The Influence of Pension Plan Risk on Equity Risk: A Study of FTSE100 Companies – 2002 to 2008

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Summary

This study has two primary objectives. First, a review of the composition of pension funds, incidence of pension scheme deficits and the impact of pension risk, variously measured, on equity risk. The latter is based on an econometric analysis of a panel data set of FTSE100 companies for the period 2002 to 2008. The primary objective of the econometric component is to ascertain whether the equity risk metrics reflect pension plan risk. If they do this suggests that with respect to pension plan funding equity markets are informationally efficient. On the other hand, if pension risk is not accurately reflected equity markets may be viewed as informationally inefficient resulting in the underestimation of risk and the resultant overvaluation of firms.

There has been a rebalancing of pension plan assets away from equity and towards debt. In 2002 equities contributed 59.83% of total pension fund assets with this proportion having declined to 44.16% in 2008. The decline in the share of equity has been matched to a significant degree by an increase in the share of debt from 30.52% in 2002 to 39.67% in 2008. We suggest that this may in part be due to volatilities in equity markets although a further contributing factor may be that recent legislative changes have clarified that pension liabilities are a form of corporate debt and that available evidence suggest mismatched investment strategies in pension schemes reduce shareholder value.

The analysis also suggests that pension plan risk does feed into firm equity risk which implies that the market views the assets and liabilities of the company pension scheme as part of the assets and liabilities of the firm itself. Having said this, it is also the case that there is some sensitivity to both model specification and adjustment techniques. More specifically, we note that the measure of pension risk proposed by Jin et al. (2006) can result in quite divergent findings influenced by only relatively small variations in the assumed value of the systematic risk of pension liabilities. With respect to this measure, it was also apparent that the resultant estimate was significantly lower than one, raising doubt on the hypothesised 1-to-1 relationship between pension risk and capital structure.

Section I: Introduction

The “perfect storm” of negative equity returns and low interest rates in the early years of this millennium has resulted in the majority of defined benefit pension schemes experiencing a deficit whereby the liabilities of the scheme exceed the assets. This situation has been made more obvious by the requirements of FRS17 and IAS19 which have required companies to disclose such deficits on their balance sheets instead of merely mentioning the deficit as a note to the accounts. To place the present magnitude of the deficit in context, David Cule, principal at Punter Southall, pointed out that the deficit is already "**significantly greater than the quantitative easing package**" and "**on a par with the level of support being put together for the banking system**".

These deficits are debt-like in nature although some differences do exist, a significant difficulty being that of measuring the value of future liabilities of the pension fund making numerous assumptions regarding, inter alia, wage increases and mortality rates within each scheme. Accepting that pension deficits are equivalent to debt then there are further implications for estimating aggregate debt and, in turn, corporate gearing. Emanating from such implications is a question regarding the perception of such deficits by the financial markets in terms of equity returns. In addition, the attention of accounting regulators and government legislation has become focussed upon defined benefit schemes in an attempt to improve both the transparency of disclosure and also protect the interest of scheme members in the event of sponsor failure.

According to Lane, Clarke and Peacock (2009) pension deficits for FTSE 100 companies in July 2009 had reached their highest ever recorded level of £96 billion. They ascribe the reason for this as being due to the collapse of Lehman Brothers in September 2008 and the subsequent sharp decline in assets values. In general, Lane Clarke and Peacock (2009) argue that pensions are a key risk for many FTSE100 companies. Indeed 46 of the 90 FTSE100 companies with defined benefit pension schemes reported pensions as either a “principal risk or uncertainty” or a key financial risk. The magnitude of these risks can be illustrated by consideration of the pension positions of British Telecom and British Airways. For end 2008, Lane, Clarke and

Peacock report that British Telecom pension liabilities amounted to almost £34.7 billion (in excess of twice its equity market value) while those of British Airways, were £13.5 billion (over five times their equity market value).

This research report strives to investigate the influence of scheme deficits upon measures of company risk, in particular systematic equity risk and total equity variability. A panel data approach is applied to those FTSE100 companies which operated defined benefit schemes during the period 2002-2008 (in 2008, 87 FTSE100 companies fell into this category).

In Section II we review and synthesize the relevant literature pertaining to defined benefit pension schemes in relation to developments in the accounting disclosure and pension plan funding and risk. The data set is described in Section III and the relationships to be estimated are detailed in Section IV. Section V presents the results obtained from the empirical analysis while Section VI concludes.

Section II: Literature

There are various characteristics of defined benefit pension scheme accounting disclosure which may call into question the ability of investors to efficiently process and accurately impound relevant information into market values. The rapidly changing disclosure regulation accompanied by its relative technical complexity can be viewed as an initial major hurdle to surmount, moreover the bulk of the prescribed disclosure is currently positioned in footnotes to the accounts rather than more prominently on the financial statements. In addition the relatively dramatic impact of seemingly minor alterations in the actuarial assumptions critical to the valuation of the pension plan assets and liabilities renders intercompany comparisons difficult. Furthermore the opportunities for earnings management appear attractive whilst flexibility remains regarding, inter alia, the expected return on pension assets and ongoing improvements in longevity. The intervention of the Pensions Regulator via the Pension Protection Fund provides an incentive for companies to improve the funding of their plans and thereby reduce the levies payable. Finally the current instability in the financial markets impacting upon equity values, interest rates and potentially inflation rates makes any long-term predictions untenable except perhaps that access to defined benefit schemes will continue to narrow as the associated costs escalate.

The main stream of research pertinent to our study relates to the extent to which the financial markets (both UK and US) are efficient at processing at the complex information disclosed in the financial statements compiled on the basis of current disclosure requirements. In addition related research which identifies earnings management activities surrounding pension disclosure and the extent to which analysts and investors see through such behaviour will also be evaluated.

