Biennial Convention 2009
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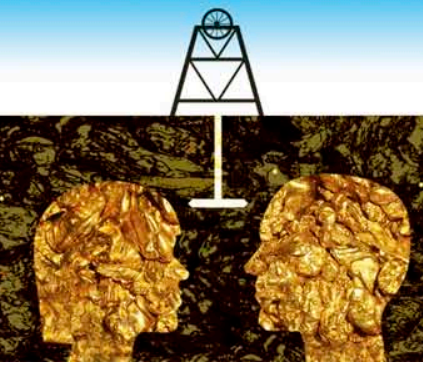

The Funding of Closed Defined Benefit Schemes

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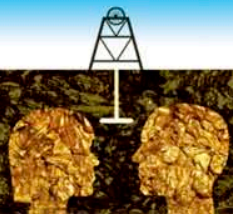
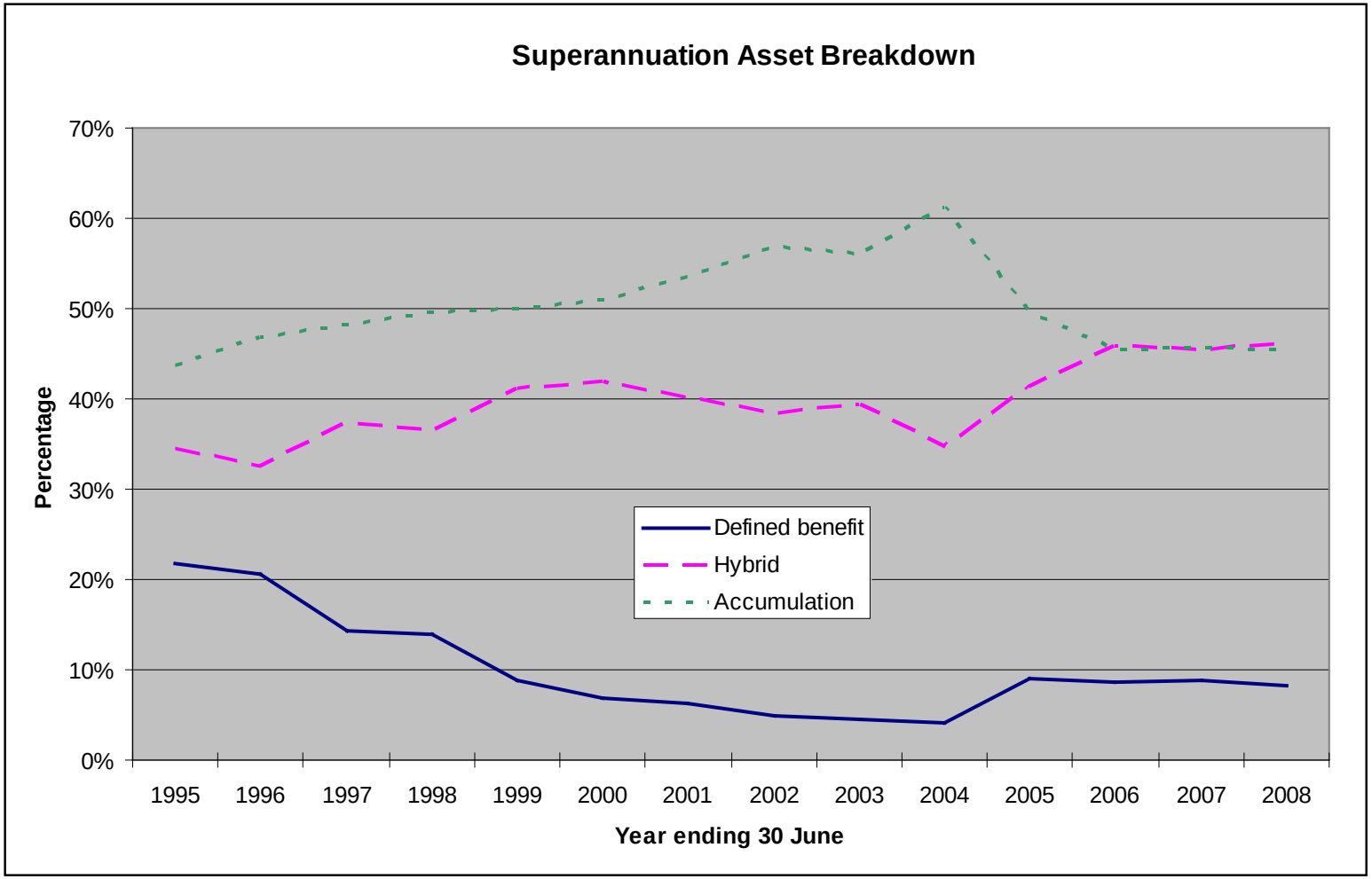


Overview

- Motivation
- Methodology
- Results
- Conclusions and future research

Motivation


Superannuation Asset Breakdown
70%
60%
50%
40%
30%
20%
10%
0%
Percentage
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year ending 30 June
Defined benefit
Hybrid
Accumulation

How does a closed scheme differ from an open scheme?

- Future liabilities decreasing relative to past liabilities
- Liabilities decreasing in duration
- Benefit outflow greater than contribution inflow

What are the key decisions for a closed scheme?

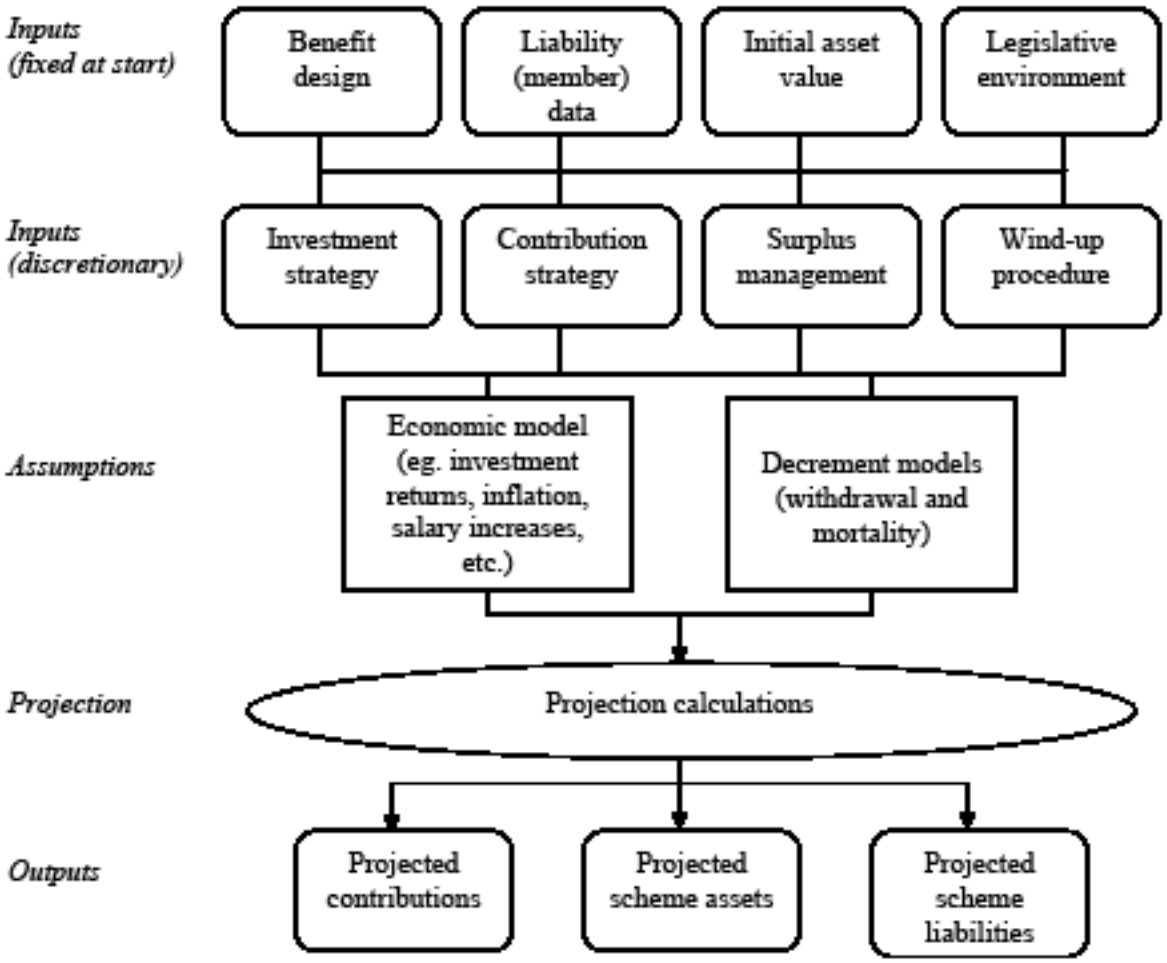
- Investment strategy
- Contribution strategy
- Winding up the scheme

What am I trying to achieve?

- Investigate the effect of different decisions on the future development of closed scheme contributions and funding levels
- Check if uncontrollable factors such as benefit design have an impact on the results

Methodology

- Stochastic model and simulations – both financial and demographic factors stochastic
- Model scheme projected forward on an annual basis until wind up
- Annual actuarial valuations with contributions backdated to the valuation date
- Membership projected individually – i.e. Bernoulli process applied to each individual in each year of projection


Inputs (fixed at start)
Benefit design
Liability (member) data
Initial asset value
Legislative environment
Inputs (discretionary)
Investment strategy
Contribution strategy
Surplus management
Wind-up procedure
Assumptions
Economic model (eg. investment returns, inflation, salary increases, etc.)
Decrement models (withdrawal and mortality)
Projection
Projection calculations
Outputs
Projected contributions
Projected scheme assets
Projected scheme liabilities

The model scheme (base scenario)

- Pays pension benefits to those who have membership greater than 5 years
- 9,000 members – made up of 5,000 active members, 2,080 deferred members and 1,920 pensioner members
- Uses the PUC method to calculate liabilities and contributions – surpluses and deficits spread over 3 years
- Actuarial assumptions equal to the expectations from the stochastic models – discount rate equal to expected return on assets

The model scheme (base scenario)

- 100% funded at the commencement of projections
- Investment strategy (rebalanced each year):

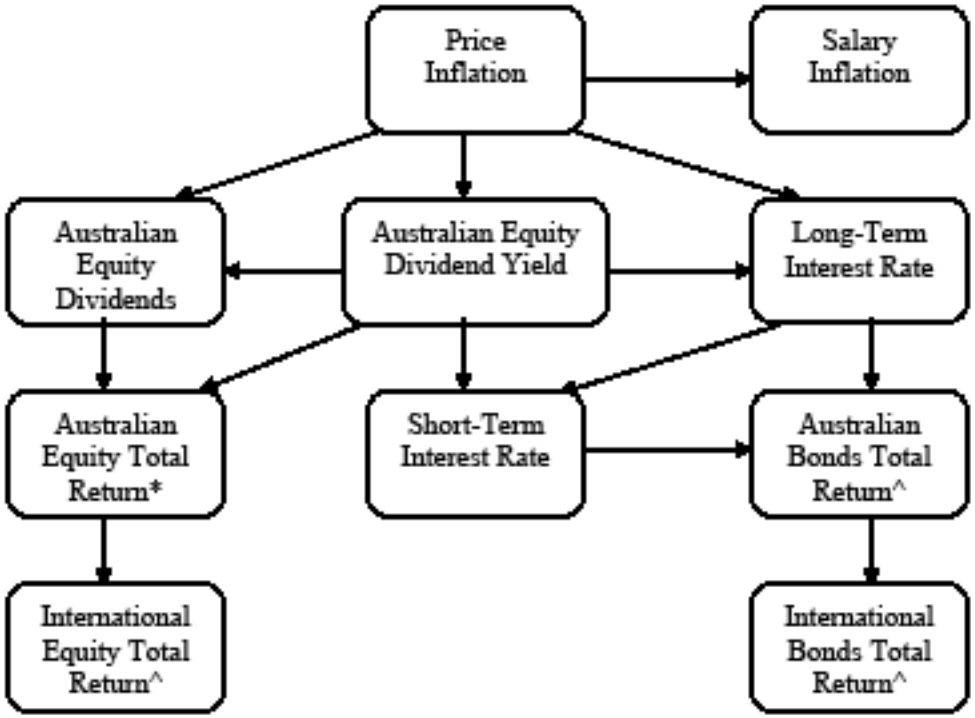
Asset Class	Percentage
Australian Shares	35%
International Shares	25%
Australian Bonds	20%
International Bonds	15%
Cash	5%

The model scheme (base scenario)

- Keeps surplus in the scheme at all times until wind up
- Wind up occurs when active membership drops below 50 - liabilities discharged by purchasing annuities valued at a discount rate 0.5% below the long-term interest rate
- Wind up liability increased by 2% to allow for the costs of wind up
- Any deficiency of assets to wind up liability made up by additional employer contributions

The economic model

- Based on Wilkie (1995) – a “cascade” structure
- Parameterised using annual data from 30 June 1982 – 30 June 2008, period selected due to relatively similar economic conditions at the start and end dates



* Not calculated directly by the Wilkie model, but can be obtained indirectly via Australian equity dividends and dividend yield.
^ Not part of the Wilkie structure but included in addition to the original structure.

The economic model - summary

Factor	Average Return (p.a.)	Standard Deviation of Return (p.a.)	Annual Autocorrelation
Price inflation	4.7%	2.8%	58%
Salary inflation	5.7%	3.2%	51%
Long-term interest rate	9.0%	2.7%	77%
Australian Equities	13.6%	23.7%	1%
International Equities	11.5%	29.2%	2%
Australian Bonds	8.6%	7.6%	18%
International Bonds	10.0%	6.4%	15%
Cash	8.8%	3.0%	82%
Scheme return *(non-pension assets post-tax)*	10.9%	13.1%	2%

The decrement model - withdrawal

- Withdrawal rates currently decrease with age and length of service
- Not currently linked to financial model – ABS job ceasing statistics suggest overall withdrawal relatively steady over economic cycle because of negatively correlated voluntary and involuntary job leaving
- A full analysis of ABS micro-data to be done in future to identify withdrawal rate links to economy, age, service, salary, etc.

The decrement model - disability

- No separate disability benefit so disability rates not required – members who become disabled are assumed become deferred members

The decrement model - mortality

- Based on ALT00-02 – lower rates suggested by Knox and Nelson (2007) not used as pension cannot be commuted and disabled members still receive a pension
- Mortality improvement not allowed for computational reasons – uncertain future mortality allowed for through random shocks to ALT00-02 rates and underlying binomial variability

The decrement model - mortality

- Not linked to economy – literature is inconclusive
- Not currently linked to salary or pension size – literature suggests mortality rate is negatively correlated with income
- Future work to be done to quantify this effect and include in modelling

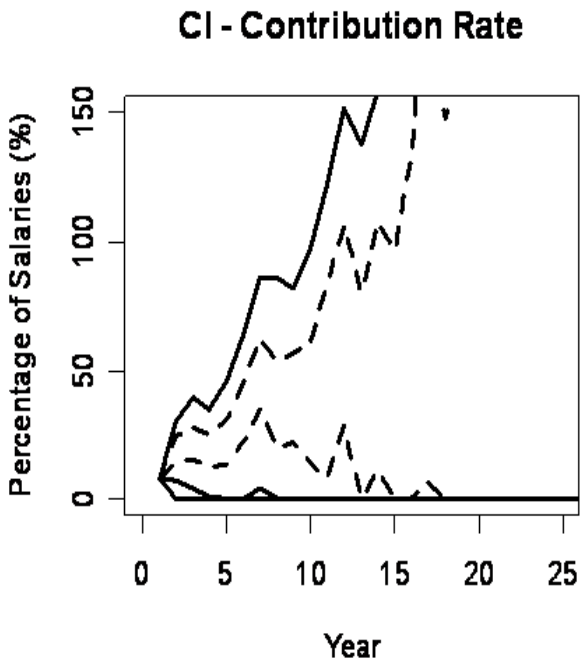
Initial Analysis

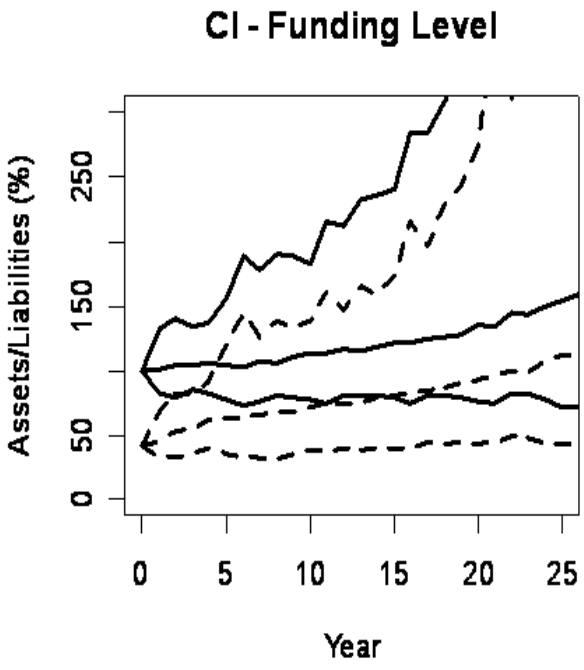
- **Median and 95% Confidence Intervals – contribution rate and funding level**, these are calculated based on the appropriate percentiles of the 1,000 simulations for each projection year
- Contribution rate as a percentage of salaries – additional 90% and 70% percentiles provided
- Funding level is assets divided by liabilities – separate calculations for funding liability and wind-up liability
- **Present value of employer contributions** – frequency plot of results for 1,000 simulations, contributions are discounted at the cash rate appropriate for that simulation

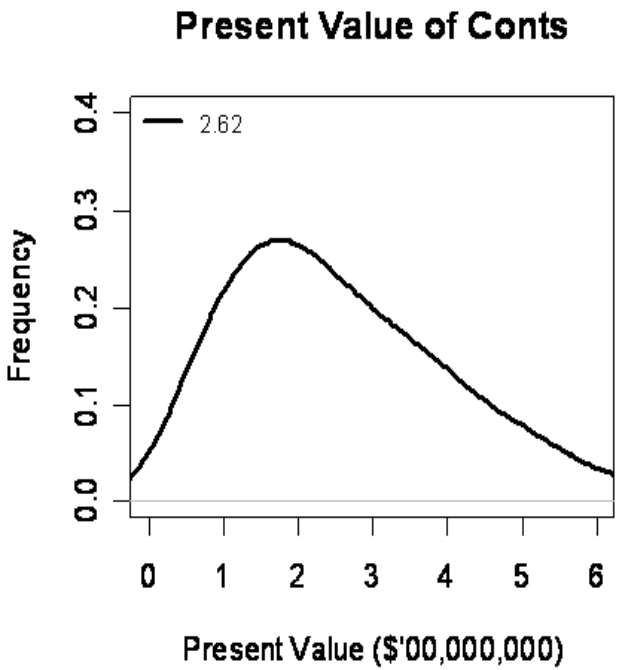
Results – base scenario

Contributions — Base — Base 90% and 70% lines

Funding — Base - Actuarial — Base - Wind-up



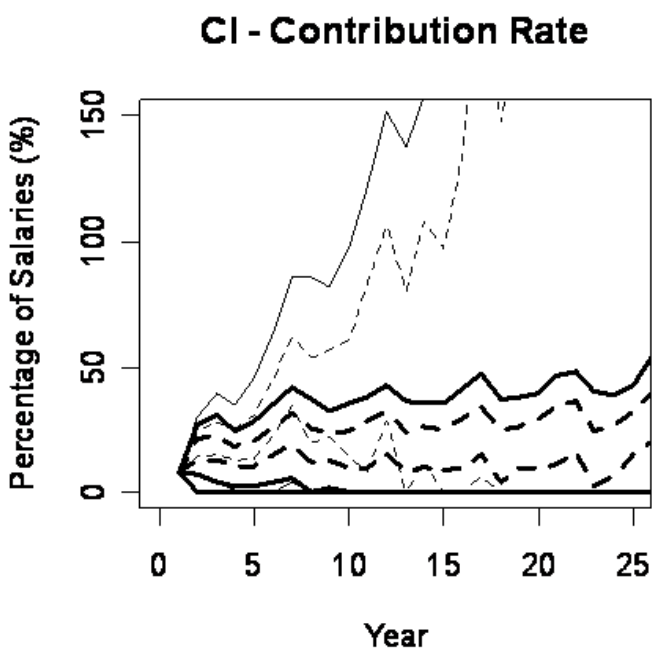


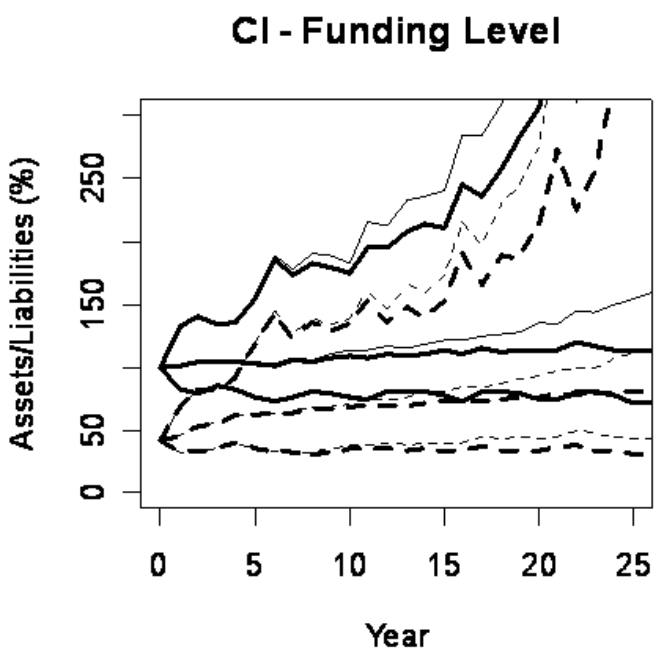


Note – the figure in the plot is the average

Results – new entrants allowed (BD2)

Contributions	BD2	BD2 90% and 70% lines
	Base	Base 90% and 70% lines
Funding	BD2 - Actuarial	BD2 - Wind-up
	Base - Actuarial	Base - Wind-up

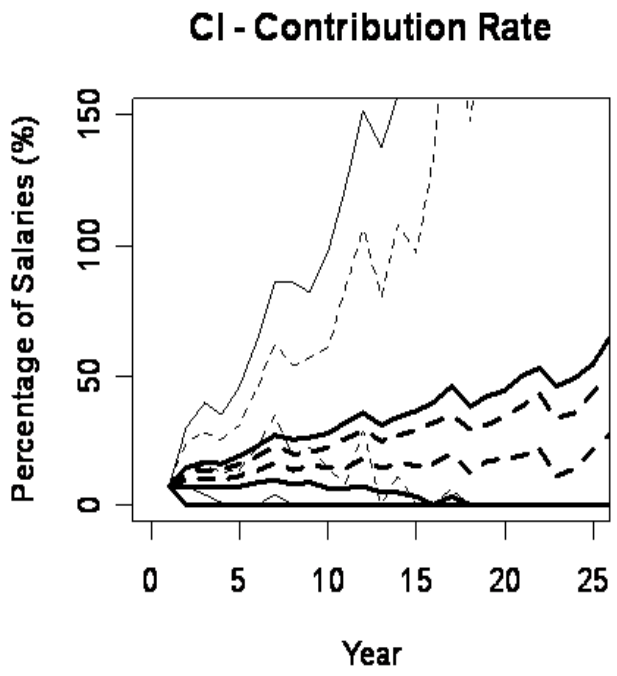


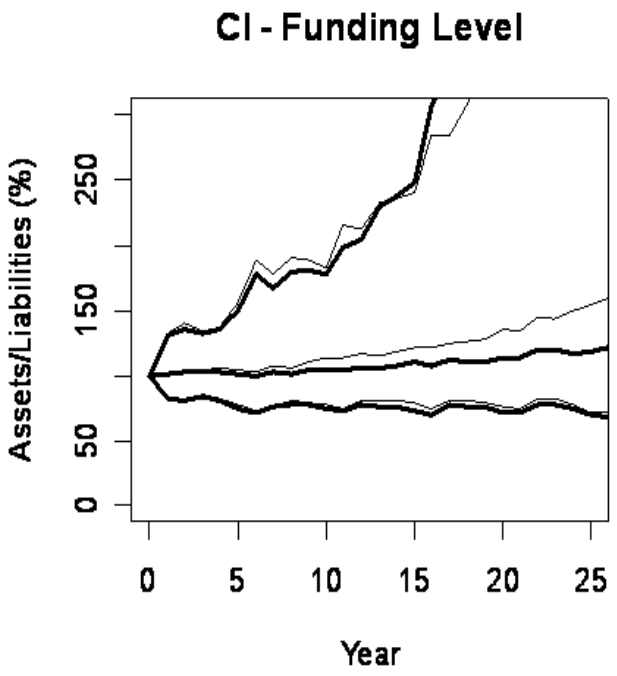


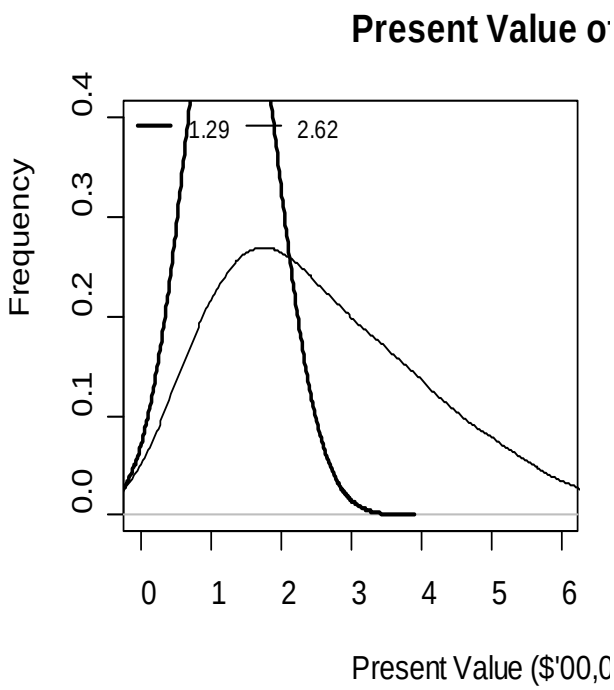
Results – lump sum only (BD3)

Contributions — BD3 — BD3 90% and 70% lines
Base — Base 90% and 70% lines

Funding — BD3 - Actuarial
Base - Actuarial



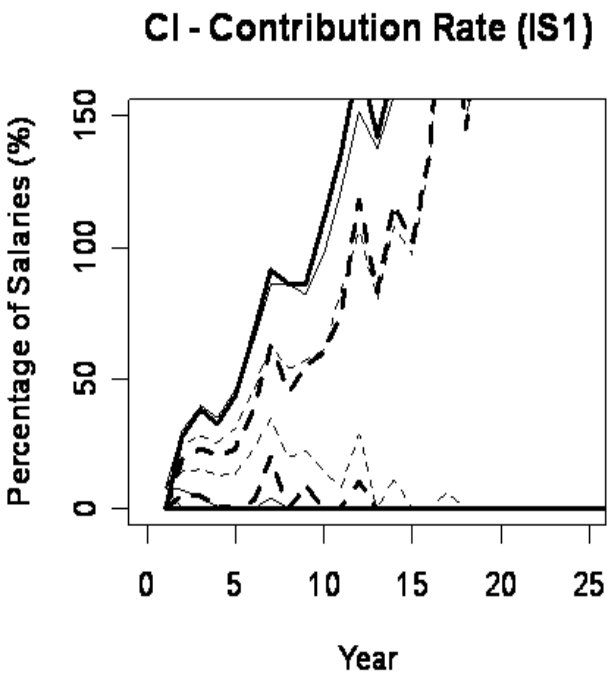


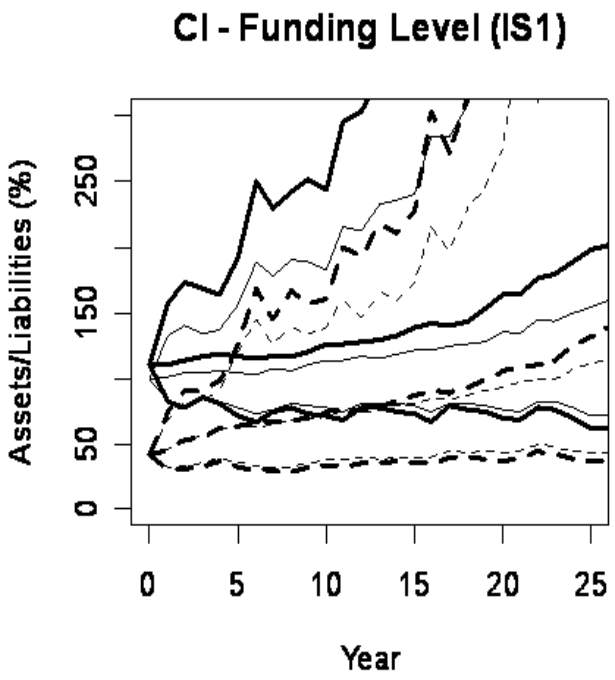


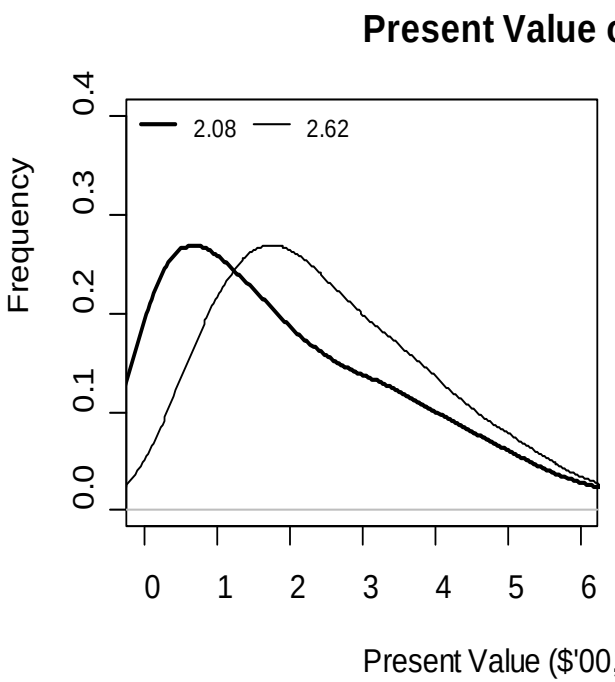
Note – the figure in the plot is the average

