The Actuarial Profession
making financial sense of the future

The influence of pensions risk on equity and bond prices

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Do equity returns reflect pension risk?

July 2010

Motivations

Answer an unanswered question

Answer an interesting question

Research an area I knew something about

Pension scheme investment decision

Liabilities are bond-like – so why invest in equities?

- Pension insurer acts as put option
- Trustees acting for Company?
- Increase equities – lower contributions ?!
- Increase equities – lower accounting expense
- Bond market deep enough?
- “Old school” views…ignore new thinking
- To hedge future salary increase?
- Cheap source of finance (borrow from pension scheme)

Does pension risk matter?

Who bares the risk?

- Ultimately the Company

What can we learn from previous research?

- The market found to significantly overvalue firms with severely underfunded pension funds (eg Franzoni & Marin)

Evidence indicates an over investment in equities

If pension risk is not accounted for…

- **Incentive to take excessive risk and;**
- **Companies will get found out**

Other related studies

Pension deficits and firm value

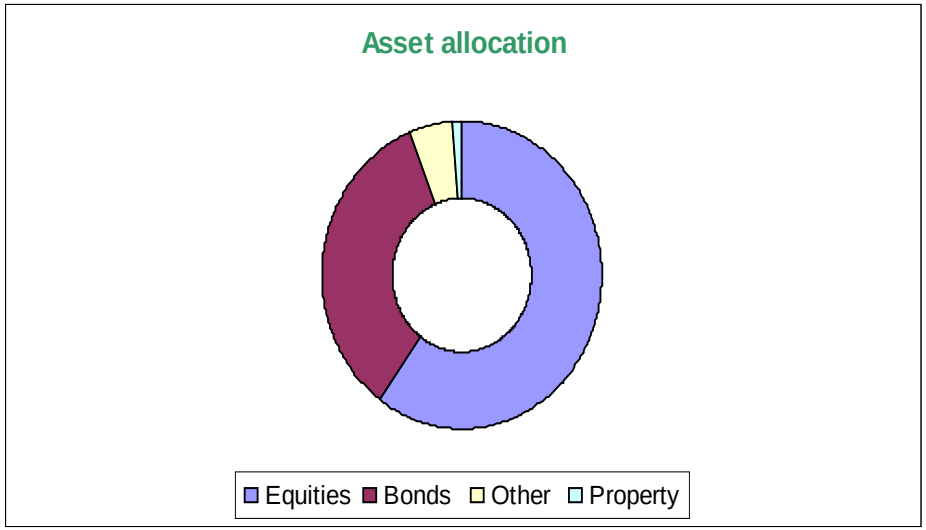
- A reasonably well researched area
- Some empirical evidence to suggest that the market significantly overvalues firms with severely under funded pension schemes (Franzoni & Marin 2006)

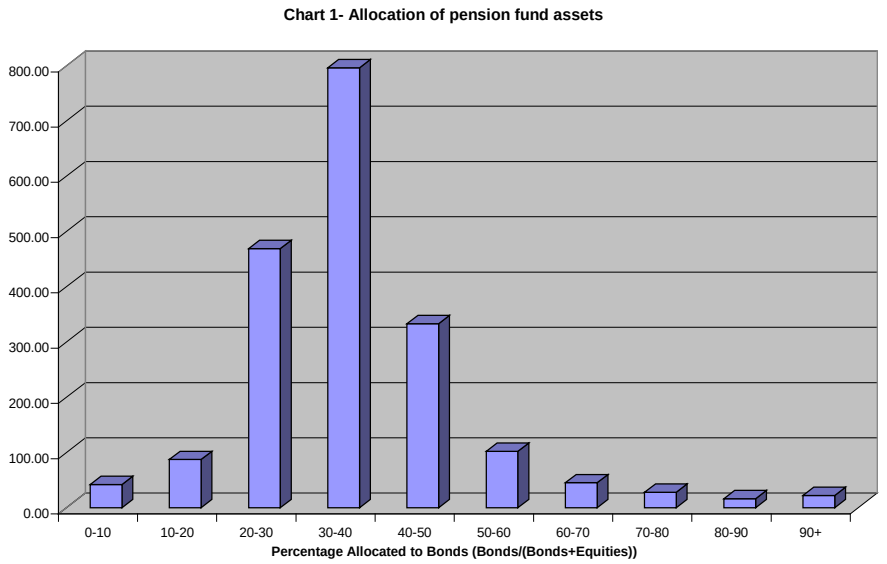
Pension risk and firm value

- Only one study covering pension risk at time of writing thesis
- Jin et al (2006) investigate whether or not the “systematic equity risk of US firms as measured by beta from the CAPM reflects the risk of their pension plans”.
- I essentially follow this project with a different data set

