Coronado and Sharpe (2003) consider this result to reflect the poor information content and lack of transparency of the US pension accounts data as published under the then prevailing disclosure rules.

2. The split assets and liabilities model

While estimates of the basic net assets model above are found to be reasonably well-determined statistically, further tests suggested that more satisfactory and stable results are obtained by separating the individual positive and negative effects of pension assets and liabilities on the market valuations using a more general model of the form:

Equation (2) $MCAPA = b0 + b1*BVCA + b2*EA + b3*NPCCA + b4*PAA + b5*PLA + fixed\ factors$

where: PAA = Pension assets/total assets
PLA = Pension liabilities/total assets

The economic interpretation of equation (2) is that reported net pension assets are not statistically "sufficient" for representing the overall pension situation, and that the market places different weights on the values of assets and liabilities. This might for example reflect measurement uncertainties or specific risk premia being attached, in particular, to reported pension liabilities.

Noting that 'net pension assets' is simply the difference between pension assets and liabilities, equation 2 above can also be rearranged in the following form:

Equation (2b) $MCAPA = b0 + b1*BVCA + b2*EA + b3*NPCCA + b4*NPAA + (b5-b4)*PLA + fixed\ factors$

Although both equations are observationally identical, equation (2b) has the advantage of providing separate testable estimates of the influence of net pension assets and the risk premium term (b5-b4) on liabilities.[21]

3. The 'risk free' liabilities and net assets model

As noted above, there are various reasons for thinking that estimated pension liabilities, measured as the net present value of expected pension obligations, may be subject to considerable uncertainty. Quite apart from those attached to longevity and inflation risks, the choice of discount factor used – required to be that of a high-grade corporate bond of the relevant duration and currency – is both influential and quite variable across companies.

To explore this as a possible source of uncertainty across company schemes, this study also uses an alternative estimation method to derive so-called 'risk free' pension liabilities, based on discounting the liabilities at a risk-free gilts rate that matches their duration profile.[22] The resulting models are of the same general form as before, but use 'risk free' estimates of net pension assets (RFNPAA) and liabilities (RFPLA) instead.

Equation (3) $MCAPA = b0 + b1*BVCA + b2*EA + b3*NPCCA + b4*RFNPAA + fixed\ factors$

Equation (3b) $MCAPA = b0 + b1*BVCA + b2*EA + b3*NPCCA + b4*RFNPAA + (b5-b4)*RFPLA + fixed\ factors$

where: RFNPAA = Risk free pension net assets/total assets
RFPLA = Risk free pension liabilities/total assets

21. It also reduces the apparent influence of collinearity on the observed parameter standard errors.
22. The general theoretical background to 'risk free' adjustment is given in the Box: IAS19 and the choice of rates for discounting Defined Benefit pension obligations. For further details of the estimation methods used, see the detailed Sources and Methods annex to this study, and also Richardson and Larcher (2014).

These strongly confirm earlier results

As for the previous study, the broad results confirm high levels of statistical significance for each of the relevant pension variables within the broad framework of a generally well-determined and stable market valuation model. Comparing different specifications of the pension effects also confirms the broad nature of previous results:

- Pension net assets are seen to be highly statistically significant, with an estimated parameter in excess of 1, implying a disproportionate effect of pension deficits on market values.
- A better-determined model with greater explanatory power is given by allowing for the influences of pension assets and liabilities separately. In such a model the estimated influence of net deficits is a little less than 1, with an additional risk premium effect equal to approximately 20% of the value of liabilities (Equations 1.2 and 1.2b), equivalent to a notional 20% 'rule of thumb'.
- Statistically however, the best overall results are obtained using the 'risk free' estimates of pension net assets, with parameter estimates which are not significantly different from 1 and with no evidence of any additional risk premia effects coming from risk-free liabilities (comparing Equations 1.3 and 1.3b).

Table 2: Summary comparisons with Richardson and Larcher (2014)

Dependent variable: Market value of company/total company assets
Sample: 2006-2013 and 2006-2012 respectively.

Equation	1.1	R & L (2014)	1.2b	R & L (2014)	1.3	R & L (2014)
Dependent Variable MCAPA	Net asset model 2006-2013 N=618	Net asset model 2006-2012 N=543	Net assets model with liabilities term 2006-2013 N=618	Net assets model with liabilities term 2006-2012 N=543	Risk Free model 2006-2013 N=618	Risk Free model 2006-2012 N=543
BVCA	0.4354*** (.14)	0.4644*** (.15)	0.4077*** (.15)	0.4377*** (.15)	0.4047*** (.14)	0.4310** (.15)
NPAA	1.8577*** (.52)	1.5990*** (.49)	0.9402* (.56)	0.8469* (.54)		
RFNPA					1.1175*** (.22)	0.9276*** (0.22)
PLA			0.2191*** (.08)	0.1765* (.08)		
EA	3.9668*** (0.78)	3.6975*** (.80)	4.0631*** (0.79)	3.7923*** (.81)	4.0421*** (0.78)	3.7853*** (.80)
NPPCA	-0.6943 (6.74)	5.9406 (6.19)	-3.3955 (6.68)	3.2991 (6.52)	-3.9525 (6.45)	2.5567 (6.27)
CON	0.87101** (.11)	-0.0048 (.14)	0.9031*** (.11)	0.0232	0.8918*** (.11)	0.0027 (.14)
R2	0.5704	0.5819	0.5764	0.5862	0.5807	0.5897
RMSE	0.4998	0.4799	0.4967	0.4779	0.4938	0.4754

Notes: Year and sector fixed-effects variables are also included in all equations, but not reported here. Coefficient significance levels are indicated * p<.05 ** p<.01 *** p<.001 (equivalent to 90%, 98% and 99.8% confidence)

MCAPA = Market value of company/Total Assets
BVCA = Book Value of Company (ex Pensions)/ Total Assets
NPAA = Net DB Pension Net Assets/Total Assets
RFNPA = Risk Free DB Pension Net Assets/Total Assets
PLA = Pension Liabilities/Total Assets
EA = Company (non-pensions) Earnings/Total Assets
NPPCA = Net Periodic DB Pension Costs/Total Assets

New model estimates

As reported in Table 2, the general results are almost identical to those of the previous study, confirming the general robustness of the relationships over the longer time period and with generally the same explanatory power. There are some differences, however, in that some coefficient estimates are marginally higher than before while others are marginally lower. This is most noticeably the case for the pension variables, for example with the net assets parameters up to 20% larger. Whilst it is tempting to suggest that this might reflect growing importance over time, the differences are not statistically significant, and also should not be confused with the overall impacts of pensions being greater, which depends not only on the estimated parameters but the paths of the relevant pension variables over time by company.[23]

The estimates are not biased by companies with the largest deficits

As in the previous study, there was some concern that the estimation results might be unduly influenced by extreme "outlier" observations. In particular, for pensions there is a relatively small number of companies with so-called "super-sized" schemes with pension liabilities and assets which commonly exceed 100% of company market values and/or total company assets. To check for sensitivity to such outliers, additional model estimates were made by sequentially removing individual data points based on the ratio of pension liabilities to market capitalisations (R). In Table 3 estimates of the preferred 'risk free' model are reported for samples ranging from the full set of observations to ones which exclude data points where liabilities successively exceed 300%, 200% and 100% of market capitalisations.[24] On this basis, the deficit parameters are seen to be consistently significant and extremely stable, in the range 1.10 to 1.17, with no systematic pattern of variations over the samples used.

A risk adjusted model is found to provide the best explanation

The broad conclusion is that the 'risk free' model again provides a stable explanation of company values over time.[25]

23. The task of evaluating the impact of DB pensions on market valuations over time and by company sector and size classes is explored in more detail in later sections of this study.
24. The specific exclusions, which are data point specific rather than applying over the whole sample period, are reported in the lower panel of Table 3.
25. Similar tests were carried out using the reported pension net assets and liabilities data. These general results suggested that the simple net assets model was somewhat less stable as the sample was reduced, consistent with a systematic specification bias.

Table 3: Testing the sensitivity of the Risk Free model (Eq. 1.3) to changes in sample composition

Sample: 2006-2013, companies as per notes.

Equation	3.1 (1.3)	3.2	3.3	3.4
Sample MCAPA	Full sample N=618	Excluding R>3 N=608	Excluding R>2 N=597	Excluding R>1 N=558
BVCA	0.4047** (.14)	0.3923** (.14)	0.3893** (.14)	0.3973** (.15)
RFNPAA	1.1174*** (0.23)	1.1019*** (0.24)	1.1305*** (0.28)	1.1743*** (0.39)
EA	4.0421*** (0.78)	3.9877*** (0.78)	3.9495*** (0.76)	3.8797*** (0.77)
NPPCA	-3.9524 (6.45)	-5.4174 (6.56)	-7.3244 (6.64)	-7.0181 (7.018)
CON	0.8918*** (.11)	0.8894*** (.11)	0.8966*** (.11)	0.9327*** (.12)
R2	0.5807	.5812	.5846	0.5772
RMSE	0.4938	.4943	.4955	0.5063

Notes: Year and sector fixed-effects variables are also included in all equations but not reported here. Coefficient significance levels are indicated * p<.05 ** p<.01 *** p<.001 (equivalent to 90%, 98% and 99.8% confidence)

MCAPA = Market value of company/Total Assets

BVCA = Book Value of Company (ex-Pensions)/ total assets

EA = Company (non-pensions) Earnings/total assets

RFNPAA = Risk Free estimate of Net DB Pension Assets /total assets

NPPCA = Net Periodic DB Pension Costs/total assets

R = -PL/MCAP = Ratio of DB Pension Liabilities to market capitalisation

In Table 3 the estimation sample was sequentially reduced by excluding individual observations for specific companies for specific years according to the ratio of pension liabilities to market capitalisation (R), as follows:

Equation	R>3	R>2	R>1
BA/ICA Group	X	X	X
BT Group	X	X	X
GKN	X	X	X
Invensys	X	X	X
BAE Systems		X	X
RBS		X	X
Aviva			X
Barclays			X
IMI			X
Lloyds			X
Marks & Spencer Group			X
National Grid			X
Rexam			X
Rolls Royce Holdings			X
RSA Insurance Group			X
Sainsbury's			X
TUI Travel			X

Notes: The mean value of R over the estimation sample period is 0.47, with a standard deviation of 0.8. The distribution is however extremely skewed, with a median of 0.22.

IV. Extending the basic model

Accounting for tax effects

A specific feature of the analysis so far is that no allowance has been made for the potential role of perceived tax credits on a sponsor's pension contributions. In practice, whenever a company contributes money into the pension fund it gets a corresponding tax credit. From a market perspective therefore, if a company is profitable, then the cost of paying down its pension deficit would be significantly less than the reported gross figure, allowing for the corresponding deferred tax asset. In the limit therefore, an expected theoretical one-for-one relationship between market valuation and the pension deficit should be on a tax-adjusted basis.

Adjusting for taxes does not affect the significance of deficits ...

To explore this issue further, the three basic models were re-estimated to include tax-adjusted gross and net pension asset measures. These adjustments essentially correspond to the theoretical post-tax value of the deficit, obtained by the product of the reported deficit and the prevailing corporate tax rates. The corresponding results are reported in Table 4.

Table 4: Tax adjusted models

Dependent variable: MCAPA, the ratio of the Market value of company to total company assets
Equations as described in Box: The underlying model.
Sample: 2006-2013, companies as per notes.

Equation	4.1	4.2	4.3
Dependent Variable MCAPA	Net asset model N=618	Asset/liability model N=618	Risk Free model With tax adjustment N=618
BVCA	0.4351*** (.14)	0.4083*** (.14)	0.4024*** (.14)
NPAt	2.5289*** (.71)		
PLA		1.5359** (.75)	
RFPLA			1.4858*** (.4527)
PAAt		1.3187* (.79)	1.5781*** (.57)
EA	3.9661*** (0.78)	4.0614*** (0.79)	4.0271*** (0.78)
NPPCA	-0.6192 (6.73)	-3.3994 (6.67)	-3.5239 (6.57)
CON	0.8687*** (.11)	0.9022*** (.11)	0.8820*** (.11)
R2	0.5703	0.5765	0.5809
RMSE	0.4999	0.4966	0.49401

Notes: Year and sector fixed-effects variables are also included in all equations but not reported here. Coefficient significance levels are indicated * p<.05 ** p<.01 *** p<.001 (equivalent to 90%, 98% and 99.8% confidence)

MCAPA = Market value of company/Total Assets
BVCA = Book Value of Company (ex Pensions)/ Total Assets
EA = Company (non-pensions) Earnings/Total Assets
NPAt = Tax adjusted Net Pension Assets/Total Assets*
PLA = Pension Liabilities/Total Assets
PAAt = Tax adjusted Pension Assets/Total Assets*
NPPCA = Net Periodic DB Pension Costs/Total Assets
RFPLA = Risk Fee Pension Liabilities/Total Assets

* Tax-adjusted variables denoted by suffix "t" allow for tax credits at the prevailing corporate rates T, measured in terms of the net pension deficit times the corresponding tax factor (1-T). In the case of the asset liability model (Equation 4.2) the adjustment is added to the pensions asset term, PAA.

... although the effects are arithmetically larger

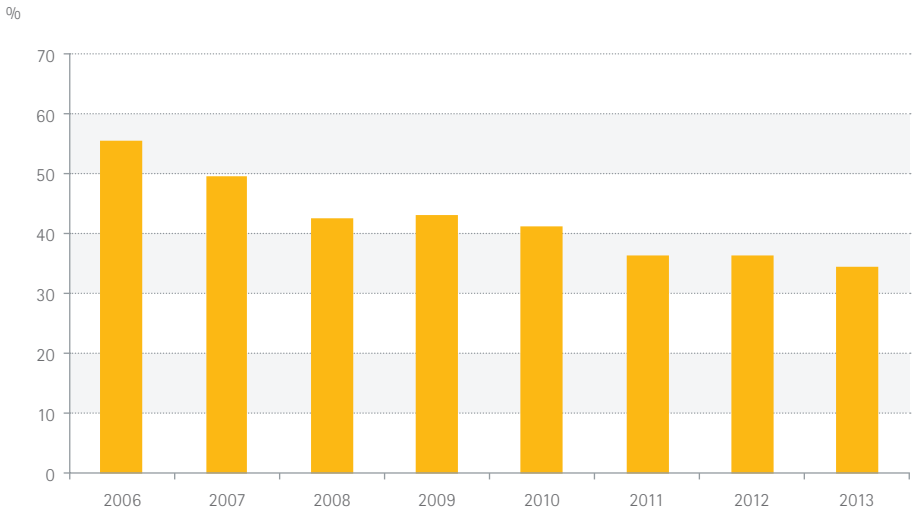
The main feature of the tax-adjusted estimates is the systematically larger values of the coefficients on the pension variables, be they on a published or risk-adjusted basis. In all other respects the model estimates, coefficients, and significance levels are more or less identical to those making no allowance for taxes. The reasons underlying this result are largely arithmetic. With the corporate tax rate declining only slowly over much of the period, the main effect is to rescale the pension deficit measures by a near-constant amount, equal to 1 minus the marginal tax rate, in this case approximately 73%.[26] As a result, the corresponding coefficient estimates are almost automatically rescaled by approximately 37%.[27] In practice, these results do not fundamentally affect the nature of the estimated relationship, but rather the interpretation of the coefficient estimates. In particular they highlight the size of the pension effects in relation to the theoretical value of unity, while allowing for normal margins of error.

How important are equity risks?

No evidence is found of equity risks although their scale is likely to have declined

While a main focus of the study is on the risks associated with pension liabilities and their measurement, it seems likely that the share of pension assets held in more risky investment categories may also play some part in the market valuation process. In the 2014 study, some allowance was made for such an influence using a composite risk variable incorporating equity, longevity, and interest rate risk components. Although composite measures of this kind were found to be statistically significant, the relevant variable was somewhat dominated by the liability element and no independent effects from equity risks were detected. In the present study further explicit tests were made for such effects, but failed to give any credible or significant results. As Figure K illustrates, equities continue to account for a fairly substantial proportion of pension assets, though with steadily falling shares over the sample period, from around 60% in 2006 to a little over 30% in 2013. Thus equity risks, though not identifiable, are likely to have fallen quite substantially over the most recent period.

Figure K: The share of equities in FTSE 100 DB pension assets



Source: The DB Pensions Analytical Data Base

26. The assumed marginal tax rates are 30% for 2006 to 2008, 28% in 2009 and 2010, 26% in 2011 and 23% in 2012 and 2013, averaging 27.3%.
27. Noting that a 1.37 scale factor is equivalent to 1 divided by the average post tax factor 0.73.

Do pension responses differ between sectors?

Pension effects may vary between sector

Given the considerable range of variations in the structure and positions of DB schemes across companies and sectors, an important question is whether the broad relationships identified in the previous section apply more or less equally to companies by sector. While all these models include fixed-factor effects to account for common influences over time and within specific sectors, these represent constant influences, and hence do not convey much information about possible different reactions to pension liability or deficit variables.

Table 5: Sectoral estimates

Dependent variable: MCAPA, the ratio of the Market value of company to total company assets
Equations as described in Box: The underlying model
Sample: 2006-2013, companies as per notes.

Equation	5.1	5.2	5.3	5.4
Dependent Variable MCAPA	Net asset model for 2 sectors N=618	Risk Free model for 2 sectors N=618	Net assets model for 3 sectors N=618	Risk Free model for 3 sectors N=618
BVCA	0.4309*** (.15)	0.4011*** (.14)	0.4328*** (.15)	0.4086*** (.14)
NPAAnf	1.8476*** (.52)			
NPAAfin	2.9668 (4.18)		2.9841 (4.16)	
RFNPAnf		1.1280*** (.23)		
RFNPAfin		-3.8188 (3.10)		-3.8118 (3.10)
NPAAcons			1.2581* (.70)	
NPAAind			2.3409*** (.66)	
RFNPAcons				0.8336*** (.31)
RFNPAind				1.2752*** (.29)
EA	3.9654*** (0.78)	4.0449*** (0.77)	3.9475*** (0.78)	4.0327*** (.78)
NPPCA	-0.6512 (6.76)	-3.7876 (6.45)	-0.6300 (6.69)	-4.0475 (6.5639)
CON	0.8729*** (.11)	0.8972*** (.11)	0.2945*** (.11)	0.8598*** (.12)
R2	0.5703	0.5824	0.5714	0.5833
RMSE	0.5002	0.4931	0.5000	0.4930

Notes: The suffixes 'fin' , 'non-fin', 'cons', and 'ind' each denote the relevant concepts included as separate variables for the Financial, Non-Financial, Consumer, and Industrial sectors, as defined in Annex 1. Year and sector fixed effects variables are also included in all equations but not reported here. Coefficient significance levels are indicated * p<.05 ** p<.01 *** p<.001 (equivalent to 90%, 98% and 99.8% confidence)

MCAPA = Market value of company/Total Assets
BVCA = Book Value of Company (ex Pensions)/ Total Assets
EA = Company (non-pensions) Earnings/Total Assets
NPAA = Net DB Pension Assets/Total Assets
NPPCA = Net Periodic DB Pension Costs/Total Assets
RFNPA = Fair Value DB Pension Net Assets/Total Assets
RFPLA = Fair Value Pension Liabilities/Total Assets

In practice, the FTSE 100 company sample is too small to look at this issue in terms of effects differentiated by the ten individual sectors in the main data set, but a limited amount of analysis is still possible on a more aggregative macro-sector basis. With this in mind, Table 5 reports the results for two sets of macro-sectoral level estimates.

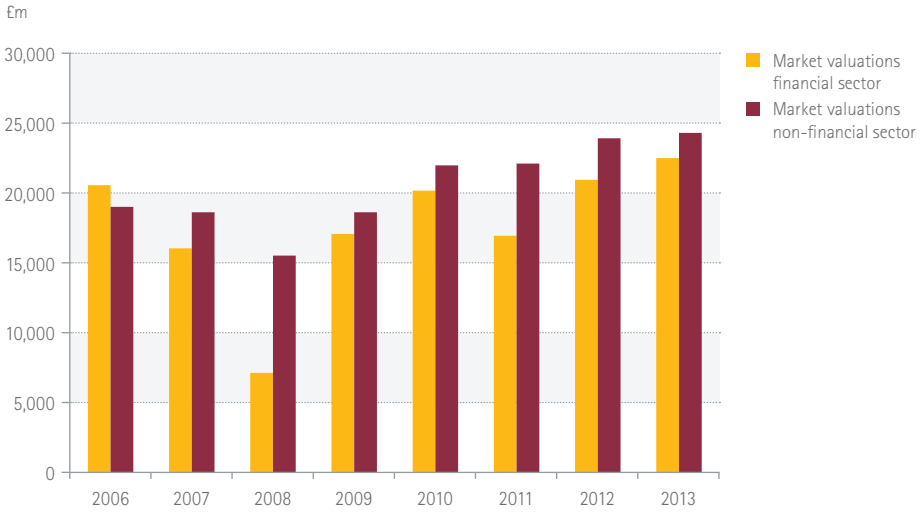
The first distinguishes between pension effects for the 20 or so companies classified to the financial sector and the remaining non-financial sector companies. In both cases estimates are made for both the net asset and risk free models (Equations 5.1 and 5.2) by including separate sector specific pension variables.

The key result is that the pension deficit effects are found to be highly significant and well determined for the non-financial sector and are generally consistent with estimates for the overall sample. By contrast, estimates for companies in the financial sector are relatively unstable and poorly determined, although their inclusion does not appear to bias the results for the full sample, which are broadly identical to those for the non-financial sector. Similar results are reported for a further 3-sector split between companies in the financial, industrial, and consumer sectors (Equations 5.3 and 5.4). Here again, estimated effects for the financial sector are found to be poorly defined, while those for consumer and industrial sectors are significant and broadly in line with those for the full sample.

... but are largely driven by the non-financial companies

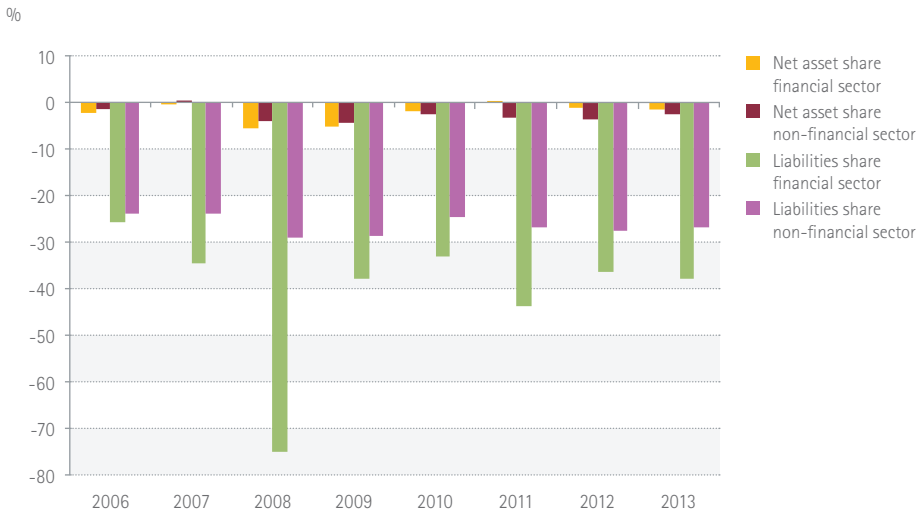
The general conclusion is that the estimated relationship between pension deficits and market values appears to be driven largely by companies in the non-financial sector. Such a result is not entirely unexpected given the differences in relative size, structure, and evolution of DB pensions in the sectors concerned and, more importantly, the difference in the scale of the shocks to financial market values during the financial crisis as illustrated in Figures L and M.

Figure L: Average FTSE 100 market valuations by sector, £m.



Source: The DB Pensions Analytical Data Base
Notes: Weighted company averages by sector

Figure M: Pension net assets and liabilities, shares of market valuations by sector



Source: The DB Pensions Analytical Data Base
Notes: Weighted company averages by sector

V. The impact of pension deficits on market valuations

Estimated impacts on market valuations combine coefficients with pensions data

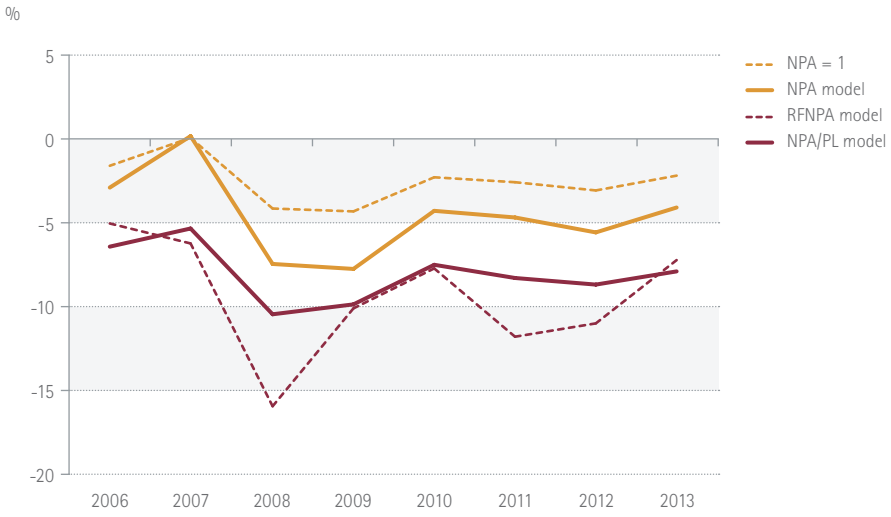
The various impacts of DB pensions on market valuations over time, by sectoral and other company classifications, can readily be estimated by combining the corresponding data sets with the estimated models.[28] This section reviews these impacts across models, for the total sample, by broad macro company sectors and by size groups.

Estimated impacts for the FTSE 100 companies

Aggregate impacts have varied over time

For the FTSE 100 companies as a whole, Figure N summarises the key estimates of DB pension impacts using the range of models discussed in the previous section. The solid yellow and burgundy and dashed burgundy lines correspond respectively to the estimated impacts given by the basic net asset (NPA), the 'rule of thumb' (NPA/PL) and Risk Free (RFNPA) models using the coefficient estimates reported for Equations 1.1, 1.2 and 1.3 respectively in Table 1. The dashed yellow line (NPA=1) corresponds to the theoretical impact given by a relationship where there was a simple one-for-one effect of pension deficits on market values. The various gaps between this dashed line and the model-based estimates are significant because they represent the estimated risk premia implicit in each model. Thus, for the basic net assets model, the risk premium is equivalent to around 85% of the reported deficit; for the 'rule of thumb' model it is an approximate 20% fixed proportion of pension liabilities; and for the 'risk free' model, a variable risk premium depending on both the levels of liabilities and the differences between gilt rates and the average corporate bond rates used in discounting pension obligations.

Figure N: Percentage impacts of DB pensions on market valuations for the FTSE 100 companies, by model



Notes: The estimates are based on the estimated parameters from Eq 1.1 (NPA model) , 1.2 (NPA/PL model) and 1.3 (RFNPA model) respectively from Table 1. The dashed yellow line represents the impacts for a one-for-one relationship between market values and net pension assets, as described in the text.

28. For a given model in which the relationship between market valuation and pension variable P is defined by the expression: Mcap = B*P + other explanatory variables, the percentage impact on market valuations relative to the baseline excluding pensions effects is given by the expression Impact = 100*B*P/(Mcap - B*P).

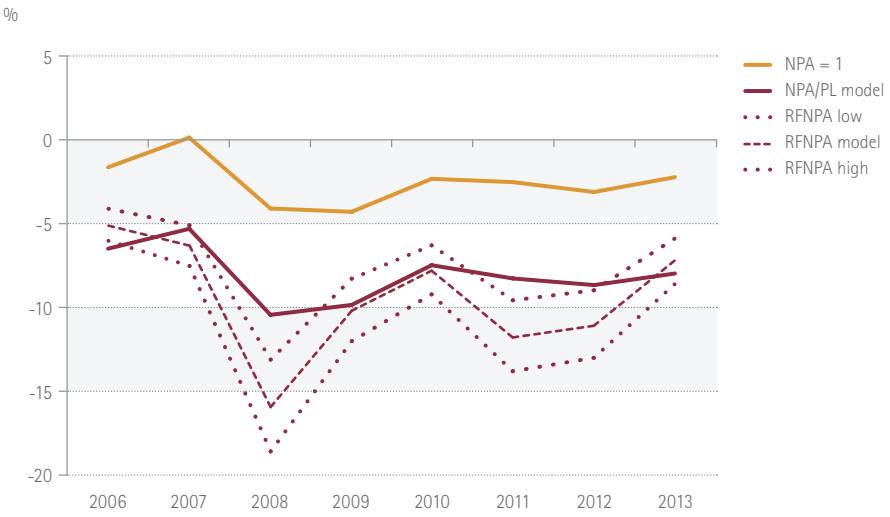
They rose sharply during the financial crisis ...

... have fallen since, but remain above pre-crisis levels

A key common feature of these estimates is the sharp increase in risk premia through the financial crisis (with impacts of 8%, 10% and 15% respectively, depending on the choice model), in part a reflection of sharply falling market prices in 2008, with some recovery thereafter.[29] Even so, the negative impact of pensions on market values remains substantial over the most recent period, and significantly greater than for the pre-crisis period, reflecting the continuing high levels of pension deficits and liabilities. Risk premia effects are substantially greater using the preferred 'risk free' and 'rule of thumb' models. Both these models show risk premia moving broadly in line, apart from in 2008 and 2011, where the risk free adjustments are greatest. Thereafter there is a general convergence in estimated impacts towards an average 7.5% in 2013, compared with 5% to 6% in 2006.

Allowing for the estimated standard errors of the pension coefficients, as illustrated in Figure O, there is little significant difference between these two sets of estimates.[30]

Figure O: Percentage impacts of DB pensions on market valuations, with confidence bands for the risk free model



Notes: As for Figure N. The fine dotted lines represent the one standard error (high and low) bands for the risk free net assets model

Differences between macro sectors

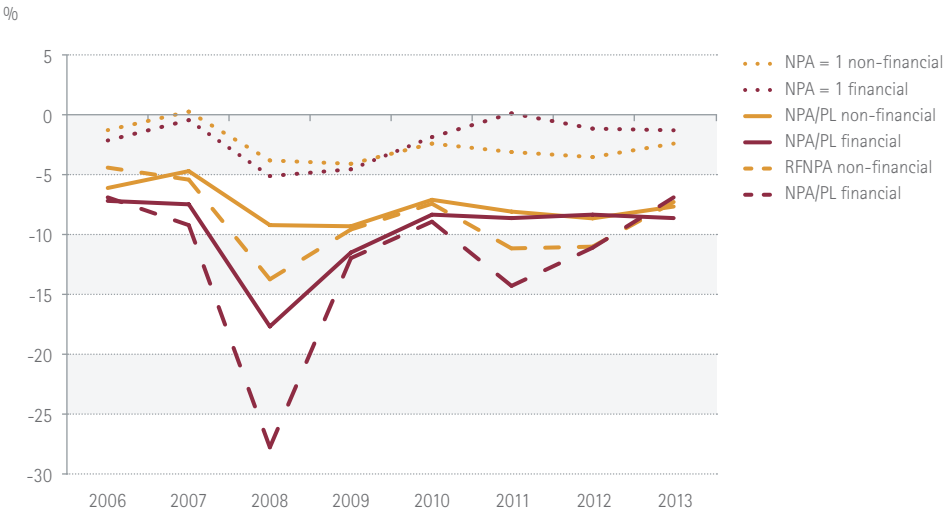
Given that the model analysis described in the previous section provides no strong evidence of major differences in pension coefficients between broad macro sectors, estimates of the relevant impacts by sector are made on the basis of the full sample equation estimates. These are illustrated in Figure P, using both the 'rule of thumb' and 'risk free models' from Table 1, along with the implicit estimates from a simple one-to-one net assets relationship.

29. Between 2006 and 2008, the average market valuations of the FTSE 100 companies in the sample fell on average by about 30%.
30. Figure O reports the impact estimates for equations 1.2 and 1.3, but allows also for a plus and minus 1 standard error band around the parameter estimates in the risk free model, as denoted by the dotted blue lines.

Impacts appear larger for financial companies but estimates are more uncertain

Consistent with full-sample impacts reported in Figure N, a key feature is the scale of risk premia effects, which imply systematically larger impacts for the two estimated models. At the same time, a sharp contrast can be drawn between impacts for the financial sector and non-financial sectors. A simple one-to-one relationship based on disclosed pension deficits would suggest broadly similar impacts for the two sectors, with marginally more favourable outcomes for the financial sector in the most recent years. By contrast, both risk premia models suggest generally larger impacts for the financial sector, largely reflecting a feedback effect between the volatility in market values for these companies and the sheer absolute size of their pension liabilities.

Figure P: Estimated impacts on market values for companies in the financial and non-financial sectors



Notes: The solid lines represent the estimated impacts for companies in the Financial and non-Financial sectors based on rule of thumb model, Eq 1.2; the dashed lines are those for the risk free net asset model, Eq 1.3. The fine dotted lines (NPA=1) represent the corresponding impacts for a one-to-one net deficit model.

In fact, financial companies have had a relatively balanced pension position in accounting terms,[31] but not on a risk-free basis, which also depends on the absolute size of pension liabilities and the risk premia on corporate bonds vis-à-vis gilts. The overall picture is however somewhat coloured by the financial crisis period, where the substantially larger shocks to the financial sector imply larger proportionate impacts (of 25% to 30%). This result reflects both the scale of risk free adjustments to pension liabilities and the sharp fall in the market capitalisation of these companies, which approximately halved between 2007 and 2008. Beyond 2009 however the estimated impacts for both sectors tend to converge, although the risk free adjustments in 2011 tend to have a disproportionate effect on the financial sector. The overall impression is that the point estimates of impacts have been generally larger for companies in the financial sector, but this result is less certain, being greatly influenced by the volatility and the uncertainty surrounding financial companies over the period.

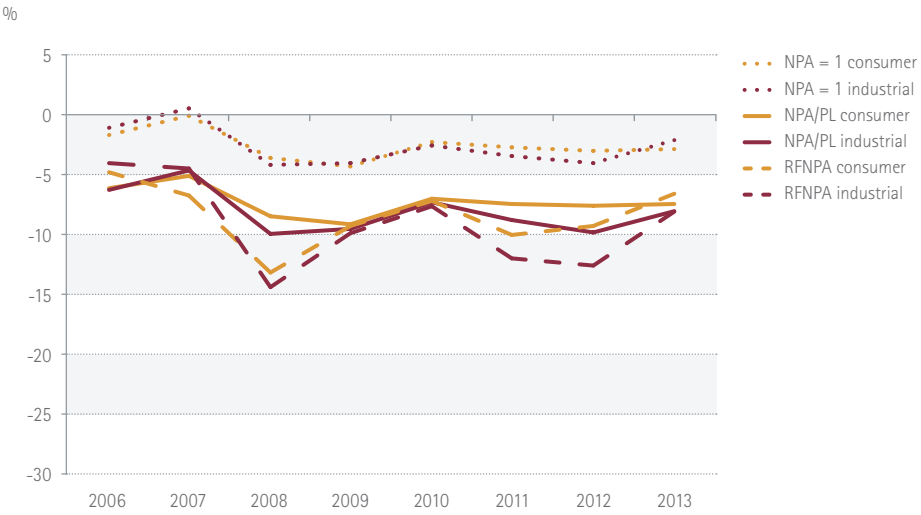
31. See Table 6

Table 6: Sectoral comparisons

(£m, company averages)

	Financial sector			Industrial sector			Consumer sector		
	Pension net assets	Risk free net assets	DB liabilities	Pension net assets	Risk free net assets	DB liabilities	Pension net assets	Risk free net assets	DB liabilities
2006	-469	-1360	5254	-212	-695	4700	-322	-863	4332
2007	-76	-1466	5529	109	-814	4823	-4	-1083	4017
2008	-397	-2463	5329	-706	-2378	4953	-579	-2079	3996
2009	-844	-2059	6414	-827	-1852	5723	-829	-1655	4780
2010	-402	-1756	6640	-631	-1757	5978	-467	-1360	4791
2011	17	-2511	7353	-869	-2890	6635	-580	-2054	5130
2012	-263	-2345	7613	-1034	-3083	7343	-771	-2205	5780
2013	-291	-1478	8458	-530	-1865	7145	-725	-1549	5890

Figure Q: Estimated impacts on market values for companies in the industrial and consumer sectors



Notes: The solid lines represent the estimated impacts for companies in the industrial and consumer sectors based on the rule of thumb model, Eq 1.2; the dashed lines are those for the risk free net asset models, Eq 1.3. The fine dotted lines (NPA=1) represent the corresponding impacts for a one-to-one net deficit model.

Impacts for industrial companies appear to be greater risks ... although there is convergence recently

A further disaggregation of impacts for the non-financial sector is reported in Figure Q, which applies the same analysis to companies separated into the industrial and consumer sectors. These show the same broad characteristics, with estimates for both sectors implying significant risk premia compared with a simple one-to-one impact of pension deficits. Risk-free adjustments at the sector level are again seen to be most significant in 2008 and later in 2011/2012, although by 2013 there is also a convergence towards an aggregate impact of around 8%. Though differences between sectors appear to be small in relation to the general margins of error, the overall impression is that of companies in the industrial sector being more adversely affected than those in the consumer sector, reflecting their larger underlying pension liabilities.

How important is size to pension related risks?

How important is size and by what criterion?

The relevance of size to the impact of pensions and pension risks can be looked at from a number of different aspects. From an econometric point of view, it is always important to check that estimated relationships are not unduly influenced by extreme observations, and in that respect the stability tests described in the earlier section provide some welcome reassurance. At the same time, the different scale and structure of pensions as between companies are likely to be important in gauging their different vulnerabilities to pension risks. This section looks at this issue from different viewpoints by combining the estimated models with data sets drawn from different size distributions, according to different measures of 'size'.

To do this 3 separate criteria were used:

- Total company assets as a measure of total company size.
- DB pension liabilities as a share of total company assets, as a measure of the size and importance of the pension scheme within the overall company balance sheet.
- DB pension liabilities as a share of market capitalisation, as a measure of the scale of pension vulnerability.

In each case the time series data for the FTSE 100 companies were divided into four approximately equal-sized quartiles, according to each of the different criteria in the specific base year (2009).[32] For each criterion, company data are grouped into Small, Medium 1, Medium 2 and Large categories as defined by the ranges shown in Table 7. The data for each separate group were then used to estimate average pension impacts in conjunction with the earlier model estimates.

To simplify exposition, the analysis here is confined to the results derived from the 'risk free' net pension assets model, as reported in Figures R, S and T, while noting that qualitatively the results and conclusions drawn are more or less identical across models.

32. The allocation of companies to individual quartile groups was fixed using a single mid-sample base year of 2009 classification. By doing the analysis avoids problems arising from individual companies moving over time between different size groups, which would otherwise complicate the comparisons.

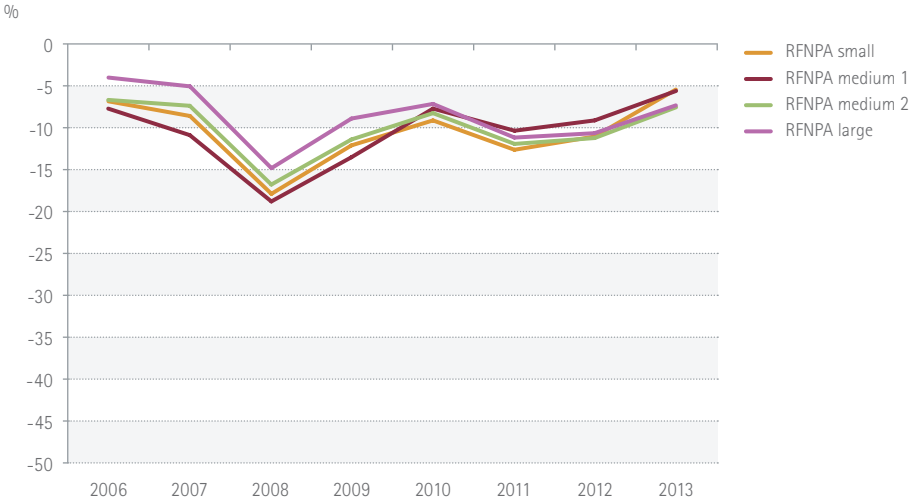
Table 7: Size groupings

Total Company Assets £m (in 2009)		
Quartiles	Maximum value	Minimum value
Large	1,696,486	42,862
Medium 2	42,862	10,677
Medium 1	10,667	4,398
Small	4,398	956
Pension liabilities as a percentage of total company assets (in 2009)		
Quartiles	Maximum value	Minimum value
Large	275%	32%
Medium 2	32%	17%
Medium 1	17%	2.6%
Small	2.6%	0.2%
Pension liabilities as a percentage of market valuation (in 2009)		
Quartiles	Maximum value	Minimum value
Large	777%	61.6%
Medium 2	61.6%	25.3%
Medium 1	25.3%	9.6%
Small	9.6%	1.0%

Source: The DB Pensions Analytical Data Base

Notes: The FTSE 100 companies used in the size-impact analysis were divided into four approximately-equal quartile groups according to 3 different size criteria in a specific base year (2009). The first is based on total assets of the company as a measure of total company size. The second is based on DB pension liabilities as a share of total company assets, as a measure of the size and importance of the pension scheme within the overall company balance sheet. The third is based on DB pension liabilities as a share of market capitalisation, as a measure of the scale of pension vulnerability.

Figure R: Risk Free model impacts on market value, by size, based on total company assets

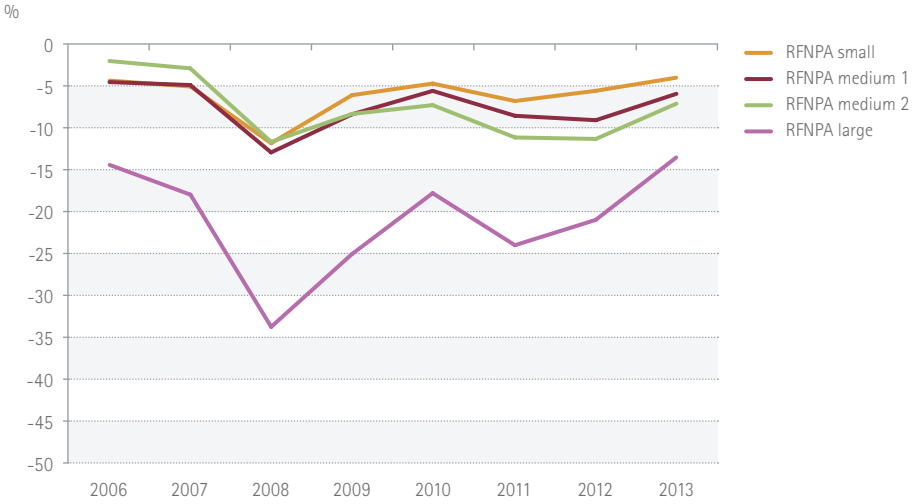


Notes: The solid lines represent the estimated impacts for companies in the respective size classes based on the risk free net asset model, Eq 1.3.

Impacts appear independent of company size based on total assets

The estimated impacts for the risk-free net assets model by total company asset size are reported in Figure R. In this case, it is overall company size, and not the relative size of pension obligations, which is the main criterion. The most interesting feature of these estimates is that the pension impacts are quite closely grouped, and do not show any clear pattern of vulnerability as between different asset-based size groups. Thus although the broad evolution of pension impacts over time is seen to be broadly similar to that for the full sample results, no particular size grouping is seen as being particularly at a disadvantage. Indeed, for much of the period it is the largest companies by size of assets which have had the lowest average pension impacts, with impacts for the smallest companies close to the sample average and the two medium-sized groups varying around the mean over the cycle. A broad conclusion is that pension risks and impacts are largely independent of company size as represented by company assets.

Figure S: Risk Free model impacts on market value, by size, based on the ratio of pension liabilities to total assets

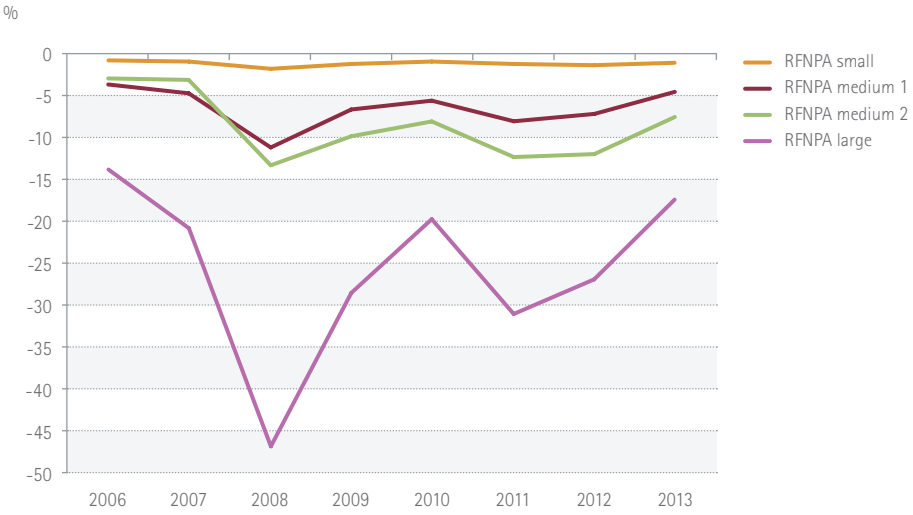


Notes: The solid lines represent the estimated impacts for companies in the respective size classes based on the risk free net asset model, Eq 1.3.

The scale of liabilities to company assets matters most for those with the highest shares

Where companies are sorted according to the size of pension liabilities in relation to total company assets, as shown in Figure S, a clearer pattern emerges. For the companies with small to medium liability ratios, the estimated impacts are again quite closely bunched together, both prior to and through the financial crisis. But they fan out gradually from 2010 on with a ranking consistent with the relative size of liabilities, with average impacts in the wider range of 5% to 10% in the most recent years. For companies with the smallest liability ratios, the current impact estimates are similar to those before the crisis, while those for the two medium categories are somewhat larger. By contrast, companies with the largest liability ratios are seen to be more significantly exposed, particularly through the crisis period, with estimated pension impacts as high as 35%. Since then, the impacts for companies in this group appear to have abated somewhat in line with pension risk premia, moving towards an average 15% in the most recent period. A broad conclusion is that the scale of pension liabilities in relation to company assets matters most for those companies in the largest size category, but only moderately so for those in other categories.

Figure T: Risk Free model impacts on market value, by size, based on the ratio of pension liabilities to market values



Notes: The solid lines represent the estimated impacts for companies in the respective size classes based on the risk free net asset model, Eq 1.3.

Impacts are largest for companies with liabilities that are highest in relation to market valuation

Grouping companies by the size of pension liabilities in relation to market valuations, as in Figure T, provides the starkest basis of comparison. A natural consequence of the model structure is that companies in the largest and smallest size categories represent polar cases, for which the estimated impacts are respectively the largest and smallest. For companies with the largest liability rates, impacts are currently well in excess of 15%, and larger still in 2008 and 2011 where the estimated risk premia were largest in relation to market values. By contrast, impacts for those companies with the lowest liability rates are negligible (less than 2% to 3%) for much of the period and also little affected by the crisis. Impacts for companies with liability rates in the two medium-sized categories are broadly ranked by their respective degrees of exposure. Both sets of these impacts increase significantly through the crisis and have recovered only slowly since, remaining in the range of 5% to 8% in the most recent period. A broad conclusion is that scale of pension liabilities in relation to market values has been of most important and that for all but those companies with the smallest exposures, the negative impacts of pension deficits and liabilities on market valuations remain significant and greater than in the pre-crisis period.

VI. Summary conclusions are the scope for future analysis

The study confirms earlier results and shows that impacts have varied greatly over time

Overall, this study confirms the main findings of the previous study in finding a broadly one-for-one effect of pension deficits on the market value of the FTSE 100 companies when measured on a consistent 'risk-free' basis, also consistent with the market attaching an additional risk premium equivalent to an average 20% of disclosed pension obligations. Taking into account such risk premia, the negative impact of DB pension liabilities and deficits on FTSE 100 market valuations is estimated to be around 7% to 9% at the end of the sample period, considerably higher than might be suggested by reported pension net deficits alone, and higher than their pre-crisis levels.

Estimates are most well-defined for non-financial companies

Compared with earlier findings, there is also some evidence of slightly larger effects from pension deficits and liabilities when analysing data over the longer period, although the differences are not statistically significant. Overall, the estimated relationships appear to be most well-defined for companies in the non-financial sectors compared with those in the financial sector, which were subject to much greater volatility and risks during and since the financial crisis. Within the non-financial sector, the companies in the industrial sector appear to have been more adversely affected than those in the consumer sector, reflecting generally higher pension liabilities.

Size matters most for companies with pension liabilities high in relation to their market value

Analysis across size groups suggests that pension risks and impacts are largely independent of company size as represented by levels of company assets, while the level of pension liabilities in relation to company assets also matters most for companies with the highest liability rates. Overall however, it is the scale of pension liabilities in relation to market values which have been of most important, with negative impacts on market valuations which are currently large and greater than in their pre-crisis levels, for all but those companies with the lowest rates of exposures.

Analysis of a low interest rate environment would better inform investment strategies

Reflecting on the results of this study suggests a number of useful areas for future analysis and research.

Firstly, this analysis highlights the importance of the choice of discount rates in the valuation of pension liabilities and DB scheme performance for the FTSE 100 companies. This will be of even greater importance in a period of continuing low or falling rates, which would have an effect on both reported and risk-free estimates of liabilities and deficits. In this context it would be interesting to further examine what happened to pension deficits and also asset returns as gilts and other rates fell, to see which investment strategies might have provided a better hedge against falling interest rates and ballooning liabilities.

Future work could also be to extend the study to the FTSE 350 companies

Secondly, a key extension would be to examine a larger sample including FTSE 250/350 companies to see whether such an analysis supports or undermines the current results, and why. For example it would be interesting to analyse whether the pension positions of FTSE 100 companies attract greater or lesser market attention than for smaller companies. At the same time, having a larger sample might permit a more detailed analysis of sectoral differences. The data challenges of such a study are nonetheless considerable, particularly in relation to the quality differences in available pension-note information, which seems likely to diminish when going from the FTSE 100 to the FTSE 350 companies. To the extent that the same detail were not available then simpler models might be required.

Adding an international dimension would also be quite revealing

Lastly, in line with the earlier US origins of the current study, it would be interesting to see to what extent earlier conclusions have been affected by more recent changes and improvements in US accounting standards. At the same time it might be possible to extend the scope to other countries for which DB pensions are still a significant part of the company balance sheet (other major European countries), although data here seem likely to be more heterogeneous.

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Annex 1: Sources and Methods

This appendix describes the main sources and methods underlying the data set used in this study – the DB Pensions Analytical Data Base – along with associated formulae and assumptions used in estimating the various concepts used.

The data set currently covers a range of company financial and DB pensions related variables for the FTSE 100 companies, based on the 2009 FTSE composition for the period 2006 to 2013.

Data sources

The data are drawn from three main sources:

- The bulk of the DB-pension-related information comes from the pension notes annex to the annual financial statements of each company.
- Corresponding annual time series for broad company accounting concepts and performance variables come from Bloomberg data services, verified against the corresponding company financial statements. Daily share price and exchange rate information come from Bloomberg's high frequency data sets.
- Additional time series data for market-related information such as interest rates and, more specifically, the yields on UK government bonds (gilts) come from the on-line historical data sets maintained by the Macro Financial Analysis Division of the Bank of England.

Sample period, accounting years, and company coverage

The estimation sample period relates to company and pensions performance over the 8-year period from 2006 to 2013, as reported in the annual financial statements for those years. In practice, not all companies publish or report the relevant accounts at the same point in time or for the same accounting period. While the accounts for the majority of FTSE 100 companies are calendar year based, a small minority relate to the financial year closing at end-March, whilst a handful of others variously report accounts to end-January, June, July and September. Thus the data set ranges from January 2006 to March 2014 depending on the company.

For the purposes of the study the data for individual companies are aligned such that all variables (standard accounts, pension related, share prices, interest and exchange rates) refer to precisely the accounting period that coincides with the published financial statement and pensions notes. In terms of data file organisation, data for companies closing their accounts in January or March year (t+1) were attributed to year t, although this has no implications for the results.

The companies included in the main sample used in estimation are listed in Table A below. Specific exclusions relate to:

- Companies without DB pension schemes;
- Companies whose operations and pension schemes are primarily outside of the UK, the European Union and the United States; and
- Companies whose pension notes are incomplete or absent.

Data notes

The broad set of financial accounting and pensions-related variables used in the study and their sources are listed in Table B in Annex 2.[33] The following notes describe a number of key assumptions and the basis of specific estimates included.

Currencies, exchange rates, and variable-scaling

All data are expressed in UK sterling terms. Where company accounts are in other currencies e.g. $US or €, they were converted to sterling terms using the rates prevailing at the balance sheet closing date. Given that in estimation all variables are expressed as ratios to Total Company Assets, the results are relatively unaffected by the specific choice of conversion rate.

33. The data set is quite heterogeneous across companies. Not all variables in Table B are available for all companies, while for some, additional information is available.

Multiple schemes

Where companies have multiple DB schemes, pensions data have been aggregated across schemes, and pension-specific technical assumptions, where relevant, are based on weighted averages across schemes or, otherwise, those reported for the dominant (largest) scheme.

Mergers, acquisitions and delisting

Changes in company structure and coverage through mergers and acquisitions over the sample period are treated pragmatically, the overriding concern being to maintain consistency between financial and pension accounts at a given point in time, for example, BA is included separately prior to the International Consolidated Airlines merger. Companies that have been delisted as a result of foreign mergers are included in the sample for those years in which they were listed on the London exchange: for example, International Power PLC is included up to its acquisition by GDF Suez, which is listed on the Paris exchange.

The definition of net pension assets

Throughout the study the definition of net pension assets corresponds to the reported gross economic surplus (or deficit) disregarding any deferred taxes, corridor adjustments, or irrecoverable surplus/minimum funding liabilities. In some cases this measure may therefore differ from that shown on the overall company balance sheet, which may include numerous non-economic adjustments.

The estimation of Risk Free pension liabilities, net assets, and related estimates

The measures of 'Risk Free' liabilities and net pension assets used in the study rely on a number of technical assumptions based on additional sensitivity analysis information reported in the standard pension notes, in particular those pertaining to interest rate sensitivity.

The duration of pension obligations

As a result of the IAS19 revisions to pension disclosure rules, companies are required to report the assumptions for the duration of pension obligations pertaining to their 2012 and 2013 pension accounts. Prior to that period it was necessary to estimate the approximate durations (D) on the basis of the sensitivity and discount rate assumptions. For the 2012 accounts, for the majority of companies, there is an overlap in information which permits an assessment of the accuracy of the relevant approximations, as described in the main data section of the study.

The first step in making 'Risk Free' estimates is to derive an estimate of the duration of pension obligations (D) implicit in the reported present value of liabilities (PL). These were calculated on the basis of the discount rate sensitivity estimates given by individual company pension notes using what is commonly known as the duration approximation method, using the following expression: [34]

Equation (A1) $D = -(dPL/PL) * (1+r)/dr$

where D, for a given company and year, is the estimated duration, and dPL/PL the proportionate change in the present value of DBO liabilities reported in the pension notes for a given change (dr) in the discount rate (r) used in calculating the present value (based on high quality corporate bond rates). Where there are multiple schemes, duration estimates were based on the sensitivities reported for the largest representative scheme.

In practice, sufficient information was available to calculate implicit durations for over two-thirds of the sample, providing duration estimates ranging from 12 to 25 years, with a sample average and median around 18 ½ years. For companies where discount rate sensitivities were not reported in the pension notes, the sample average duration was used in subsequent estimates. Experimentation suggested that subsequent estimates were relatively robust to variations in this assumption in the range of 15 to 20 years.

34. Effectively D is backed out of the sensitivity calculation using the derivate rule for NPV of liabilities of duration D.

Risk Free liabilities

The main factor taken into account in calculating Risk Free pension liabilities is the difference between the discount rate (AA corporate bond) assumptions used in the calculation of DBO liabilities, as reported in the pension notes, and the (lower) market rates on government bonds (gilts) of equivalent duration. Effectively, corresponding Risk Free estimates were made using gilt rates, matched to the timing of the company accounts and the duration of the DBO, based on the following expression: [35]

Equation (A2) $RFPL = PL*[1 - D*(g-r)/(1 + r)]$

where the Risk Free pension liability estimate (RFPL) is the reported net present value of pension liabilities (PL) rescaled by one minus the difference between gilt (g) and published (r) discount rates as a ratio of the published discount factor (1 + r), times the estimated duration (D). These adjustments typically resulted in a higher level of liabilities, but with considerable variation over time and companies, depending on the risk premia assigned by the market to the chosen corporate bonds over gilts, at a given point in time. Averaged across companies and time, such Risk Free adjustments added approximately 25% to the levels of pension liabilities.

Corresponding Risk Frees of pension net assets were then recomputed as the difference between the Risk Free of scheme assets (PA), reported in the pension notes and estimated Risk Free of liabilities (RFPL), thus:

Equation (A3) $RFNPA = PA + RFPL$ [36]

On average, this adjustment added approximately 25% of the reported value of pension liabilities to net pension asset positions, effectively eliminating all but a few reported net surpluses.

35. Equation A2 essentially applies the sensitivity rule on which equation A1 is based.
36. Note that, following usual accounting conventions, PL and RFPL are negative entities that are added to pension assets to give net pension assets.

Annex 2: Tables – FTSE 100 DB company list

Table A: FTSE 100 DB pensions company list for reference year 2009[37]

Company	Macro Sectors[38]	Sector	Accounting year end
3i Group PLC	Financial	Financial	March
Aggreko PLC	Non-Fin, Industrial	Industrial	December
AMEC PLC	Non-Fin, Industrial	Energy	December
Anglo American PLC	Non-Fin, Industrial	Materials	December
Associated British Foods PLC	Non-Fin, Consumers	Consumer Staples	September
AstraZeneca PLC	Non-Fin, Consumers	Health Care	December
Aviva PLC	Financial	Financial	December
BAE Systems	Non-Fin, Industrial	Industrial	December
Barclays PLC	Financial	Financial	December
BG Group PLC	Non-Fin, Industrial	Energy	December
BHP Billiton PLC	Non-Fin, Industrial	Materials	June
BP PLC	Non-Fin, Industrial	Energy	December
British American Tobacco PLC	Non-Fin, Consumers	Consumer Staples	December
British Land Co PLC	Financial	Financial	March
BT Group PLC	Non-Fin, Consumers	Telecom Services	March
Bunzl PLC	Non-Fin, Industrial	Industrials	December
Burberry Group PLC	Non-Fin, Consumers	Consumer Discretionary	March
Capita PLC	Non-Fin, Industrial	Industrial	December
Capital Shopping Centres Group PLC	Financial	Financial	December
Centrica PLC	Non-Fin, Industrial	Utilities	December
Compass Group PLC	Non-Fin, Consumers	Consumer Discretionary	September
Diageo PLC	Non-Fin, Consumers	Consumer Staples	June
Experian PLC	Non-Fin, Industrial	Industrial	March
G4S PLC	Non-Fin, Industrial	Industrial	December
GKN PLC	Non-Fin, Industrial	Consumer Discretionary	December
GlaxoSmithKline PLC	Non-Fin, Consumers	Health Care	December
Hammerson PLC	Financial	Financial	December
HSBC Holdings PLC	Financial	Financial	December
IMI PLC	Non-Fin, Industrial	Industrial	December

37. The data set currently excludes 16 companies whose activities and pension schemes are wholly foreign-based, those not having DB pension schemes, and those where the pension notes are incomplete or absent from the accounts.
38. The non-financial classification is further split into two groups: consumers = consumer discretionary + consumer staples + health care + and telecom services, and industrials = industrial + materials + utilities.

Company	Macro Sectors	Sector	Accounting year end
Imperial Tobacco Group PLC	Non-Fin, Consumers	Consumer Staples	September
Inmarsat PLC	Non-Fin, Consumers	Telecom Services	December
InterContinental Hotels Group PLC	Non-Fin, Consumers	Consumer Discretionary	December
Intertek Group PLC	Non-Fin, Industrial	Industrials	December
International Consolidated Airlines Group formerly British Airways	Non-Fin, Industrial	Industrials	December March
International Power PLC/UK	Non-Fin, Industrial	Utilities	December
Investec PLC	Financial	Financial	March
J Sainsbury PLC	Non-Fin, Consumers	Consumer Staples	March
Johnson Matthey PLC	Non-Fin, Industrial	Materials	March
Kingfisher PLC	Non-Fin, Consumers	Consumer Discretionary	January
Land Securities Group PLC	Financial	Financial	March
Legal & General Group PLC	Financial	Financial	December
Lloyds Banking Group PLC	Financial	Financial	December
Lonmin PLC	Non-Fin, Industrials	Materials	September
Man Group PLC	Financial	Financial	March
Marks & Spencer Group PLC	Non-Fin, Consumers	Consumer Discretionary	March
National Grid PLC	Non-Fin, Industrial	Utilities	March
Next PLC	Non-Fin, Consumers	Consumer Discretionary	January
Old Mutual PLC	Financial	Financial	December
Pearson PLC	Non-Fin, Consumers	Consumer Discretionary	December
Prudential PLC	Financial	Financial	December
Reckitt Benckiser Group PLC	Non-Fin, Consumers	Consumer Staples	December
Reed Elsevier PLC	Non-fin, Consumers	Consumer Discretionary	December
Rexam PLC	Non-Fin, Industrial	Materials	December
Resolution Ltd	Financial	Financial	December
Rio Tinto PLC	Non-Fin, Industrial	Materials	December
Rolls-Royce Holdings PLC	Non-Fin, Industrial	Industrial	December
Royal Bank of Scotland Group PLC	Financial	Financial	December

Annex 2: Tables – FTSE 100 DB company list

Table A: FTSE 100 DB pensions company list for reference year 2009 (Cont)

Company	Macro Sectors	Sector	Accounting year end
Royal Dutch Shell PLC	Non-Fin, Industrial	Energy	December
RSA Insurance Group PLC	Financial	Financial	December
SABMiller PLC	Non-Fin, Consumers	Consumer Staples	March
Sage Group PLC/The	Non-Fin, Consumers	Information Technology	September
Schroders PLC	Financial	Financial	December
Serco Group PLC	Non-Fin, Industrial	Industrials	December
Severn Trent PLC	Non-Fin, Industrial	Utilities	March
Smith & Nephew PLC	Non-Fin, Consumers	Health Care	December
Smiths Group PLC	Non-Fin, Industrials	Industrials	July
SSE PLC	Non-Fin, Industrial	Utilities	March
Standard Chartered PLC	Financial	Financial	December
Standard Life PLC	Financial	Financial	December
Standard Life PLC	Financial	Financial	December
TESCO PLC	Non-Fin, Consumers	Consumer Staples	February
TUI Travel PLC	Non-Fin, Consumers	Consumer Discretionary	December
Unilever PLC	Non-Fin, Consumers	Consumer Staples	December
United Utilities Group PLC	Non-Fin, Industrial	Utilities	March
Vodafone Group PLC	Non-Fin, Consumers	Telecomm Services	March
Weir Group PLC/The	Non-Fin, Industrial	Industrials	December
Whitbread PLC	Non-Fin, Consumers	Consumer Discretionary	February
WM Morrison Supermarkets PLC	Non-Fin, Consumers	Consumer Staples	January
Wolseley PLC	Non-Fin, Industrial	Industrials	July
WPP PLC	Non-Fin, Consumers	Consumer Discretionary	December
Xstrata PLC	Non-Fin, Industrial	Materials	December

Table B: FTSE 100 DB pensions company and pensions variables

Company name	
Macro Sectoral grouping	GICS sectors
Sectoral Grouping	GICS sectors
Date of Annual Report and period covered	Financial statement
Number of reported DB Schemes	Pension notes
Currency	Financial statement
Date of Accounts	Financial statement
General company variables	
Book equity value	Bloomberg
Number of shares	Bloomberg
Share price at the reporting date	Bloomberg
Earnings	Bloomberg
Total Company Assets	Bloomberg
DB pension accounts (by scheme)	
Date of Accounts	Pension notes
Name of Scheme	Pension notes
Net Amount	Pension notes
Net Amount (post tax)	Pension notes
Fair Value of Scheme Assets	Pension notes
DBO/ PV of Scheme Liabilities	Pension notes
Interest Cost	Pension notes
Current Service Cost	Pension notes
Gain on Curtailment/Settlement	Pension notes
Expected Return on Assets	Pension notes
Interest Charge on Liabilities	Pension notes
Past Service Costs	Pension notes
Net Periodic Pension Costs	Pension notes
RPI/CPI	Pension notes
Increase in Salaries	Pension notes
Increase in Deferred Pension	Pension notes
Increase in Pensions	Pension notes
Discount Rate	Pension notes

Annex 2: Tables – FTSE 100 DB company list

Table B: FTSE 100 DB pensions company and pensions variables (Cont)

Other variables and constructs	
Exchange rates	Bloomberg data services
Durations	Pension note from 2012; prior to then estimated (see text notes)
Government bond rates (matched by date and duration)	Bank of England yield curves
Risk Free Pension Liabilities	Estimated (see text notes)
Risk Free Pension Net Assets	Estimated (see text notes)
Longevity risk	Estimated (see text notes)
Interest risk	Estimated (see text notes)
Asset risk	Estimated (see text notes)
Composite risk	Estimated (see text notes)
Sensitivity analyses for global or main schemes (as available)	
Interest Rate	Pension notes
Salary escalation	Pension notes
Price Inflation	Pension notes
Rate of Pension Increases	Pension notes
Mortality	Pension notes
Longevity assumptions	
Retirement age	Pension notes
Further life expectancies from retirement age	
from retirement age: male	Pension notes
from retirement age: female	Pension notes
male at 20 yrs younger than retirement age	Pension notes
female at 20 yrs younger than retirement age	Pension notes

Pension asset composition	
UK Equity	Pension notes
Overseas Equity	Pension notes
Bonds - Total	Pension notes
Government Bonds	Pension notes
Corporate Bonds	Pension notes
Property	Pension notes
Derivatives	Pension notes
Cash	Pension notes
Other	Pension notes
Total	Pension notes
Expected returns on assets	
UK Equity	Pension notes
Overseas Equity	Pension notes
Bonds - Total	Pension notes
Government Bonds	Pension notes
Corporate Bonds	Pension notes
Property	Pension notes
Derivatives	Pension notes
Cash	Pension notes
Other	Pension notes
Total	Pension notes
Other pension related variables	
Total Employer contribution	Pension notes
Actuarial Gains & Losses (Year)	Pension notes
Actual return on scheme assets	Pension notes
Difference in returns (Act-Exp)	Pension notes
Actuarial G & L on liabilities	Pension notes
Cumulative G & L to date	Pension notes

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