One of the first studies to explore the effect of a firm's pension deficit on its share price was Feldstein and Seligman (1981). Using a sample of 200 US firms they concluded that a deficit is rapidly incorporated into the share price suggesting that the unfunded pension liability is being recognised by shareholders as equivalent to corporate debt. Similarly Bulow, Morck and Summers (1987), using a variable effect event study methodology, conclude that unfunded pension liabilities are accurately reflected in lower share prices whereas Aldersen and Chen (1987) find that an abnormal rise in the share price is experienced by companies which recover a pension plan surplus.

Of most direct significance to the current study, Jin et al (2006) examine whether the systematic equity risk of 4,500 US companies during the period 1993-1998 reflects the risk of their pension plans. Whilst initially suggesting reasons why this may not be the case, such as the opaque nature of accounting rules and the existence of the Pension Benefit Guaranty Corporation, their findings are consistent with the capital markets exhibiting informational efficiency in processing the pension information. However despite this positive conclusion they also suggest that standard cost of capital calculations used for capital budgeting do not distinguish between operating asset risk and pension plan risk. The outcome is a significant overestimation of the discount rate, as much as 30% higher than its true value, thereby leading to the rejection of positive net present value projects. Whilst Jin et al are quite positive regarding the ability of the equity market to accurately reflect, other studies tend to portray rather mixed results regarding the efficiency of the financial markets.

Franzoni and Marin (2006), using 36,651 company-years between 1980 and 2002, find that the market significantly overvalued firms with severely underfunded pension plans. The consequence of this is that such companies earn lower raw and risk adjusted stock returns than firms with healthier pension plans for at least five years after the first emergence of the underfunding. The explanation provided by the authors is that investors are systematically surprised by the negative impact of the pension underfunding on earnings and cash flows.

Coronado et al (2008) considered whether investors can look beyond the financial statements to identify the economic value of pension assets and liabilities. Extending previous research (Coronado and Sharpe (2003)), which focussed on a more benign period for defined benefit pension schemes (1993-2001), they investigate the period from 2002-2005 when huge variations in pension valuations encouraged increased scrutiny from analysts and policyholders. Despite this heightened attention they conclude that the equity values of defined benefit sponsoring companies continue to inadequately reflect the true economic value of pension assets and liabilities. Instead company valuations appear unduly influenced by the accrual reported on the company income statement whilst placing little emphasis upon the incremental information reported in the footnotes. Although in aggregate the errors estimated are not large they can be significant for individual companies. They suggest that ongoing FASB reform will result in the migration of key footnote information to the balance sheet.

Picconi (2006) arrives at a similarly pessimistic conclusion regarding the ability of investors and analysts to fully process the information available under SFAS87. Initially addressing changes in the pension plan parameters which exert a quantifiable impact upon future (year-ahead) earnings he suggests that both analysts and the equity market only gradually reflect the information. Subsequently taking a longer term perspective a similar conclusion is reached in that investors appear unable to properly account for both the magnitude of a company's pension liability and the importance of the unfunded liability that has yet to be recognised on the income statement. In other words investors fail to fully impound the valuation impact of pension liabilities disclosed only in the footnotes.

Kiosse et al (2007) examine the measure of pension expense required under SFAS87 (the GAAP method) together with two alternatives based upon the S&P Core Earnings Concept (2002) and another method which substitutes a fair value pension expense for the smoothed expense reported under the GAAP method. Their analysis suggested that the pension expense as currently reported better captured the market's aggregate valuation of pension costs compared to the S&P method. However when the pension cost was disaggregated it was revealed that the unexpected return on pension assets included in the fair value specification was significant. Again the results emphasise the importance of the information only currently disclosed in footnotes.

McKillop and Pogue (2009) examined pension plan risk, variously measured and its impact upon both equity risk, variously measured, and debt ratings for FTSE100 companies over the period 2002 to 2006. Over this period the majority of defined benefit pension schemes of FTSE100 companies were in deficit. In addition, it was noted that a trend has been for pension plan assets to marginally shift away from equities and towards bonds. In general terms the authors found that for FTSE100 companies pension plan risk does feed into firm equity and debt risk. This suggests that the market views the assets and liabilities of the company pension scheme as part of the assets and liabilities of the firm itself. The authors further note that there is some sensitivity to model specification and the adjustment techniques utilised. More specifically the measure of pension risk proposed by Jin et al. (2006) can result in quite divergent findings influenced by only relatively small variations in the assumed value of the systematic risk of pension liabilities.

Section III: Data Overview

The data for this study is drawn from a number of sources – Moody's Rating Agency, Standard & Poor's Rating Agency, Worldscope Database, annual reports of FTSE companies and London Business School (LBS) Risk Management Service. The analysis is carried out for those FTSE100 companies which operate a defined benefit pension plan. The analysis is carried out in a panel framework covering the period 2002 to 2008. Prior to 2002 few companies provided details of their defined benefit schemes in their annual accounts. (Although FRS17 was introduced in November

2000 it was not until year end 2002 that its impact reached most balance sheets.) In the first year of our sample, 2002, we were only able to obtain full information for 52 FTSE100 companies thereafter the number reached a peak of 92 in both 2005 and 2006 before declining to 87 in 2008.

The hypothesis to be tested is that a higher pension plan risk translates into higher overall firm risk both in terms of a firm's equity risk and its corporate debt rating. The initial issue to be considered is the measurement of the dependent variable, variously defined as either equity risk or corporate debt risk. In the equity risk specification three alternate measures are considered. The first, and theoretically most appropriate, is that of capital risk structure and is defined as

$$\text{Capital structure risk } \beta_{E+D} = \beta_E \frac{Equity[E]}{E + Debt[D]} + \beta_D \frac{D}{E+D} \qquad (1)$$

The equity beta β_E is taken from the LBS Risk Management Service. For a small number of companies β_E was not available from this source and consequently we estimated β_E using five years of daily data and employing the Dimson (1979) adjustment with one lag and no lead to control for nonsynchronous trading.[1] Following Jin et al. (2006) a value of 0.175 was taken as the beta value for debt β_D

To test the robustness of our empirical results we also report findings based on two alternate measures of the dependent variable, they are systematic risk and the variance of returns

$$\text{Systematic risk} = \beta_E \qquad (2)$$

$$\text{Variance of total return} = \sigma_R^2 \qquad (3)$$

[1] Using this procedure we estimated β_E for some firms which were already provided by the LBS Risk Management Service. Both sets of estimates were very similar.