Research – data

North American firms – a large database, readily available. Data used from 31 Dec 2002 – 31 December 2007





c60% invested in equities
Most have similar debt to equity ratios

Research – the maths

Key formulae

For a firm……Assets = Liabilities

Including the pension scheme gives…..OA + PA = E + D + PL

OA = value of operating assets of a company

PA = value of pension assets

E = value of equity in the firm

D = value of debt in the firm

PL = value of pension liabilities

- CAPM $$R_{firm} = rf + \beta_{firm}(R_{market} - rf)$$

Research – more maths

Key formulae

For a firm……OA + PA = E + D + PL

$$\beta_{E+D} = \frac{E}{E+D}\beta_E + \frac{D}{E+D}\beta_D$$

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

$$= \beta_{PF} + \frac{OA}{E+D}\beta_{OA}$$

where

Pension fund risk

$$\beta_{PF} = \frac{PA}{E+D}\beta_{PA} - \frac{PL}{E+D}\beta_{PL}$$

$$\beta_{E+D} = a + b\beta_{PF} + \varepsilon$$

Equation to test

Research
- key assumptions

Table 2 - Pension asset categories as reported in COMPUSTAT and assumed beta risk
*5% allocation to "other investments"

Pension Asset Categories	Assumed Beta	Average Asset Allocation (percent)*
Equities	1	60%
Bonds	0.2	34%
Real Estate	0.2	1%

- Simplified approach
- In line with other research
- Equities are main investment

** Assumed beta of liabilities also = 0.2 (in line with Jin et al (2006))

Research
Step 1 - estimating firm beta

Variable	Number of observations	Mean	Standard Deviation	Quartile 1	Median	Quartile 3
Equity Beta	4,164	1.230	1.533	0.415	1.067	1.874
Firm Risk (weighted average beta for equity and debt)	4,164	0.950	1.127	0.322	0.775	1.419
Pension Risk (pension asset risk minus pension liability risk)	4,164	0.074	0.226	0.010	0.030	0.079

$$R_i = r_f + \beta(r_m - r_f)$$

"average" beta circa 1 i.e. the market return

Research – simple test

$$\beta_{E+D} = a + b\beta_{PF} + \varepsilon$$

	All firms	Measure of distress		
		Book-market ratio	Return on investments	Financial leverage
Intercept	0.910	0.918	0.904	0.945
	(42.54)	(43.14)	(42.95)	(42.80)
Pension risk	0.171	0.180	0.287	0.090
	(1.97)	(2.16)	(3.23)	(1.03)
Number of observations	3,608	3,267	3,266	3,267
R-squared	0.0011	0.0014	0.0032	0.0003

Pension risk is +ve and <1

BUT…

- not good at explaining firm risk and;
- omitted variables

Research – more thorough test

	All firms	Measure of distress		
		Book-market ratio	Return on investments	Financial leverage
Intercept	0.677	0.664	0.544	0.839
	(5.94)	(5.92)	(4.69)	(6.90)
Pension risk	0.211	0.209	0.333	0.106
	(2.48)	(2.59)	(3.83)	(1.23)
Capital	0.539	0.548	0.490	0.429
intensiveness	(4.48)	(4.65)	(4.09)	(3.37)
Cash position	1.008	1.350	0.593	0.581
	(4.47)	(5.95)	(2.54)	(2.43)
Financial Leverage	-0.345	-0.298	-0.351	-1.120
	(3.76)	(-3.35)	(-3.47)	(-6.33)
Growth rate	0.971	0.829	0.493	1.239
	(5.95)	(5.18)	(2.56)	(7.17)
Liquidity	-0.009	-0.168	-0.002	-0.003
	(-0.97)	(-1.96)	(-0.26)	(-0.34)
Return on	0.731	1.067	2.335	-0.099
investment	(4.00)	(5.82)	(8.06)	(-0.44)
Firm size	-0.010	-0.120	0.114	0.028
	(-0.38)	(-0.49)	(0.46)	(1.12)
Number of observations	3,608	3,267	3,266	3,267
R-squared	0.0538	0.0710	0.0622	0.0527

- A host of explanatory variables now allowed for
- Pension risk is +ve and significantly different from zero
- But <1 and not good at explaining firm risk

Research – other studies

Jin et al (2006)

- 1993-1998 US dataset
- Concluded equity betas are consistent with the hypothesis that equity risk does value the risk in the pension plan
- Relationship less than expected 1 to 1 relationship

McKillop & Pogue (2009)

- 2002-2006 FTSE 100 firms
- Relationship positive but less than 1 to 1 expected
- Results sensitive to liability risk measure – which is difficult to estimate
- Expanded to consider other risk measures

Broadly consistent with my findings

Summing up

Conclusions

- Results broadly similar outcome to other research
- Pension risk is (at best) only partially accounted for in share prices

Implications

- Incentive for firms to maintain equity holdings within pension scheme
- But…..at some point they will get found out

Limitations / caveats

- Suitability of a single statistic for pension risk?
- Stability of conclusion dependant on some key assumptions
- Data – asset information just “bonds” and “equities” - LDI?
- Data – simplified treatment pension liability

Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter.