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

For the FTSE 100 companies, size really does matter

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Executive Summary

- Although most defined benefit (DB) pension schemes have been progressively modified and closed to new entrants over the past decade, their liabilities and net assets remain a large and potentially volatile component of sponsoring companies' balance sheets.
- There have, however, been few studies of the significance of DB pension deficits and related risks to company valuations to determine how far the existence of such obligations and risks is reflected in a company's share price.
- This then is the first in-depth study to have been done on this topic in the UK. It is based on data gathered from FTSE 100 companies for the period 2006 to 2012, and matches company financial- and DB-pension-related data taken from the company financial statements and pension notes with corresponding stock market performance and company valuation data, so as to assess the significance of the scale and net surplus/deficit position of existing DB schemes for company market values.
- The study also looks at major issues relating to the valuation of pension risks, most importantly with respect to the market valuation of DB pension obligations, as well as possible influence of 'corridor adjustments' to the accounting for pensions in the company accounts.
- The principal finding is that, in the UK, the market appears to give a large and significant weight to the DB pension net asset positions of FTSE 100 companies; as significant in many regards as to their non-pension related book values and earnings.
- Significantly, whether through valuation adjustments, specific risk assessment, or simple rules of thumb, although the size of a DB pension deficit matters, a more important factor for markets when assessing company values is the total scale of the associated pension obligations.
- In short, size matters: for two companies reporting identical levels of pension net assets in relation to total company assets, the company with the lower (higher) gross pension liabilities (also in relation to total assets) will tend to attract a higher (lower) market valuation. The implication is that reported pension liabilities are regarded by markets as being systematically undervalued; that markets give larger weight to pension liabilities than to pension assets; and/or that a higher level of liabilities is viewed as representing a higher risk.
- In monetary terms, the basic analysis indicates that a £100 increase in the reported pension deficit of a FTSE 100 company would reduce a company's value by £160. Further analysis, however, indicates that a company's present market valuation generally reflects the possibility of an increased deficit almost fully, such an increased deficit being built directly into the share price when allowing for a true underlying pension obligation that is, on average, 20% larger than the reported obligation.
- The study therefore reveals that the impact on a sponsoring company's market valuation over the estimation period appears to have been most consistent with the 'fair value' representation of DB pension liabilities and net assets – specifically, an alternative gilts-based discount rate, as opposed to the actual reported data. The weight given to such a 'fair value' measure of a net pension deficit is close to 90%, a result which is largely invariant to changes in sample composition.
- Averaged across companies, this 'fair value' representation added approximately 20% to 25% to the levels of liabilities and pension net asset positions. From the practical perspective, it seems unlikely that many investors would make such formal calculations of the inconsistencies in assumptions and market discount rates: more likely they simply apply a rule of thumb, e.g. adding 20%-odd to reported pension liabilities.
- This is then fed directly through to the share price of the sponsoring company.
- The effects of this, measured at the aggregate level, have been substantial, particularly at the time of the financial crisis in 2008 and, to a lesser extent, in 2011 – reflecting not only the fall in market values, but also the larger disconnects between corporate bond and gilt rates.

- But the results also show that the market appears to 'see through' so-called 'corridor adjustments' to DB pension valuations – adjustments that allow exceptional gains and losses from pension schemes to be deferred, (or 'smoothed'), over a period of years.
- It is also striking that, even where a pension scheme is reported as being in approximate balance, the scale of its pension obligations can be of major importance to the market's assessment of company value. Hence, even where the reported assets and obligations appear to be basically matched, the associated biases and risks are seen as being proportional to the size of the scheme.
- These findings contrast with those of comparable US-based studies, which have not found a significant role for DB net pension assets, with expected short-term pension costs and earnings playing a more significant role in the market valuation process.
- In this respect, the UK market appears to follow a 'transparent' valuation model, whereas an 'opaque' model seems to have dominated in the US. A plausible explanation for this finding is that the EU pension reporting standards embodied in IAS19 and its precursors have given the UK published accounting for pensions in the company accounts greater market credibility than have their US counterparts.
- There is also evidence of the market giving weight to a range of other risk influences, for example those associated with longevity, interest rates, and individual equity risks, although these considerations are outperformed by the simple 'fair valuation' explanations.

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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 background

The UK has seen a systematic shift in pension provision

Driven by increasing concerns of affordability, reflecting secular changes in longevity trends, economic growth, investment returns, and other financial uncertainties, the past decade has seen a systematic shift in UK company pensions from defined benefit (DB) to defined contribution (DC) based schemes, and progressive changes to, and eventual closure of, existing DB schemes to new members.

Pension liabilities and net assets nevertheless remain large and volatile

DB pension liabilities and net assets nevertheless remain a large and potentially volatile component of company balance sheets. Indeed, in 2012 the DB pension net deficits and associated underlying pension benefit obligations of the FTSE 100 companies represented on average some 4.7% and 47.5% of their market capitalisations respectively. The figures were even larger during the recent period of recession and financial stagnation.

Since 2006, movements in pension net deficits have been influenced strongly by stock market movement through volatile equity prices and falling investment yields and interest rates, overlaid on the cost side by further secular increases in longevity, changes in inflation expectations, and other pension related costs. At the same time, there is considerable variation in the scale of pension schemes and associated net asset positions across companies, with net deficits well in excess of 10% of market valuations for some companies, and pension benefit obligations well in excess of 100% for those with the largest schemes (Figures 1 and 2).

A variety of de-risking products have been developed

The inherent uncertainties in companies' pension positions have led, in turn, to the development and use of a variety of products in an attempt to de-risk DB pension asset and liability positions. These range from financial instruments and insurance policies to hedge specific risks (such as interest rates, inflation rates and longevity), through to insurance buy-ins of specified liabilities and partial or outright buy-outs of the pension schemes.

This raises a number of important issues, from a number of perspectives:

- **For companies**, seeking to manage their pension schemes and make informed choices on the costs and benefits of reducing or de-risking their existing pension obligations for company values;
- **For pension specialists**, in the analysis of pension scheme performance, and in the choice and design of de-risking products for specific companies and scheme characteristics; and
- **For general market participants**, in assessing the financial risks and investment opportunities associated with the performance of particular companies and their pension obligations.

Notwithstanding such wide-ranging interest, there have been relatively few systematic studies of the impact of DB pension deficits and related risks and obligations on the market valuation of companies.

A number of US studies have examined this issue in the context of the S&P 500 companies. These, however, have been conducted against the background of a rather different regulatory system, particularly as regards the ability to settle pension obligations and the cost of doing so, as well as required pension disclosures, from that which obtains in the United Kingdom.[1]

There are few studies of the impact of DB schemes on company valuations

In the United Kingdom, while there is an accumulation of anecdotal and case-study evidence on the effects of pension de-risking and buyout-related activities, there have been relatively few systematic studies of the possible influence across the range of UK company experiences. Some work has however been undertaken at the Bank of England, looking at pension deficits as a contributory factor to short-term stock market volatility; but as regards the effects on market valuation as a whole, UK evidence overall is relatively scant.[2]

This study seeks to address this situation by applying a basic stock market valuation model to the largest UK companies, as represented by their FTSE 100 composition, so as to assess the possible significance of the scale and net asset position of existing DB schemes for company market values over the period 2006 to 2012. This study also looks at major issues related to the valuation of pension risks, most importantly with respect to the market valuation of DB pension obligations, as well as possible influence of 'corridor adjustments' to the pension accounts.

II. The DB Pensions Analytical Data Base

This study started by compiling a clean and consistent data base

An essential first requirement for the study was to construct a new research resource in the form of a DB Pensions Analytical Data Base (DBPADB). This data base, which covers the period January 2006 to March 2013, matches company financial- and DB-pension-related concepts taken from the company financial statements and pension notes with corresponding stock market performance and company valuation data. A number of sources, including the underlying assumptions and sensitivity analyses routinely provided in the pension notes of the majority of the FTSE 100 companies, were used in its construction.[3]

Figure 1: DB net assets as a share of market capitalisation

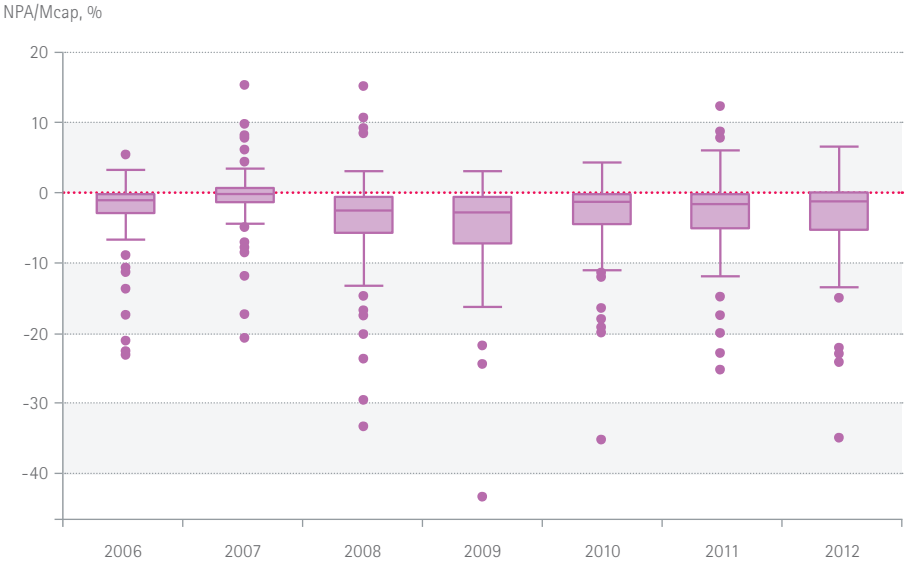
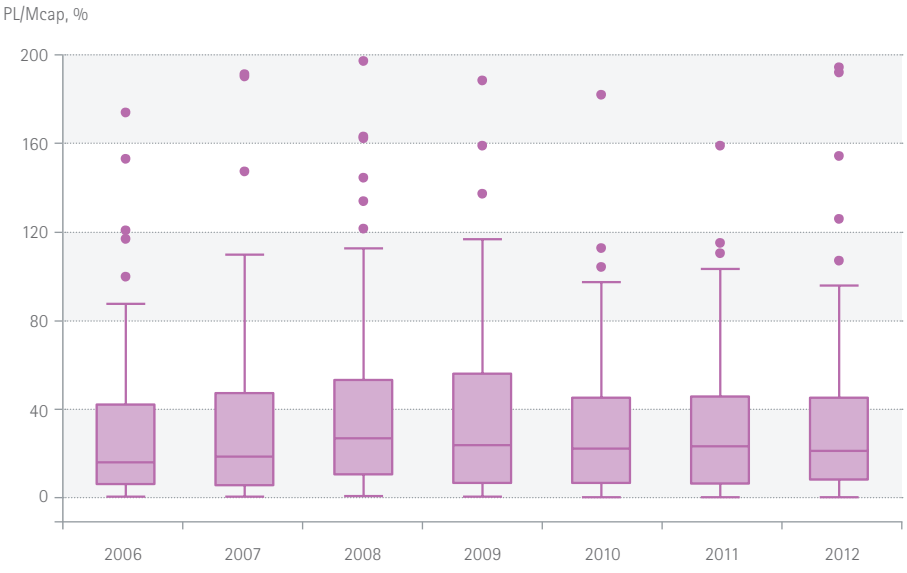


Figure 2: DB pension liabilities as a share of market capitalisation



Source: *The DB Pensions Analytical Data Base*

Notes: The shaded areas indicate the inter-quartile range, with median values shown as a solid bar. Maximum and minimum values in the normal range are shown by the outer bars, whilst the dotted points represent minor outliers. A small number of major outliers which go beyond the scale of the graphs are not shown for some years. These include BA, BAE, BT, GKN, International Consolidate Airlines, Invensys and RBS. Figures 1 and 2 have been reproduced from the originals. The originals are available upon request.

Published pension data sources are relatively heterogeneous in form and presentation, and differ considerably from company to company. To ensure that the data set was assembled on a consistent basis, a number of important procedural rules have been followed:

- The company sample is based on the specific composition of the FTSE 100 index for 2009. Companies affected by mergers and acquisitions or delisted over the sample period have therefore been included for those years in which the relevant accounts are available.
- Multiple pension schemes have been aggregated, and all pension accounts expressed on a common sterling basis.
- The basic company, pension, and market valuation data have been aligned to a common period, typically attributed to the year to which they largely refer. For example, data for the accounting year closing in March 2013 have typically been attributed to 2012. Market valuations are based on those coinciding with the reporting dates of the accounts in question.
- A small number of companies have been excluded: those without DB schemes; those with activities, employees, and pension schemes outside the EU and the US; and those with partial or inadequate pension data.

In the majority of cases, the pension notes provided sufficient information to recover robust estimates of the key assumptions underlying the net present value of pension obligations estimates. Where the relevant detail is insufficient, the sample average has been used.

Unless otherwise stated, the measure of pension net assets used throughout the study has been based on the strict economic definition, and therefore excludes any subsequent 'corridor adjustments', although their significance has been examined as part of the study.

III. The underlying model

The starting point is a simple valuation model

The starting point for the analysis is a simple valuation model based on the residual-income approach, as used by Coronado and Sharpe in their original US-based 2003 study, of the following form:

Equation (1)

$$P = b0 + b1\,BVC + b2\,cor\,E + b3\,NPA + b4\,EPS + u$$

where the share price (P) is taken to be a function of: company book value (ex-pensions) (BVC); expected core earnings (corE); pension net assets (NPA); and the pension-related counterpart to core earnings (EPS) – essentially derived from net periodic pension costs – all expressed per share.

Of which two variants are considered

Within this framework, two underlying valuation models were considered:

- The first is a 'transparent' model, in which market investors, when valuing a company, simply focus on the value of pension and non-pension net assets, rather than the associated flow of net financing pension accruals i.e. one in which b1, b3<1 and b4=0.
- The polar alternative, the 'opaque' model, is one where account is taken of the stream of pension-related earnings and accruals, but no account is taken of the pension net asset position, that is, b3 = 0 and b4 >0.

US evidence suggests net pension assets are only found to be significant when pension earnings are excluded

The key finding of Coronado and Sharpe, who used data for the S&P 500 companies over the period 1993-2001, was that net pension assets were significant only when pension earnings were excluded from the equation. The data were therefore generally found to support the 'opaque' view, where expected pension earnings play a more significant role than pension net assets, in combination with the book value of assets and core company earnings. The authors take this as being specific criticism of the information content and transparency of the US pension accounts as permitted under the (then) prevailing disclosure rules.

A follow-up study using a revised (normalised) model found similar results

Similar results were found in the follow-up study, Coronado et al (2008), which extended the analysis to 2005. This study used a revised version of the model, in which the dependent variable is the market equity value of the company normalised by the book value of total assets, rather than by the share price, with all other relevant financial and pension-related regressors also normalised by the book value of total assets.

The underlying model

Essentially the model used in that extended study was of the following form:

Equation (2)

$$MCAPA = (P*N/A) = b0 + b1\ BVCA + b2\ EA + b3\ NPAA + b4\ EPSA + u$$

where MCAPA represents the current market value of the company; and BVCA, EA, NPAA and EPSA correspond to non-pension and pension book values and earnings, each scaled by total company assets (A).

Although observationally equivalent, there are strong prior reasons to consider that a non-normalised price model such as Equation (1) is likely to be statistically unstable, in the sense that share prices and the regressors involved are all inherently volatile and non-stationary (trended and non-constant variance), and thereby prone to the various effects of heteroskedasticity, spurious correlations, and related estimation bias.

Econometrically, there are good reasons to believe that the normalised model is more likely to be stable, particularly during a period of high share price volatility which might otherwise mask the underlying economic relationship.

All estimates in this study are based on the normalised model

Given that the sample for the current study, for the period 2006 to 2012, includes episodes of major share price volatility, all estimates are therefore based on the normalised model, Equation (2).[4]

IV. Evidence based on the published data set

Preliminary estimates were made for three selected panels of companies

Preliminary estimates of the corresponding market valuation models, based on the published data set, were made for three selected panels of companies. These include:

- **A 'full' sample**, comprising the unfiltered set of all companies for which the basic relevant information was available;
- **A 'deficits' subsample**, comprising all observations where pension net deficits were reported; and
- **A 'fair value'[5] subsample**, comprising those companies which provided sufficient information for the computation of 'fair value' pension liabilities and net assets.

The relevant model and parameter estimates obtained using the data sample, along with associated (robust) standard errors and conventional test statistics, are summarised in Table 1.

All model estimates were obtained using the robust panel data estimation methods provided by the Stata package.[6] All model estimates also included seven annual time and ten broad sector/industry-specific constant shift effects (not reported here), in order to pick up common influences related to the macroeconomic cycle and sectoral developments.

Two forms of the model are used

Results for two forms of the model are included:

1. **The basic form** of Equation (2), in which a single measure of DB pension net assets (NPAA) is used; and
2. **A modified version,** in which a separate term in pension liabilities (PLA) is included as a test of the statistical sufficiency of the net assets variable in representing pension assets and liabilities.

The basic model is supported by the data ...

The basic model (Equations 1.1, 1.3, and 1.5).[7] While there are some variations in parameter estimates across different samples, some broad points of agreement emerge. In general, the basic model is supported by the data:

- The estimated correlation coefficients – at or above 0.5 – are reasonably high for a time series cross section study of this type, and the standard errors are reasonably low.
- The estimated coefficients for key variables, notwithstanding some variations, are fairly robust, have correct signs, and are mostly statistically significant.
- The estimated coefficients on company book values (BVCA) are all highly significant and in the plausible range of 0.45 to 1.0, and lowest for the 'fair value' sample.

... in contrast with comparable US data

- The estimated coefficients on net pension assets (NPAA) are all correctly signed, statistically significant, and notably greater than 1. This is consistent with the market ascribing a disproportionate weight to net pension assets relative to the book value of assets, and contrasts strongly with the US finding discussed earlier.[8]
- The estimated coefficients on company earnings (EA) are fairly robust, highly significant, and plausible – typically implying a £3.70 to £5.50 increase in company value per £1 of additional earnings. These estimates are somewhat lower than those given by corresponding US studies.
- By contrast, the estimated coefficients on net periodic pension costs (NPPCA) are not well determined, but are of similar orders of magnitude and not significantly different from those for core earnings, implying that the market may give similar weight to both influences.
- The results for 'full' and 'deficits' samples are not significantly different, although the pension cost estimates for the 'deficits' sample are perverse and ill-defined.

At first sight a greater-than-unit coefficient estimate for net pension assets (NPAA) is somewhat puzzling, because it could be taken to imply that the market gives a disproportionately large weight to movements in pension deficits compared with changes in core book values (BVCA). Such a conclusion, however, would need to be carefully qualified when the corresponding estimates for Equations 1.2, 1.4 and 1.6 are also considered.

V. Does size matter?

The modified model (Equations 1.2, 1.4 and 1.6). The key finding here is that, by including a separate liabilities term, and giving different implicit weights to pension assets and liabilities, the coefficients on net pension assets fall to within a fairly narrow range around 1, with little effect on the coefficients of other significant variables. At the same time, the separate liability terms are all statistically significant and of the order of 0.2, i.e. around 20% of pension liabilities.

The broad conclusion is that size matters ...

The broad conclusion here is that size matters. Thus for two companies reporting identical levels of pension net assets in relation to total company assets, the company with the lower (higher) gross pension liabilities (also in relation to total assets) will tend to attract a higher (lower) market valuation. The implication is that reported pension liabilities are regarded by markets as being systematically undervalued and/or that a higher level of liabilities is viewed as representing a higher risk.[9]

... and higher pension liabilities seem to attract a lower valuation

The next section refines the analysis to consider alternative measures of 'fair value' liabilities and pension risks with a view to testing both these hypotheses.

VI. Estimating 'fair values' and reported pension liabilities

Consideration of 'fair value' and risks warrants scrutiny

The consideration of 'fair values' and pension risks necessitates closer scrutiny of the underlying data set, and greater focus on the detailed technical assumptions and sensitivity analyses contained within the pension notes.

Outliers were excluded

Following the examination of data sources and sensitivity analysis using the net assets model, it was concluded that a number of company outliers should be excluded.[10] Typically these exclusions involved companies quoted on the London Stock Exchange but whose operations, employment, and pension schemes are largely outside Europe and the United States; have particularly high and volatile market values (often they are in the mining, precious metals and raw material sectors); and have extremely low DB pension liabilities.[11] The resulting sample corresponds to the 'fair value' sample of companies used in Table 1.

Sources of valuation bias were examined

Although there are a number of probable sources of systematic bias in pension liability estimates, the largest, and that for which the market is best equipped to account, relates to the discount rate assumptions embodied in the net present value estimates for pension obligations.[12]

While the IAS 19 accounting standards have been important in introducing additional pension disclosure requirements, and stipulating that liabilities and assets should be valued using market rates, there nonetheless remains some discretion in the choice of discount rates – both in the choice of a specific corporate bond rate, and in the adjustments used in making it appropriate for the maturity of the scheme's liabilities (which in turn depend on the proportion of pensioner and active members in the scheme). As a result there is considerable variation in the discount rate assumptions used across companies and over time.

Reported liability and net asset estimates were standardised

Accordingly, this study has sought to standardise the reported pension liability and net asset estimates by taking specific account of the differences between the discount rate assumptions used in calculating DB liabilities and the (usually lower) current market rates on government bonds (gilts) of similar maturity. To achieve this, associated measures of 'fair value' liabilities and associated pension net assets have been estimated, taking full account of the underlying technical assumptions and additional sensitivity analysis information reported in the standard pension notes, in particular those pertaining to interest rate sensitivity.

A first step in the standardisation process is to estimate the approximate duration (D) of pension obligations implicit in the reported present value of pension liabilities. These are estimated on the basis of the discount rate sensitivity estimates given by individual company pension notes using the following expression:[13]

Equation (3)

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

where D represents 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), as used in calculating the present value for a given company and year.[14]

In practice, sufficient information was available to calculate implicit durations for over two-thirds of the sample. Estimates ranged from 12 to 25 years, with a sample average and median of around 18 ½ years.

For companies where discount rate sensitivities are not reported in the pension notes, the sample average duration was used.[15] Corresponding 'fair value' adjustments to pension liability estimates were then made using gilt rates, matched to the timing of the company accounts and the duration of the defined benefit obligations (DBO), using the following expression:[16]

Equation (4)

$$FVPL = PL*[1 - D*(g-r)/(1 + r)]$$

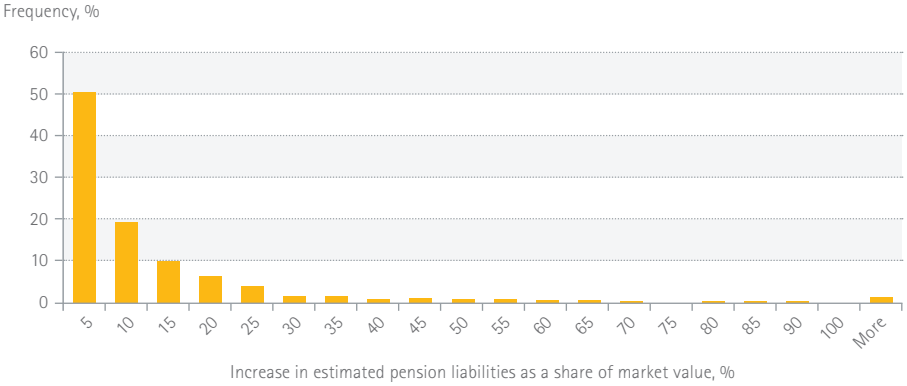
where the 'fair value' pension liability estimate (FVPL) is the reported net present value of pension liabilities (PL) rescaled by 1 minus the duration (D) times the difference between gilt (g) and published (r) discount rates as a ratio of the published discount factor (1 + r).[17]

Adjustments typically result in a higher level of liabilities

These adjustments typically result in a much 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, for each company and at each given point in time.

Averaged across companies, these adjustments added approximately 20 to 25% to the levels of liabilities and pension net asset positions.[18] As illustrated in Figures 3, 4, and 5, the effects measured at the aggregate level are quite substantial, particularly at the time of the financial crisis in 2008 and to a lesser extent in 2011 – reflecting not only the fall in market values, but also the larger disconnects between corporate bond and gilt rates.

Figure 3: The impact of 'fair value' adjustments on pension liabilities as a percentage of market value



Source: *The DB Pensions Analytical Data Base*

Notes: Figure 3 reports the frequency distribution of percentage revisions to pension liabilities made through fair valuation adjustments as described in the main text.

VII. 'Fair value' estimates versus the published data set

Four key results emerge

To test the relative explanatory power of the published versus 'fair value' pension estimates, Table 2 presents a series of summary model estimates designed to illustrate different features, all based on the same data sample. Four key results emerge:

- Although most parameter estimates are little affected by the choice of net asset and liability estimates, 'fair value' net assets appear to provide a more satisfactory explanation, with uniformly-higher goodness of fit and greater plausibility.
- Equations using the 'fair value' measures (comparing Equation 2.1 to 2.4), exhibit more plausible net asset coefficients (of the order of 0.9 to 1.0), without the inclusion of a separate liabilities term, which is also statistically insignificant and close to zero in Equation 2.4.
- Testing for the significance of the differences between published and 'fair value' net pension assets, the published data add nothing to the basic 'fair value' model (2.3), with the corresponding measure (FVdif) close to zero and insignificant as in Equation 2.5.

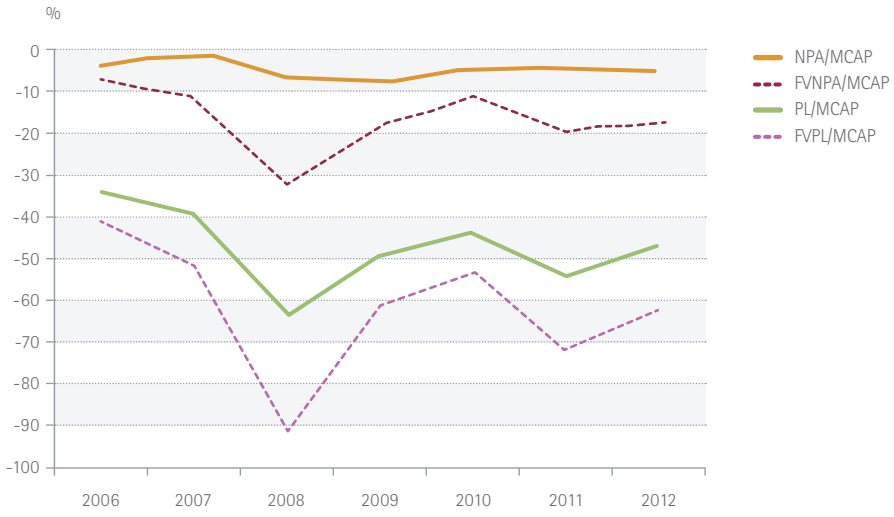
Equation 2.6 represents perhaps best the 'fair value' model

- Following up earlier observations about the apparent insignificance of periodic pension costs, Equation 2.6 confirms that they can be readily combined within a single company earnings term (E) without loss of significance or impact on other parameter estimates. Indeed Equation 2.6 provides the simplest and most parsimonious representation of the 'fair value' model, achieving the lowest overall standard error, and without loss of explanatory power.

Additional estimates were made to further examine robustness

To examine further the robustness of the basic 'fair value' model and to address possible concerns that the results could be biased by outliers with respect to the scale of pension liabilities in relation to market values (those having so-called 'super-sized' pension obligations), additional estimates were made using sequential tests with smaller samples of company pension data, as reported in Table 3. These estimates were made by sequentially removing data points ordered by the ratio of pension liabilities to market capitalisation (R).

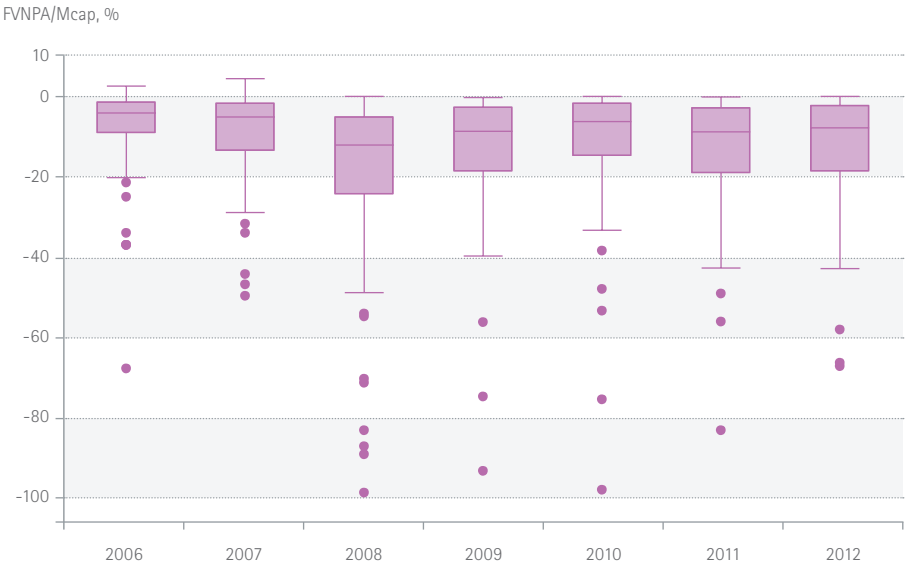
Figure 4: The effects of 'fair value' adjustments on pension net assets and liabilities as a percentage of market value



Source: *The DB Pensions Analytical Data Base.*

Notes: The dashed lines correspond to the 'fair value' adjusted values of pension net assets and liabilities.

Figure 5: Estimated 'fair value' DB net assets as a share of market capitalisation



Source: *The DB Pensions Analytical Data Base.*

Notes: See the notes for Figures 1 and 2. Figure 5 has been reproduced from the original. The original is available upon request.

Estimates remained unaffected by 'supersized' obligations

These range from the full sample to the set of companies with reported liabilities successively below 300%, 200%, and 100% of market capitalisations. The specific company exclusions are listed in the note to Table 3. [19] The broad finding is that, notwithstanding some small variation in estimates obtained for different samples (Equations 3.1 to 3.4), the overall parameter estimates are relatively robust and unaffected by the influence of 'super-sized' obligations.

'Fair value' data yield the most satisfactory statistical explanation

An overall conclusion is that market valuations over the estimation period appear to have been most consistent with the 'fair value' representation of DB pension liabilities and net assets, as opposed to the actual reported data. It seems unlikely, however, that many investors would make such formal calculations of the inconsistencies in assumptions and market discount rates: more likely is that they would simply apply a rule of thumb, for example by adding roughly 20% to reported pension liabilities.

VIII. Allowing for generic risks

Composite risk indicators were constructed

An alternative to the 'fair value' calculations would be to assess the risks associated with the specific characteristics and structure of each of the pension schemes. To do this comprehensively would be highly demanding, and go beyond the scope and information set of this study. However, taking it forward on a broad generic basis, the study has constructed composite risk indicators designed to embody rules of thumb for selected risks, as follows:

- Longevity risks: +5% of gross pension liabilities
- Discount risk: the effect of a 1% shift in rates on pension liabilities[20]
- Equity risks: -20% of equity assets

The risk indicator is relatively smooth at the aggregate level...

Although arguably broad-brush and somewhat arbitrary, such a composite risk measure does at least reflect, in a consistent quantified manner, some of the main concerns of pension specialists in assessing the uncertainties attached to specific schemes.

As illustrated in Figure 6, the resulting risk indicator is relatively smooth at the aggregate level, compared with the corresponding degrees of 'fair value' adjustments, rising significantly in 2008 and relatively stable thereafter. There is nonetheless considerable variation at the company level, rising to 100% or more for those companies with greatest exposure (Figure 7).

Table 4 reports a variety of model estimates using the composite risk variable in conjunction with published and 'fair value' data, all based on the same 'fair value' sample of companies. On this basis, a number of points emerge:

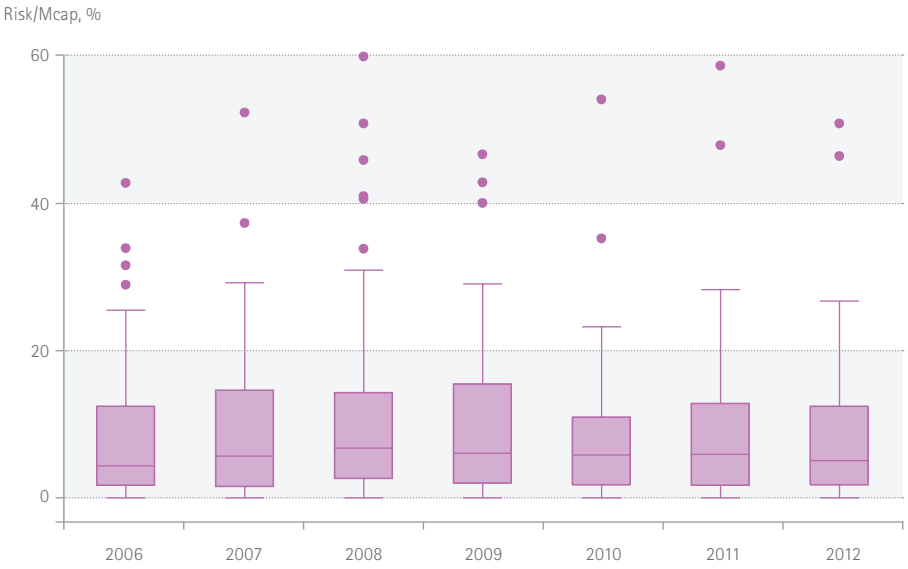
... is significant and plausible in the basic models

- First, the composite risk variable (Risk A) is found to be significant, with a plausible and correctly-signed parameter of 0.9 where the published net assets data are used (compare 4.1 with 4.2), performing much the same role as liabilities in reducing the net asset term to a plausible value of 0.8.
- It is also plausible in the unrestricted form of the model (4.3 and 4.4), but its statistical significance and those of the separate assets and liabilities are greatly reduced.
- Overall, Equation 4.2 with reported net assets and the risk variable is the most acceptable representation.

... but performs relatively poorly in the fair value models

In the 'fair value' models, by contrast, the risk variable performs relatively poorly (4.5 to 4.8). Its influence is small and insignificant in the basic 'fair value' specification (4.6) and, though plausible, remains insignificant in the unrestricted form of the model (4.7 and 4.8). Overall, the basic 'fair value' models (4.4 and also 2.6) still appear to provide the most satisfactory statistical explanations.

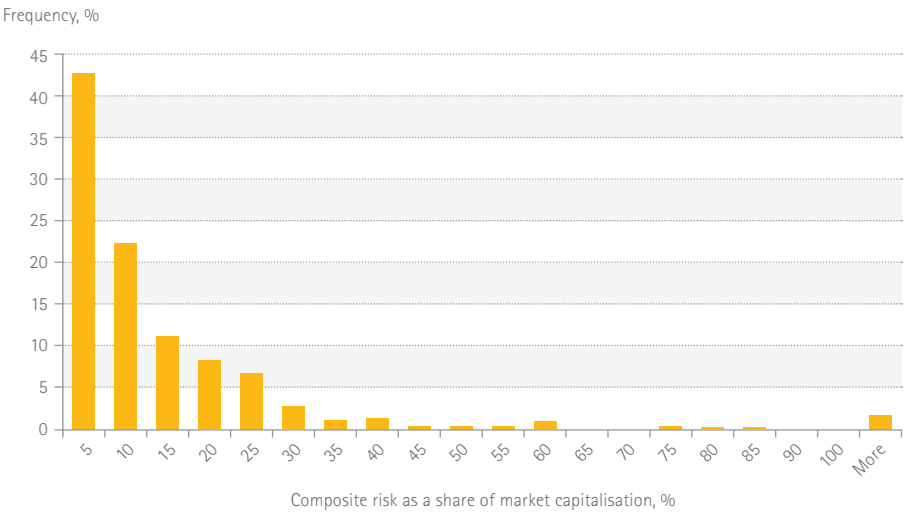
Figure 6: Generic risk variable as a share of market capitalisation



Source: *The DB Pensions Analytical Data Base.*

Notes: See the notes for Figures 1 and 2. Figure 6 has been reproduced from the original. The original is available upon request.

Figure 7: Distribution of composite risk within the 'fair value' sample



Source: *The DB Pensions Analytical Data Base*

Notes: This figure reports the frequency distribution of the composite risk variable as described in the main text.

IX. How important are 'corridor adjustments'?

'Corridor adjustments' were excluded from the basic analysis

The measure of DB pension net assets used throughout the study is based on the strict economic definition, and therefore excludes any subsequent 'corridor adjustments'. The rationale for doing so is that the market ought to be sufficiently sophisticated to use all the information available to 'see through' any accounting adjustments that are made to 'smooth the data'.

'Corridor accounting' allows exceptional gains and losses from pensions schemes to be deferred, (or 'smoothed'), over a period of years. Concerns have been expressed in some quarters about the call for a halt in the practice as announced in the pension scheme accountancy standards for 2013 (IAS 19). According to some analysts, the changes will bring about greater financial cost to schemes and changes to investment decisions, such as increasing the move to lower-risk portfolios and incentivising more de-risking within the pensions industry.

Additional tests allowing for such smoothing were run

Accordingly, to explore this issue further, additional tests were run using both the original full sample and the 'fair value' model, incorporating some allowance for 'corridor smoothing' in the form of a variable equivalent to the corridor adjustment in those cases when they are made, and zero otherwise.

Evidence suggests that markets see through the practice

The corresponding results are reported in Table 5. Admittedly, the test is of relatively low power, affecting fewer than 10% of observations, but the broad outcome is that the effects of corridor adjustment appear to be insignificant and possibly negative. To this extent they support the view that the market essentially sees through any corridor smoothing.[21]

X. Box: If size matters, then what is it worth?

As a broad guide to the size and significance of the identified market valuation effects coming from DB pensions, this table provides a guide to the estimated scale of valuation effects identified with changes in individual factors and the corresponding implications for a range of hypothetical pension schemes with stylised characteristics.

These estimates are all based on the best overall relationship found, but are subject to the usual statistical margins of error, as indicated in the reported ranges.[22] The assumed scale of 'fair value' adjustment is based on the FTSE 100 average for the sample period although, for an individual pension scheme, the degree of adjustment is likely to differ considerably, being larger or smaller depending on its specific circumstances and the deviation of its discount rate assumptions from the prevailing market rate for gilts.

It is striking that, even where a pension scheme is reported as being in approximate balance, the scale of its pension obligations can be of major importance to the market's assessment of company value. Hence, even where the reported assets and obligations appear to be basically matched, the associated biases and risks are seen as being proportional to the size of the scheme (Pensions A and B).

This result applies equally to mid-range schemes (Pensions C and D) and particularly for supersized schemes (Pensions E and F), where the effects of the reported net deficits are dwarfed by the associated scale of risks.

Table: If size matters, then what is it worth?

1. Market value sensitivities

	Best 'fair value' model
Estimated market value sensitivities to £100m increases in:	
Non-pension book values	+£43m (± £15m)
Company earnings	+£377m (± £80m)
'Fair value' adjusted pension net assets	-£90m (± £19m)

Note: These estimates are based on Equation 2.6, which allows for 'fair value' adjustments to net pension assets taking account of possible bias in reported Defined Benefit Obligations (DBO). The figures in brackets correspond to estimated one standard error margins.

2. DB pension effects on market values

				'Fair value' model based estimates
Estimated DB pension effects on market values:				
Pension A	NPA = 0	DBO = -£500m	FVNPA = -£100m	-£90m (± £19m)
Pension B	NPA = 0	DBO = -£10,000m	FVNPA = -£2,000m	-£1,800 (± £380m)
Pension C	NPA = -£500m	DBO = -£3,000	FVNPA = -£1,100m	-£990 (± £209m)
Pension D	NPA = -£500m	DBO = -£20,000m	FVNPA = -£4,500m	-£4,050m (± 855£m)
Pension E	NPA = -£2,000m	DBO = -£20,000	FVNPA = -£6,000	-£5,400m (± £1,140m)
Pension F	NPA = -£2,000	DBO = -£40,000	FVNPA = -£10,000m	-£9,000m (± £1,900m)

Note: 'Fair value' net pension asset estimates include a 20% adjustment to Defined Benefit Obligations (DBO) based on the FTSE 100 sample average estimate, as discussed in the main text. The specific scale of valuation adjustment for an individual pension scheme is likely to vary considerably, larger or smaller, according to its specific circumstances and the deviation of the discount rate assumptions used from the prevailing market rate for gilts.

XI. Summary conclusions

Evidence suggests that ...

Overall this study provides reasonably robust empirical support for the simple company valuation approach when applied to UK FTSE 100 companies over the recent past, with evidence of statistically-significant influences coming from core (non-pension) company book values, company earnings, and pension liabilities and deficits.

... a relatively large weight is given to net pension deficits ...

In contrast to comparable US studies, the UK market appears to ascribe quite large and significant weight to pension liabilities and deficits in the overall valuation process as reflected in share prices and market capitalisation.

Given that the focus of US research has been on the inadequacy and lack of transparency in US company pension notes, a plausible explanation of this result is that superior EU pension reporting standards embodied in IAS19 and its precursors give the published pension accounts greater market credibility.

Taken at face value, the preliminary evidence based on the published data suggests that a relatively large weight (160%) is given to net pension deficits, and that this weight is somewhat greater than that given to non-pension company book values. This implies that overall company values are reduced by about £160 per £100 of pension deficit.

... larger than that given to non-pension company book values

On the face of it this presents a puzzle. This apparent puzzle, however, can be explained by making further allowance for systematic bias or risks associated with the measurement and scale of pension estimates as a simple proportion of gross liabilities or by more sophisticated means.

In the former case, making allowance for the scale of pension liabilities suggests a more plausible weight for pension deficits (of around 85%), but an additional deadweight loss equivalent to around 17% of total pension liabilities.

Looking more closely at sources of bias and systematic risk associated with estimated pension liabilities, the one which the market may be best able to allow for – and the largest – relates to the differences between corporate bond rates used in their estimation and the market rate for gilts. Making such an allowance, in the form of 'fair value' adjustments to the present values of pension liabilities and net asset positions, is found to have substantial effects on the scale of liabilities (increased by 20% on average) and deficits, most notably in the recession period (Figure 4 and comparing Figures 5 and 1). Indeed in such a case, few if any FTSE 100 company pensions are likely to have been in surplus since 2008.

But 'fair value' data yield a more satisfactory explanation

Empirically, models that incorporate such 'fair value' adjustments are found to be generally more satisfactory in terms of plausibility and explanatory power, and appear to be unaffected by changes in company sample, e.g. the removal of those with 'supersized' pension schemes. The weight given to 'fair value' pensions is found to be reasonably close to 90%, but in this case size also matters, to the extent that it affects the scale of the 'fair value' adjustments to liabilities and deficits.

Where unadjusted published data are used, there is also evidence of the market giving systematic weight to the range of other risk influences, for example those associated with longevity, interest rates, and equity risks. However, these prove to be marginally outperformed by the simple 'fair valuation' model.[23]

Size really does seem to matter to markets

The overall conclusion is that, whether through valuation adjustments, specific risk assessment, or crude rules of thumb, both the size of the pension deficit itself and the scale of the associated pension obligations really do matter to markets when assessing company value.

Whether the same overall conclusions apply also to the wider set of companies, for example to the FTSE 350, is an interesting question that warrants investigation, because it would encompass a much wider range of schemes and experiences, as well as offering the scope to explore a more refined set of risk factors.

The data requirements for such a study would pose considerable further challenges, reflecting the much wider range of pension accounting and reporting practices amongst the FTSE 350 companies.

Tables – model estimates

Table 1: Valuation model estimates using the published data set

Dependent variable: Market Value of Company/Total Company Assets, MCAPA = f (BVCA, EA, FVNPAA, NPPCA)
Sample: 2006-2012. Companies as per notes.

Equation	1.1	1.2	1.3	1.4	1.5	1.6
Sample/ equation notes	Net asset model full sample N=581	Eq.1.1 with liability term full sample N=581	Net asset model deficits only N=471	Eq.1.3 with liability term deficits only N=471	Net asset model 'fair value' sample N=543	Eq. 1.5 with liability term 'fair value' sample N=543
BVCA	0.8796*** (0.22)	0.8340*** (0.22)	1.0337*** (0.28)	0.9889*** (0.29)	0.4644** (0.15)	0.4377** (0.15)
EA	5.0030*** (1.01)	5.1116*** (1.02)	5.3788*** (1.17)	5.4940*** (1.17)	3.6975** (0.80)	3.7924*** (0.81)
NPAA	2.0347*** (0.51)	1.0724** (0.55)	2.1671*** (0.56)	0.9421 (0.70)	1.5990* (0.49)	0.8469* (0.54)
PLA		0.2153** (0.09)		0.2145* (0.11)		0.1765* (0.08)
NPPCA	3.6317 (6.68)	0.6011 (7.09)	-2.2337 (7.13)	-4.9755 (7.56)	5.9406 (6.19)	3.2990 (6.53)
CON	0.4213** (0.16)	0.4591 (0.16)	0.2349 (0.19)	0.2451 (0.19)	-0.0048 (0.14)	0.0232 (0.14)
R2	0.5266	0.5309	0.5144	0.5182	0.5819	0.5862
RMSE	0.6187	0.6165	0.6314	0.6296	0.4799	0.4779

Note: 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

NPPCA = Net Periodic DB Pension Costs/Total Assets

Table 2: Summary of results for the 'fair value' vs. published data based model estimates

Dependent variable: Market Value of Company/Total Company Assets, MCAPA = f (BVCA, EA, FVNPAA, NPPCA)
Sample: 2006-2012. Companies as per notes.

Equation	2.1	2.2	2.3	2.4	2.5	2.6
Sample/ equation notes	Net asset model FV sample N=543	Eq.2.1 with liabilities term N=543	FV Net asset model N=543	Eq.2.3 with liabilities term N=543	Eq.2.3 with valuation test N=543	Eq.2.3 with total earnings term N=543
BVCA	0.4644*** (0.15)	0.4377*** (0.15)	0.4310** (0.15)	0.4376** (0.15)	0.4295*** (0.15)	0.4296** (0.15)
EA	3.6975*** (0.80)	3.7923*** (0.81)	3.7853*** (0.80)	3.7647*** (0.80)	3.7872*** (0.80)	
E						3.7692*** (0.80)
NPAA	1.5990*** (0.49)	0.8469* (0.54)				
FVNPAA			0.9276*** (0.22)	1.1742** (0.47)	0.9457*** (0.29)	0.9054*** (0.19)
FVdiff					-0.0596 (0.47)	
PLA		0.1765* (0.08)				
FVPLA				-0.0690 (0.43)		
NPPCA	5.9406 (6.19)	3.2991 (6.52)	2.5567 (6.27)	2.6723 (6.39)	2.5894 (6.3)	
CON	-0.0048 (0.14)	0.0232	0.0027 (0.14)	-0.0043 (0.14)	0.0002 (0.14)	0.0225 (0.10)
R2	0.5819	0.5862	0.5897	0.5899	0.5897	0.5896
RMSE	0.4799	0.4779	0.4754	0.4758	0.4759	0.4750

Note: 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
E =Total Company Earnings/Total Assets
NPAA = Net DB Pension Net Assets/Total Assets
FVNPA = 'Fair value' DB Pension Net Assets/Total Assets
FVdiff = FVNPA-NPAA
PLA = Pension Liabilities/Total Assets
FVPLA = 'Fair value' Pension Liabilities/Total Assets
NPPCA = Net Periodic DB Pension Costs/Total Assets

Tables – model estimates

Table 3: Testing the sensitivity of the 'fair value' model (Eq. 2.3) to changes in sample composition

Dependent variable: Market Value of Company/Total Company Assets, MCAPA = f (BVCA, EA, FVNPAA, NPPCA)
Sample: 2006-2012. Companies as per notes.

Equation	3.1	3.2	3.3	3.4
Sample/ equation notes	Full sample N=543	Excluding R>3 N=532	Excluding R>2 N=500	Excluding R>1 N=486
BVCA	0.4310** (0.15)	0.4136** (0.15)	0.4225** (0.15)	0.4080** (0.15)
EA	3.7853*** (0.80)	3.7256*** (0.80)	3.6554*** (0.80)	3.6311 (0.80)
FVNPAA	0.9276*** (0.22)	0.8965*** (0.23)	0.9199** (0.37)	0.8356** (0.38)
NPPCA	2.5567 (6.27)	0.8633 (6.51)	0.0111 (7.7)	-0.8326 (7.81)
CON	0.0027 (0.14)	0.8295*** (0.11)	0.8667*** (0.12)	0.8645 (0.12)
R2	0.5897	0.5901	0.5892	0.5828
RMSE	0.4754	0.4760	0.4845	0.4897

Note: 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
FVNPAA = 'Fair value' 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 according to the ratio of company 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	X
RSA Insurance Group			X
Rexam			X
Marks & Spencer Group			X
National Grid			X
Barclays			X
Lloyds			X
TUI Travel			X
Rolls Royce Holdings			X
IMI			X

Note: The mean value of R over the estimation sample period is 0.47, with a standard deviation of 0.8.

Table 4: Testing alternative models against a generic risk measure (RiskA)

Dependent variable: Market Value of Company/Total Company Assets.
Sample: 2006-2012. Companies as per notes.

Equation	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8
Sample/ equation notes	Net asset model N=543	Eq. 4.1 with risk term N=543	Unrestricted basic model N=543	Eq. 4.3 with risk term N=543	FV Net asset model N=543	Eq. 4.5 with risk term N=543	Unrestricted FV model N=543	Eq. 4.7 with risk term N=543
BVCA	0.4644*** (0.15)	0.4216** (0.15)	0.4377*** (0.15)	0.4231** (0.15)	0.4310** (0.15)	0.4296** (0.15)	0.4376** (0.15)	0.4301** (0.15)
EA	3.6975*** (0.80)	3.7955*** (0.81)	3.7924*** (0.81)	3.7981** (0.81)	3.7853*** (0.80)	3.7879*** (0.80)	3.7647*** (0.80)	3.7688*** (0.80)
NPAA	1.5990*** (0.49)	0.8033 (0.57)	0.8469* (0.54)	0.7854 (0.56)	0.9276** (0.22)	0.9006** (0.43)		
FVNPAA					0.9276** (0.22)	0.9006** (0.43)	1.1742** (0.47)	1.1571** (0.48)
PAA								
PLA			0.1765* (0.08)	0.0317 (0.13)				
FVPLA							-0.0690 (0.13)	-0.1413 (0.13)
RiskA		-0.8958* (0.43)		-0.7641 (0.79)		-0.0463 (0.72)		-0.4722 (0.82)
NPPCA	5.9406 (6.19)	3.3157 (6.39)	3.2990 (6.53)	3.2277 (6.42)	2.5567 (6.27)	2.5379 (6.39)	2.6723 (6.39)	2.6020 (6.36)
CON	-0.0048 (0.14)	0.1334 (0.14)	0.0232 (0.14)	0.1181 (0.16)	0.0027 (0.14)	0.0094 (0.15)	-0.0043 (0.14)	0.0573 (0.16)
R2	0.5819	0.5869	0.5862	0.5870	0.5897	0.5897	0.5899	0.5902
RMSE	0.4799	0.4775	0.4779	0.4779	0.4754	0.4759	0.4758	0.4761

Note: 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).

RiskA = Generic Pension Risk Variable/Total Assets

Tables – model estimates

Table 5: Testing the significance of corridor adjustment effects

Dependent variable: Market Value of Company/Total Company Assets.
Sample: 2006-2012. Companies as per notes.

Equation	5.1	5.2	5.3	5.4	5.5	5.6
Sample/ equation notes	Net asset model full sample N=581	Eq. 5.1 with corridor test N=581	Net asset model 'fair value' sample N=543	Eq. 5.3 with corridor test N=543	'Fair value' model N=543	Eq. 5.5 with corridor test N=543
BVCA	0.8707*** (0.22)	0.8836*** (0.22)	0.4644** (0.15)	0.4682** (0.15)	0.4310** (0.15)	0.4344** (0.15)
EA	4.9979*** (1.02)	4.9799*** (1.02)	3.6975** (0.80)	3.6630*** (0.80)	3.7853** (0.80)	3.7551*** (0.80)
NPAA	2.0320*** (0.51)	2.0152*** (0.51)	1.5990** (0.50)	1.5676** (0.49)		
FVNPAA					0.9276*** (0.22)	0.9022*** (0.22)
DIFNPA		-1.7586 (1.66)		-2.4728 (1.73)		-2.0017 (1.40)
NPPCA	3.6368 (6.68)	2.8302 (6.99)	5.9406 (6.19)	4.7265 (6.51)	2.5567 (6.27)	1.7270 (6.41)
CON	0.4216* (0.17)	0.4140 (0.16)	-0.0048 (0.14)	-0.0744 (0.16)	0.0027 (0.14)	-0.0544 (0.16)
R2	0.5243	0.5272	0.5819	0.5838	0.5897	0.5910
RMSE	0.6215	0.6189	0.4799	0.4793	0.4754	0.4752

Note: 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).

DIFNPA = Corridor adjustment to NPA/Total Assets; zero where corridor is not used

Annex 1: Sources and Methods

This appendix describes the main sources and methods underlying the data set used in the DB pensions study – the DB Pensions Analytical Data Base (DBPADB) – 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 its 2009 composition.

Data sources

The data are drawn from 3 main sources:

1. The bulk of the DB pension-related information comes from the pension notes annex to the annual financial statements of each company.
2. 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.
3. 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 period from 2006 to 2012, as reported in the annual financial statements for those years. 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 most FTSE 100 companies are calendar-year based, a small minority relate to the financial year closing at end-March, while a handful of others variously report accounts to end-January, June, July, and September. Thus the data set ranges from January 2006 to March 2013, depending on the company.

For the purposes of the study the data for individual companies have been aligned so that all variables (standard accounts, pension related, share prices, interest and exchange rates) refer to precisely the same accounting period, namely that coinciding 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 model estimation are listed in Table A of Annex 2. Specific exclusions relate to:

- Companies without DB pension schemes;[24]
- Companies whose operations and pension schemes are primarily outside of the UK, the European Union and the United States; and
- Companies whose financial statements and 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 of Annex 2.[25] 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. Since in estimation all variables are expressed as ratios to Total Company Assets, the results are unaffected by the specific choice of conversion rates.

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 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 aim being to maintain consistency between financial and pension accounts at a given point in time: for example British Airways (BA) is included separately prior to the International Consolidated Airlines merger. Companies which have been delisted as a result of foreign mergers are included in the sample for those years where 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 'fair value' pension liabilities, net assets and related estimates

The measures of 'fair value' 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

A first step is to derive an estimate of the duration of pension obligations (D) implicit in the reported present value of pension liabilities (PL). These were calculated on the basis of the discount rate sensitivity estimates given by individual company pension notes using the following expression:[26]

Equation A1

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

where D is, for a given company and year, the estimated duration and dPL/PL the proportionate change in the present value of 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). In cases of multiple schemes, duration estimates were based on the sensitivities reported for the largest representative scheme.

Sufficient information was available to calculate implicit durations for over two-thirds of the FTSE 100 sample, providing duration estimates ranging from 12 to 25 years, with a sample average and median of 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.

'Fair value' liabilities

The main factor taken into account in calculating 'fair value' 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 usually-lower market rates on government bonds (gilts) of similar maturity. Effectively corresponding 'fair value' 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:[27]

Equation A2

$$FVPL = PL*[1 - D*(g-r)/(1 + r)]$$

where the 'fair value' pension liability estimate (FVPL) is the reported net present value of pension liabilities (PL) rescaled by 1 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 'fair value' adjustments added approximately 20% to 25% to the levels of pension liabilities.

Corresponding fair values of pension net assets were then recomputed as the difference between the 'fair value' of scheme assets (PA), reported in the pension notes and estimated 'fair value' of liabilities (FVPL), thus:

Equation A3

$$FVNPA = PA + FVPL$$[28]

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.

Risk variables

In addition to the size of pension liabilities and net pension assets, a number of individual and composite variables were calculated to represent the possible influence of other risk factors, on the basis of the following rules of thumb:

a. Longevity extension - 5% of gross liabilities
b. Discount rate - the effect of a 1% shift in discount rates on liabilities
c. Asset and bond risk - 20% of equity assets less 10% of bond holdings
d. Composite risk - the sum of longevity, discount rate and asset risks

Annex 2: Tables – FTSE 100 DB company list

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

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

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

Annex 2: Tables – FTSE 100 DB company list

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

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

Note: 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.

Table B: FTSE 100 DB pensions company and pensions variables

Company name	
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 end of financial year	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
1. '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
Estimated durations	Estimated (see text notes)
Government bond rates (matched by date and duration)	Bank of England yield curves
2. 'Fair value' Pension Liabilities	Estimated (see text notes)
3. 'Fair value' 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

Endnotes

1. Two key US studies are those carried out at the Federal Reserve by Coronado and Sharpe (2003) and Coronado, Mitchell, Sharpe and Nesbitt (2008). A key theme of both papers concerns the inadequacy of US reporting standards with respect to pension scheme disclosure, the implications for the US stock market, and the need for greater transparency.
2. See Trivedi and Young (2006), Bank of England Working Paper No. 289.
3. The main data sources include Bloomberg company data sets, the published company accounts and pension notes included in annual financial statements and the Bank of England's historic information on market interest rates and gilts. Further specific details of the DBPADB are given in the Sources and Methods annex.
4. Preliminary screening of the non-normalised data confirmed its general non-stationarity with high degrees of co-linearity. Corresponding tests on the model in normalised form confirmed general stability and stationarity of the variables involved.
5. The term 'fair value' is used in a variety of senses in the economic and financial literature. In this paper it is used in a specific sense, explained fully in the following section.
6. Stata is widely regarded as one of the most comprehensive statistical estimation packages available, with robust estimation techniques specially developed for time-series, cross-section and panel data analysis of this type (see http://www.stata.com).
7. Results for the conditioning time and sectoral variables, which suggest some significant sectoral and cyclical differences, are not reported here.
8. Given that the focus of US research was on the inadequacy and lack of transparency in US company pension notes, a plausible explanation of this result is that superior EU pension reporting standards embodied in IAS19 and its precursors give the published pension accounts greater market credibility.
9. More generally the results imply that the published net pension assets measure is not a sufficient statistic for the overall company pension position.
10. Data sensitivity analyses were carried out by sequentially trimming the sample for companies in the highest and lowest percentiles for pension net assets and market capitalisation. The broad conclusion was that a very small number of companies with the highest and most volatile market capitalisations (most often reflecting commodity price volatility) exerted undue influence on parameter estimates.
11. Typical examples are Fresnillo and Vedanta both of which are natural resource based companies.
12. Other differences, for example those related to pension increases and longevity, may be equally important but are less easily allowed for by the market.
13. Effectively the estimated duration D is backed out of the interest rate sensitivity calculation using the derivate rule for the net present value of liabilities of duration D.
14. Where multiple schemes exist, duration estimates were based on the sensitivities reported for the largest representative scheme.
15. Further experimentation suggested that subsequent estimates were relatively robust to variations in this assumption in the range of 15 to 20 years.
16. Equation 4 essentially applies the sensitivity rule on which Equation 3 is based.
17. Similar 'air value' liability estimates were also computed using an alternative geometric adjustment method as follows FVPL=PL*[(1+r)/1+g)]^D. This method yielded fair value liability estimates some 1% to 10% larger than those discussed above. Model estimation using these alternative geometric adjusted values however gave almost identical results in terms of size and significance of effects except for a smaller coefficient on net pension assets, of the order of 8, thus leaving the overall interpretation broadly unchanged.
18. Such an adjustment effectively eliminates all but a few reported pension net asset surpluses in the sample.

19. Over the period, the sample mean value of R is 47%, with only 10% of observations involving pension liabilities greater than 100% of market capitalisations. In total, observations for 16 companies were excluded for one or more years.
20. The discount risk is calculated using the same method used to evaluate 'fair value' liabilities, allowing also for an average 10% holdings in bonds.
21. In principle a negative effect would imply that corridor adjustments are not only discounted but may have a perverse effect.
22. Evaluations based on a wider range of relationships used in the study show these estimates to be relatively robust.
23. A secondary conclusion drawn from the same analysis is that the market appears to "see through" so called corridor adjustments to pension valuations by giving no significant weight to such distortions, although this result is based on a rather small set of observations.
24. Note that Alliance Trust PLC is also excluded on the grounds that as an investment fund its share price dynamics are likely to be driven by different forces than those of other companies, and because of the limitations of its balance sheet data.
25. The data set is quite heterogeneous across companies. Not all variables in Table B are available for all companies, whilst for some additional information is available.
26. Effectively D is backed out of the sensitivity calculation using the derivate rule for NPV of liabilities of duration D.
27. Equation A2 essentially applies the sensitivity rule on which Equation A1 is based.
28. Note that, following usual accounting conventions, PL and FVPL are negative entities which are added to pension assets to give net pension assets.

References

Works that have informed this Study, and which have in most cases been explicitly cited, include:

Coronado and Sharpe (2003), "Did Pension Plan Accounting Contribute to a Stock Market Bubble?", Brookings Papers on Economic Activity (1).

Coronado, Mitchell, Sharpe and Nesbitt (2008), "Footnotes Aren't Enough: The Impact of Pension Accounting on Stock Values", NBER Working Paper No.13726.

Trivedi and Young (2006), "Defined Benefit Company Pensions and Corporate Valuations: Simulation and Empirical Evidence from the United Kingdom", Bank of England Working Paper no.289, March 2006.

Disclaimers

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