The key independent variable is that of pension plan risk. We utilise three alternate measures. These are

$$\text{Pension Risk } (PR_1) = \text{pension liabilities [PL]} / (E+D) \quad (4)$$

$$\text{Pension Risk } (PR_2) = \frac{\text{pension assets}[PA]-PL}{E+D} \quad (5)$$

$$\text{Pension Risk } (PR_3) = \frac{\beta_{PA}PA}{E+D}-\frac{\beta_{PL}PL}{E+D} \quad (6)$$

The first measure is guided by the work of Cardinale (2007) who suggested that UK bond market prices reflect corporate pension liabilities and what is important is the absolute size of liabilities and not pension deficits. The second is a version of that used by Franzoni and Marin (2006), with emphasis in this instance on whether the pension fund is in deficit or surplus. The third measure is that used by Jin et al. (2006) and links directly to our key measure of equity risk, capital risk structure, (equation 1). Pension liabilities are taken as reported in terms of FRS17/IAS19 and are the projected benefit obligation which represents the actuarial present value of vested and nonvested benefits earned by an employee for service rendered to date plus projected benefits attributable to salary increase. The pension assets are represented by the contributions made by the sponsoring firm over the life of the defined benefit scheme. These contributions tend to be invested in traded assets and are valued at their market prices. In the Jin at al. (2006) measure of pension risk the pension assets and liabilities are weighted by average systematic risk exposure. The systematic risk exposure from pension plan assets average β_{PA} is measured by making certain assumptions about the beta risk of the various categories of assets (equity, bonds, property, cash and other). In Table 2 we provide summary data for the pension plan assets[2] allocations for the sample companies plus the assumed β for the various classes.[3] It is clear from the asset allocations in Table 2 that there has been a rebalancing of pension plan assets

[2] The Jin et al. (2006) measure of pension risk, which takes account of the structure of the firm's pension assets, may be viewed as particularly appropriate as firms have recently changed their pension asset allocation in an attempt to alter the pension plan risk profile (see Table 2).

[3] The various values of β draw from work undertaken by the Harvard Management Company (see Light (2001)).

away from equity and towards debt. At the start of the sample period equities contributed 59.83% of total pension fund assets with this proportion falling to 44.16% by 2008. The commensurate increase in the share of debt being from 30.52% in 2002 to 39.67% in 2008. In part this may be due to volatilities in equity markets although a further contributing factor may be that recent legislative changes have clarified that pension liabilities are a form of corporate debt and that available evidence suggest mismatched investment strategies in pension schemes reduce shareholder value. With regard to the systematic risk of pension liabilities β_{PL} we adopt a similar approach to that followed by Jin et al. (2006) although in this instance UK bond data is utilized. Monthly closing prices for a 30 year UK treasury bond and the FTSE all-share index were employed in a market model regression to estimate a value for β_{PL}. Using a 60 month rolling estimate consisting of all monthly returns up to the end of the previous year, the in sample estimate of the beta of pension liabilities is about 0.30. An estimate using all 84 months of in-sample data from 2002 to 2008 would come to about 0.28. We display results conditioned on both of these values in addition to the upper bound from the previous version of this study, McKillop and Pogue (2010), sample period 2002 to 2006 and β_{PL} = 0.38. In the empirical analysis we report findings on the basis of these three values and it will be noted that our findings are quite sensitive to the chosen value of pension liability systematic risk.

Although findings for univariate specifications between the various measures of pension and firm risk are presented it is important to assess whether the pension risk variable is merely a surrogate for other variables which might impact upon firm risk. There are a plethora of studies exploring the equity risk of firms and consequently an equally large number of control variables viewed to be important. Young et al. (1991) suggest that liquidity and capital intensiveness are of importance. Chan et al. (2001) argue that research and development and advertising expenditure have a systematic impact upon stock returns. Rosett (2001) highlights the importance of leverage while a majority of studies point to the importance of firm size, profitability and growth, (see for example, Gombola and Ketz, (1983)). Data for a small number of these variables were not available, notably research and development and advertising expenditure while others, such as liquidity and capital intensiveness, did not prove significant.

In Table 3 we present a profile of all the explanatory variables which proved to be of importance in at least one of our equity specifications. A correlation matrix is also detailed. A key feature of this correlation matrix is that it highlights that the various measures of pension risk are strongly correlated.

Section IV: Estimating Relationships

In this section we derive specifications which link equity risk to pension risk. We establish univariate specifications and, drawing from the literature, multivariate specifications which include relevant control variables.

For illustrative purposes consider a specification involving our primary measure of equity risk, capital structure equation (1), and the linked measure of pension risk denoted PR_3, equation (6). Following Jin et al. (2006) we define the 'integrated' company's balance sheet as:

$$OA + PA = E + D + PL \tag{7}$$

OA is operating assets and the other terms are as before. The company's financial capital (E + D) can then be found by rearranging (7), that is E + D = OA +PA – PL. Therefore the company's capital structure risk can be reworked in the following form

$$\beta_{E+D} = \frac{\beta_{PA} PA}{E+D} - \frac{\beta_{PL} PL}{E+D} + \frac{\beta_{OA} OA}{E+D} \tag{8}$$

$$\text{or } \beta_{E+D} = PR_3 + \frac{\beta_{OA} OA}{E+D} \tag{9}$$

and the estimating equation can then be specified as

$$\beta_{E+D} = \alpha + b\, PR_3 + \varepsilon \tag{10}$$

b represents the sensitivity of firm risk to firm pension risk and α represents the part of the expected firm risk that cannot be picked up by the pension risk. The expectation is that b is positive and close to one.

Equation 10 is estimated in panel data form with fixed effects at industry level controlled for by incorporating a dummy variable for each one-digit Standard Industrial Classification (SIC).

Petersen (2006) notes that in corporate finance and asset pricing empirical studies, researchers are often confronted with panel data where the residuals may be correlated across firms or across time[4], and OLS standard errors can be biased. Historically, the two literatures have used different solutions to this problem. Corporate finance has relied on clustered standard errors (Rogers, 1977), while asset pricing has used the Fama-MacBeth (1973) procedure. Petersen (2006) shows that in the presence of an unobserved firm effect both OLS and the Fama-MacBeth standard errors are biased downward and only clustered standard errors are unbiased as they account for the residual dependence created by the firm effect.[5] In the results section we report findings using both approaches. As is expected the Fama-MacBeth standard errors tend to be generally smaller leading to a marginal improvement in the significance of coefficient estimates.

Earlier it was emphasized that it is important to assess, through the introduction of control variables (see Table 3), whether pension risk is merely a surrogate of other variables which might impact upon firm risk. This point is reinforced through examination of equation (9) and the estimating relationship, as given by (10). The regression specification only gives an unbiased estimate of the impact of pension risk on capital structure risk if operating asset risk is uncorrelated with pension risk. This

[4] There are two general forms of dependence which are most common in finance applications. The residuals of a given firm may be correlated across years (time series dependence) for a given firm. This is called an unobserved firm effect. Alternatively, the residuals of a given year may be correlated across different firms (cross-sectional dependence). This is called an unobserved time effect.

[5] The Fama-MacBeth approach to calculating standard errors requires that cross-section regressions are run separately for each year, fixed effects at industry level are controlled for using the one-digit SIC and then time series averages of both the coefficient estimates and standard errors are calculated. Estimation on an individual year basis is not required to calculate Rogers clustered standard errors and consequently coefficient estimates using the two approaches are likely to differ marginally.

is unlikely to hold because as Jin et al. (2006) note "*Much of the risk in the pension fund comes from its equity holdings and firm human resource policy, and these are potentially highly correlated with the firm's own operating asset risk.*"

Section V: Empirical Findings and Interpretation

In Tables 4 and 5 empirical findings of various univariate specifications are detailed. In Table 4 the Fama-MacBeth methodology is used to compute robust standard errors while in Table 5 Rogers clustered standard errors are employed. In broad terms, a similar picture emerges from both tables. The coefficient estimates on PR_1 (pension risk metric derived from Cardinale, 2007) and PR_3 (based on Jin et al., 2006) are all positive and generally significant indicating that higher levels of pension risk feed into higher levels of capital structure risk, systematic risk and return variability. The exception to this uniform picture is when PR_3 is based on the pension liability upper limit β_{PL} = 0.38. Again each of the coefficient estimates in Tables 4 and 5 is positive but only one of the six prove significant. With respect to PR_2 (risk measure derived from Franzoni and Marin, 2006) the coefficient estimates are negative as expected, although one of the six estimates is not significant.

In Tables 6 and 7 we explore whether the pension risk variable, variously measured, is merely a surrogate for other variables which may impact upon company equity risk. In both tables all specifications pass the F-test of joint significance of regressors at the 5 percent level of significance or better. Four control variables proved significant in this aspect of the analysis (financial leverage, firm size, firm growth and the return on investment). The coefficient estimates on financial leverage, firm growth and the return on investment were consistently negative and mostly significant, with the incidence of significance more pronounced in Table 6 where standard errors were calculated using the Fama- MacBeth methodology. Overall these coefficient estimates suggest that FTSE100 companies which were more levered, more profitable and faster growing had reduced levels of capital structure risk, systematic risk and return variability. The other control variable, firm size, was also negative when the dependent variable was either capital structure risk or return variability but positive when the dependent variable was systematic risk. In this latter instance the larger the FTSE100 company the greater the equity β .

The pension risk estimates in Tables 6 and 7, relative to those in the previous two tables are similar in sign, slightly smaller in absolute magnitude and a marginally greater number of the pension risk estimates (11 out of 30) are not different from zero at acceptable levels of significance. It is also the case that six of the insignificant estimates relate to the PR_3 metric calculated using the pension liability upper limit β_{PL} = 0.38. This confirms that β_{PL} assumptions materially impact upon our findings with respect to this risk measure. When the pension liability lower limit, β_{PL} = 0.28, was used to calculate PR_3 the resultant estimates, detailed in Tables 6 and 7, for the capital structure risk specification were 0.2741 and 0.3448. This implies that one unit of pension risk increases capital structure risk by 0.2741 - 0.3448 units. This is decidedly below the earlier hypothesized 1-to-1 relationship. That the coefficient is lower than expected may be due to differing and/or opaque actuarial assumptions blurring the relationship between pension and firm risk. It may also in part be due to the quasi underwriting role provided by the pension protection fund or it may centre on accounting practice which now recognizes actuarial gains and losses direct in equity and there is deferred taxation on the actuarial gain or loss with this charged straight to reserves.

Section VI: Concluding Comments

This study has examined pension plan risk, variously measured and its impact upon both equity risk, variously measured, for FTSE100 companies over the period 2002 to 2008. This period has coincided with the introduction of the pension protection fund, greater transparency and standardisation in pension accounting and increased efforts to disclose and harmonise actuarial assumptions. Over the period under investigation the majority of defined benefit pension schemes of FTSE100 companies have been categorised as in deficit. In addition, it was noted that a trend has been for pension plan assets to significantly shift away from equities and towards bonds.

In general terms our analysis also indicates that for FTSE100 companies, over the 2002 to 2008, period pension plan risk does feed into firm equity risk. This suggests that the market views the assets and liabilities of the company pension scheme as part of the assets and liabilities of the firm itself. Having made this point it is also the case that there is some sensitivity to model specification and the adjustment techniques utilised. More specifically, we note that the measure of pension risk proposed by Jin et al. (2006) can result in quite divergent findings influenced by only relatively small variations in the assumed value of the systematic risk of pension liabilities. Where the correct sign was obtained, with respect to this measure, it was also apparent that the resultant estimate was significantly lower than one, raising doubt on the hypothesised 1-to-1 relationship between pension risk and capital structure. This in turn raises the spectre that there may be a weakness in the informational efficiency of equity markets which may be caused by shadows cast on the market by the plethora of accounting rules and actuarial assumptions.

References

Aldersen, M., Chen, K., (1987), “The Stockholder Consequences of Terminating the Pension Plan.” Midland Corporate Finance Journal, 4 (Winter), 55-61.

Bulow, J., Morck, R., Summers, L., (1987). “How does the market value unfunded pension liabilities?” In: Bodie, Z., Shoven, J., Wise, D. (Eds.), Issues in Pension Economics National Bureau of Economic Research Project Report Series. University of Chicago Press, Chicago, Illinois and London, UK, pp. 81–104.

Cardinale, M., (2007), “Corporate Pension Funding & Credit Spreads”, Financial Analysts Journal 63 (5), 82-101

Chan, L., Lakonishok, J., Sougiannis, T., (2001). “The stock market valuation of research and development expenditures”. Journal of Finance 56 (6), 2431–2456.

Coronado, J.L. and Sharpe, S.A., (2003), "Did Pension Plan Accounting Contribute to a Stock Market Bubble?", Brookings Papers on Economic Activity, 34 (1), 323-371.

Coronado, J.L., Mitchell, O.S., Sharpe, S.A. and Nesbitt S.B., (2008), "Footnotes Aren’t Enough: The Impact of Pension Accounting on Stock Values,” NBER Working Paper No. W13726

Dimson, E., (1979). “Risk measurement when shares are subject to infrequent trading”. Journal of Financial Economics 7 (2), 197–226.

Fama, E., MacBeth, J., (1973). “Risk, return, and equilibrium: empirical tests”. Journal of Political Economy 81 (3), 607–636.

Feldstein, M., Seligman, S., (1981). “Pension funding, share prices, and national savings”. Journal of Finance 36 (4), 801–824.

Franzoni, F., Marin, J.M., (2006), “Pension plan funding and stock market efficiency”, Journal of Finance 61, 921-956.

Gombola, M., Ketz, E., (1983). “A note on cash flow and classification patterns of financial ratios”. Accounting Review 58 (1), 105–114.

Jin, L, Merton, R., Bodie, Z., (2006), “Do a Firm’s Equity Returns reflect the Risk of its Pension Plan?” Journal of Financial Economics, 81, 1-26.

Kiosse, P., Lubberink, M. & Peasnell, K. (2007) "How does the market price pensions accruals?",Lancaster University Management School Working Paper 2007/034

Lane, Clark & Peacock.,(2009). “Accounting for Pensions 2009”

McKillop, D.G., and Pogue, M., (2009), The Influence of Pension Plan Risk on Equity Risk and Credit Ratings: A Study of FTSE100 Companies, Journal of Pension Economics and Finance, Volume 8, 4, 405-428.

Petersen, M.A., (2006). "Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches," NBER Working Papers 11280, National Bureau of Economic Research, Inc.

Picconi, 2006, "The Perils of Pensions: Does Pension Accounting Lead Investors and Analysts Astray?", The Accounting review, 81 (4), 925-955

Rosett, J., (2001). “Equity risk and the labor stock: the case of union contracts”. Journal of Accounting Research 39 (2), 337–364.

Young, S.D., Berry, M., Harvey, D., Page, J., (1991). “Macroeconomic forces, systematic risk, and financial variables: an empirical investigation”. Journal of Financial and Quantitative Analysis 26 (4), 559–564.

Table 1: Measures of Equity

Equity Risk (FTSE 100)						
Variable		Mean	Std Dev	Q1	Median	Q3
Equity Beta	β_E	0.9878	0.3711	0.7000	0.9800	1.2300
Firm Risk	$\beta_E(E/E+D)+\beta_D(D/E+D)$	0.7245	0.3096	0.4787	0.7032	0.9283
Return Variability (%)	σ_R^2	27.70	8.77	21.00	26.00	33.00

Table 2: Asset Allocation

Variable	2002	2003	2004	2005	2006	2007	2008	Assumed Asset Class Beta
No. of Firms	52	89	91	92	92	86	87	-
Equities (%)	59.83	59.50	56.94	57.60	54.73	50.02	44.16	1.000
Bonds (%)	30.52	30.63	32.44	32.82	35.32	35.80	39.67	0.175
Property (%)	3.36	2.39	2.48	3.07	3.74	4.06	3.77	0.150
Other (%)	6.30	7.48	8.14	6.51	6.20	10.12	12.41	0.006
Total Pension Fund Assets (£bn)	195.44	294.13	326.71	381.07	419.96	382.77	356.50	-
Total Pension Fund Assets As % Of Market Cap	21.88	24.33	24.26	23.95	24.51	24.48	29.20	-

Table 3: Independent Variables

Variable	Calculation	Mean	Std Dev	Q1	Median	Q3
Pension Risk (1)	$\frac{PL}{E+D}$	0.3708	0.6649	0.0790	0.1777	0.3908
Pension Risk (2)	$\frac{(PA-PL)}{E+D}$	-0.0277	0.0650	-0.0352	-0.0116	-0.0018
Pension Risk (3) (β_{PL}= 0.28)	$\frac{\beta_{PA}PA}{E+D}-\frac{\beta_{PL}PL}{E+D}$	0.0574	0.0823	0.0084	0.0298	0.0751
Pension Risk (3) (β_{PL}= 0.30)	$\frac{\beta_{PA}PA}{E+D}-\frac{\beta_{PL}PL}{E+D}$	0.0499	0.0707	0.0076	0.0277	0.0681
Pension Risk (3) (β_{PL}= 0.38)	$\frac{\beta_{PA}PA}{E+D}-\frac{\beta_{PL}PL}{E+D}$	0.0325	0.0632	0.0032	0.0169	0.0461
Financial Leverage (FL)	$\frac{Debt}{TotalAssets}$	26.5186	16.5752	15.0640	25.6950	36.8517
Growth Rate (GR)	$Log(\frac{TotalAssets}{LaggedTotalAssets})$	0.0446	0.1556	-0.0061	0.0358	0.0742
Return On Investment (ROI)	$\frac{NetIncome}{TotalAssets}$	0.0522	0.0619	0.0087	0.0427	0.0784
Firm Size (FS)	$Log(TotalAssets)$	4.1477	0.6967	3.6849	3.9844	4.4346

	PR1	PR2	PR3 β_{PL}=0.28	PR3 β_{PL}=0.30	PR3 β_{PL}=0.38	FL	GR	ROI	FS	Beta	FR	Variability
PR1	1.0000											
PR2	-0.6165	1.0000										
PR3 β_{PL}=0.28	0.6165	-0.4792	1.0000									
PR3 β_{PL}=0.30	0.5383	-0.3958	0.9859	1.0000								
PR3 β_{PL}=0.38	0.3471	-0.2781	0.8897	0.8878	1.0000							
FL	0.0599	-0.0329	-0.0195	0.0153	0.0023	1.0000						
GR	-0.1293	0.0945	-0.1277	-0.1191	-0.0739	-0.0283	1.0000					
ROI	-0.1381	0.0900	-0.0804	-0.0422	-0.0308	0.0509	-0.0594	1.0000				
FS	-0.0333	0.0519	-0.0479	-0.0567	0.0010	-0.1709	0.1439	-0.3418	1.0000			
Beta	0.2417	-0.0928	0.1228	0.0944	0.0323	-0.3000	-0.0215	-0.2634	0.2410	1.0000		
FR	0.0741	-0.0360	0.1036	0.0874	0.0288	-0.4804	-0.0559	0.0548	-0.1665	0.7704	1.0000	
Variability	0.3587	-0.3657	0.1861	0.1469	0.0289	-0.1859	-0.1640	-0.1520	-0.1132	0.4862	0.4598	1.0000

Table 4: Univariate Analysis[a] – Fama-Macbeth Standard Errors

VARIABLES	Firm Risk					Equity Beta					Variability				
PR1	0.1408**					0.2541***					5.1189***				
	0.0454					0.0443					0.6424				
	3.1009					5.7427					7.9687				
	0.0211					0.0012					0.0002				
PR2		-0.6402*					-1.5104**					-42.6535***			
		0.3140					0.4541					9.5706			
		-2.0391					-3.3262					-4.4567			
		0.0876					0.0159					0.0043			
$PR_{\beta PL0.28}$			0.6219***					1.0095***					21.1310***		
			0.1483					0.1927					5.1852		
			4.1936					5.2381					4.0753		
			0.0057					0.0019					0.0065		
$PR_{\beta PL0.30}$				0.7145***					1.1515***					21.8864***	
				0.1543					0.2305					5.6367	
				4.6295					4.9966					3.8828	
				0.0036					0.0025					0.0081	
$PR_{\beta PL0.38}$					0.3842					0.5294*					1.4693
					0.2770					0.2514					4.7825
					1.3871					2.1059					0.3072
					0.2147					0.0798					0.7691
Constant	0.8836***	0.8927***	0.8860***	0.8853***	0.8928***	1.0189***	1.0308***	1.0239***	1.0227***	1.0358***	29.9755***	30.0735***	29.9385***	29.9469***	30.2992***
	0.0183	0.0177	0.0198	0.0204	0.0203	0.0243	0.0281	0.0286	0.0300	0.0284	1.2203	1.1980	1.1529	1.1438	1.2076
	48.2116	50.4110	44.6929	43.4212	43.9878	41.8824	36.7328	35.7802	34.0824	36.4925	24.5645	25.1027	25.9672	26.1811	25.0906
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.1948	0.1728	0.1893	0.1941	0.1782	0.3168	0.2477	0.2417	0.2296	0.2110	0.1936	0.1800	0.1262	0.1159	0.0901
F test	1001.4210	27.9255	65.8294	220.8915	85.0307	4852.9296	530.4328	625.3790	354.6684	1118.4894	136.7233	85.7814	21.1267	260.1648	12.3932
Prob >F	0.0000	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000	0.0033

*** p<0.01, ** p<0.05, * p<0.1

[a]Coefficient, Std Error, T-statistic, P-value

Table 5: Univariate Analysis[b] – Rogers Clustered Standard Errors

VARIABLES			Firm Risk					Equity Beta					Variability		
PR1	0.0500					0.1731***					6.1726***				
	0.0307					0.0280					0.8191				
	1.6310					6.1846					7.5363				
	0.1035					0.0000					0.0000				
PR2		-0.0929					-0.8230*					-50.5680***			
		0.3127					0.4540					10.1350			
		-0.2971					-1.8129					-4.9894			
		0.7665					0.0704					0.0000			
$PR_{\beta PL0.28}$			0.5086**					0.8989**					24.1679***		
			0.2184					0.3535					9.2062		
			2.3289					2.5433					2.6252		
			0.0202					0.0113					0.0089		
$PR_{\beta PL0.30}$				0.5456*					0.9375**					22.1662*	
				0.2878					0.4446					11.5314	
				1.8962					2.1085					1.9222	
				0.0585					0.0355					0.0552	
$PR_{\beta PL0.38}$					0.1751					0.3596					1.7076
					0.3461					0.4853					16.3133
					0.5057					0.7410					0.1047
					0.6132					0.4590					0.9167
Constant	0.8999***	0.9040***	0.8944***	0.8946***	0.9025***	1.0406***	1.0524***	1.0386***	1.0394***	1.0525***	29.1335***	29.4310***	29.1554***	29.2245***	29.5842***
	0.0453	0.0453	0.0455	0.0455	0.0455	0.0733	0.0758	0.0746	0.0752	0.0745	2.4578	2.4612	2.4236	2.4260	2.4601
	19.8734	19.9703	19.6349	19.6780	19.8430	14.1886	13.8926	13.9148	13.8209	14.1234	11.8535	11.9579	12.0300	12.0463	12.0256
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.1184	0.1085	0.1228	0.1314	0.1088	0.2484	0.1815	0.1948	0.1818	0.1646	0.1537	0.1480	0.0496	0.0345	0.0129
F test	11.4872	11.1371	11.5743	11.6616	10.9865	19.5969	18.5201	17.0416	14.5422	14.0984	20.9646	8.0362	3.2090	2.1766	1.1336
Prob >F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0015	0.0281	0.3390

*** p<0.01, ** p<0.05, * p<0.1

[b]Coefficient, Std Error, T-statistic, P-value

Table 6: Multivariate Analysis[a] – Fama-Macbeth Standard Errors

VARIABLES	Firm Risk					Equity Beta					Variability				
PR1	0.0951**					0.2181***					4.3591***				
	0.0356					0.0461					0.7686				
	2.6735					4.7310					5.6715				
	0.0369					0.0032					0.0013				
PR2		-0.6004					-1.1908**					-39.6492***			
		0.3521					0.4765					8.8185			
		-1.7052					-2.4991					-4.4961			
		0.1390					0.0466					0.0041			
$PR_{\beta PL0.28}$			0.2741*					0.6372**					17.3180***		
			0.1359					0.1974					4.6608		
			2.0174					3.2276					3.7157		
			0.0902					0.0180					0.0099		
$PR_{\beta PL0.30}$				0.3417**					0.7369**					17.8930**	
				0.1073					0.2087					4.9094	
				3.1836					3.5315					3.6446	
				0.0190					0.0123					0.0108	
$PR_{\beta PL0.38}$					0.1382					0.2034					2.0202
					0.1414					0.2057					4.2347
					0.9773					0.9887					0.4771
					0.3661					0.3610					0.6502
Financial	-0.0102***	-0.0102***	-0.0101***	-0.0097***	-0.0102***	-0.0057***	-0.0056***	-0.0055***	-0.0051***	-0.0057***	-0.1179***	-0.1102**	-0.1111**	-0.1097**	-0.1199***
Leverage	0.0006	0.0005	0.0006	0.0006	0.0006	0.0008	0.0006	0.0007	0.0007	0.0007	0.0308	0.0326	0.0323	0.0317	0.0311
	-16.1028	-20.0343	-16.8545	-16.4683	-16.9967	-7.1039	-9.9544	-7.6365	-7.8821	-8.3925	-3.8261	-3.3771	-3.4408	-3.4561	-3.8574
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0001	0.0003	0.0002	0.0002	0.0087	0.0149	0.0138	0.0135	0.0084
Growth	-0.2602*	-0.3328**	-0.3089**	-0.2741**	-0.3230**	-0.2119	-0.4285*	-0.4023	-0.3646	-0.4867*	-7.1166	-9.5750	-9.6320	-9.4929	-13.2901*
Rate	0.1107	0.1069	0.1033	0.0980	0.1029	0.1708	0.1863	0.2096	0.2219	0.2256	4.9826	5.5624	5.5773	5.6420	6.6800
	-2.3502	-3.1116	-2.9915	-2.7976	-3.1379	-1.2401	-2.2997	-1.9194	-1.6433	-2.1568	-1.4283	-1.7214	-1.7270	-1.6825	-1.9895
	0.0570	0.0208	0.0243	0.0313	0.0201	0.2612	0.0611	0.1033	0.1514	0.0744	0.2031	0.1360	0.1349	0.1435	0.0938
Firm	-0.0808**	-0.0802**	-0.0834**	-0.0694*	-0.0824**	0.0689**	0.0705**	0.0670*	0.0811**	0.0714**	-2.4372***	-2.3558***	-2.5466***	-2.4507***	-2.1884***
Size	0.0258	0.0270	0.0265	0.0296	0.0260	0.0249	0.0259	0.0274	0.0284	0.0269	0.2951	0.2915	0.2561	0.2240	0.2669
	-3.1358	-2.9743	-3.1413	-2.3461	-3.1725	2.7611	2.7212	2.4405	2.8576	2.6593	-8.2585	-8.0813	-9.9428	-10.9418	-8.1994
	0.0202	0.0248	0.0200	0.0574	0.0193	0.0328	0.0346	0.0504	0.0289	0.0376	0.0002	0.0002	0.0001	0.0000	0.0002
Return on	-0.8076*	-0.8447*	-0.8506*	-0.8097*	-0.8735*	-1.5687***	-1.6707***	-1.7250***	-1.7084***	-1.7929***	-24.7944***	-24.2922***	-28.1459***	-28.2736***	-29.6162***
Investment	0.3809	0.3947	0.3793	0.3721	0.3897	0.3673	0.4027	0.3877	0.3880	0.4138	3.5652	3.3950	3.6246	3.9757	4.0136
	-2.1201	-2.1402	-2.2426	-2.1759	-2.2412	-4.2707	-4.1484	-4.4491	-4.4034	-4.3326	-6.9546	-7.1552	-7.7651	-7.1116	-7.3790
	0.0783	0.0761	0.0661	0.0725	0.0662	0.0053	0.0060	0.0043	0.0046	0.0049	0.0004	0.0004	0.0002	0.0004	0.0003
Constant	1.4894***	1.5032***	1.5110***	1.4460***	1.5160***	1.0272***	1.0540***	1.0654***	1.0030***	1.0732***	44.6633***	44.3316***	45.4928***	45.0362***	44.8344***
	0.1020	0.1022	0.1083	0.1165	0.1063	0.1049	0.1045	0.1180	0.1159	0.1143	1.5040	1.5219	1.3313	1.1953	1.0778
	14.6036	14.7076	13.9535	12.4077	14.2596	9.7939	10.0909	9.0274	8.6570	9.3896	29.6959	29.1295	34.1724	37.6789	41.5972
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.5045	0.5001	0.4950	0.4965	0.4901	0.4507	0.4004	0.3900	0.3835	0.3769	0.3165	0.3096	0.2622	0.2521	0.2463
F test	82.1880	91.0615	22.6468	154.8283	32.0064	241.0236	26.6236	74.4362	197.5750	95.3912	32.9184	134.1238	15.9062	67.6946	17.7342
Prob >F	0.0000	0.0000	0.0005	0.0000	0.0002	0.0000	0.0003	0.0000	0.0000	0.0000	0.0002	0.0000	0.0014	0.0000	0.0010

*** p<0.01, ** p<0.05, * p<0.1

[a]Coefficient, Std Error, T-statistic, P-value

Table 7: Multivariate Analysis[a] – Rogers Clustered Standard Errors

VARIABLES			Firm Risk					Equity Beta					Variability		
PR1	0.0515**					0.1612***					5.6591***				
	0.0250					0.0288					0.7717				
	2.0623					5.6072					7.3332				
	0.0397					0.0000					0.0000				
PR2		-0.1374					-0.6373					-46.2745***			
		0.2918					0.4554					10.1707			
		-0.4709					-1.3992					-4.5498			
		0.6379					0.1623					0.0000			
$PR_{\beta PL0.28}$			0.3448					0.6654*					20.7178***		
			0.2112					0.3559					7.3292		
			1.6326					1.8694					2.8268		
			0.1031					0.0621					0.0049		
$PR_{\beta PL0.30}$				0.4140					0.7294*					19.0996**	
				0.2611					0.4327					9.4272	
				1.5856					1.6859					2.0260	
				0.1134					0.0924					0.0433	
$PR_{\beta PL0.38}$					0.1031					0.1614					2.9569
					0.2814					0.4541					14.4359
					0.3665					0.3554					0.2048
					0.7142					0.7224					0.8378
Financial	-0.0093***	-0.0092***	-0.0091***	-0.0087***	-0.0092***	-0.0051***	-0.0050***	-0.0047***	-0.0044***	-0.0049***	-0.1321***	-0.1246**	-0.1222**	-0.1207**	-0.1369***
Leverage	0.0013	0.0013	0.0014	0.0013	0.0014	0.0014	0.0014	0.0014	0.0014	0.0015	0.0478	0.0508	0.0479	0.0477	0.0434
	-6.9523	-6.8716	-6.6723	-6.5463	-6.6840	-3.7045	-3.5937	-3.2943	-3.1147	-3.3700	-2.7658	-2.4495	-2.5520	-2.5318	-3.1507
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0004	0.0011	0.0019	0.0008	0.0059	0.0147	0.0110	0.0117	0.0017
Growth	-0.0693	-0.0912*	-0.0748	-0.0696	-0.0933*	-0.1053**	-0.1667***	-0.1482***	-0.1470***	-0.1842***	-5.7837	-7.4294	-8.6384*	-9.0387*	-10.8710*
Rate	0.0502	0.0551	0.0485	0.0490	0.0541	0.0470	0.0544	0.0450	0.0445	0.0591	4.3998	4.5706	4.8758	5.0238	5.8656
	-1.3803	-1.6568	-1.5411	-1.4201	-1.7224	-2.2402	-3.0666	-3.2919	-3.3030	-3.1189	-1.3145	-1.6255	-1.7717	-1.7992	-1.8533
	0.1681	0.0981	0.1239	0.1562	0.0856	0.0255	0.0023	0.0011	0.0010	0.0019	0.1893	0.1047	0.0771	0.0727	0.0645
Firm	-0.0813**	-0.0813*	-0.0839**	-0.0706	-0.0815**	0.0767*	0.0750*	0.0729*	0.0872**	0.0776*	-3.1583***	-3.2098***	-3.2141***	-3.1093***	-2.9129***
Size	0.0410	0.0420	0.0405	0.0429	0.0408	0.0407	0.0436	0.0418	0.0430	0.0428	1.0258	1.0570	1.1179	1.1398	1.0871
	-1.9801	-1.9355	-2.0744	-1.6432	-1.9961	1.8878	1.7214	1.7438	2.0254	1.8124	-3.0788	-3.0368	-2.8753	-2.7280	-2.6794
	0.0482	0.0535	0.0385	0.1009	0.0464	0.0596	0.0857	0.0818	0.0433	0.0705	0.0022	0.0025	0.0042	0.0066	0.0076
Return on	0.0606	-0.0004	0.0065	0.0187	-0.0206	-0.6638	-0.8266*	-0.8638*	-0.8651*	-0.9183*	-28.8206***	-29.4853***	-35.8412***	-35.3515***	-37.2143***
Investment	0.4665	0.4757	0.4637	0.4565	0.4807	0.4204	0.4578	0.4591	0.4616	0.4999	9.7252	9.0296	11.4190	11.8367	12.3640
	0.1299	-0.0009	0.0141	0.0409	-0.0429	-1.5789	-1.8058	-1.8815	-1.8743	-1.8371	-2.9635	-3.2654	-3.1387	-2.9866	-3.0099
	0.8967	0.9993	0.9888	0.9674	0.9658	0.1150	0.0715	0.0604	0.0614	0.0667	0.0032	0.0012	0.0018	0.0030	0.0028
Constant	1.3929***	1.4052***	1.4039***	1.3428***	1.4076***	0.9174***	0.9577***	0.9517***	0.8901***	0.9581***	48.5119***	49.0965***	49.6433***	49.2328***	49.4468***
	0.1783	0.1822	0.1793	0.1859	0.1795	0.1857	0.1945	0.1932	0.1947	0.1941	5.6814	5.6803	6.0788	6.1822	5.9975
	7.8126	7.7127	7.8280	7.2234	7.8434	4.9410	4.9228	4.9271	4.5711	4.9352	8.5388	8.6432	8.1666	7.9636	8.2445
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.3493	0.3395	0.3453	0.3462	0.3376	0.3345	0.2738	0.2797	0.2724	0.2610	0.2484	0.2452	0.1620	0.1462	0.1426
F test	18.8034	19.2711	19.2649	18.1709	17.7820	19.1903	18.3474	17.0550	15.6126	15.9168	23.1957	10.4714	7.2094	6.0337	5.9948
Prob >F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

*** p<0.01, ** p<0.05, * p<0.1

[a]Coefficient, Std Errors, T-statistic, P-value