Results – more aggressive investment (IS1)

Contributions	IS		IS 90% and 70% lines	
	Base		Base 90% and 70% lines	
Funding	IS - Actuarial		IS - Wind-up	
	Base - Actuarial		Base - Wind-up	





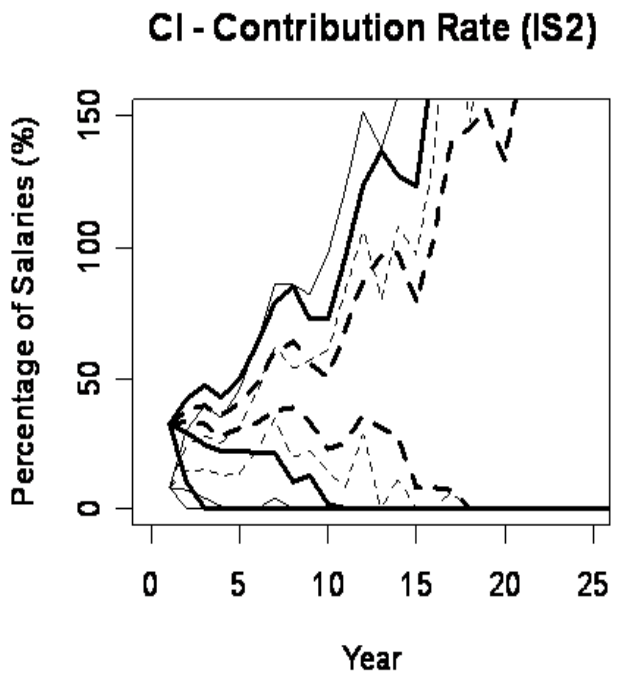


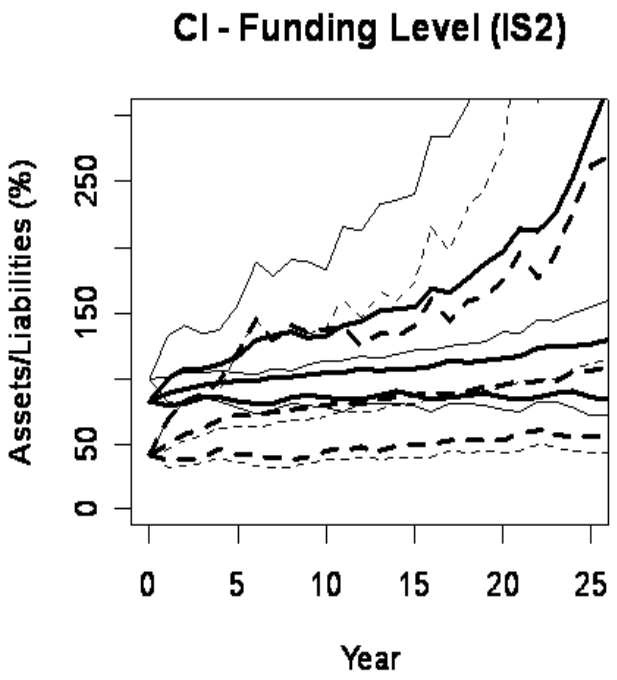
Note – the figure in the plot is the average

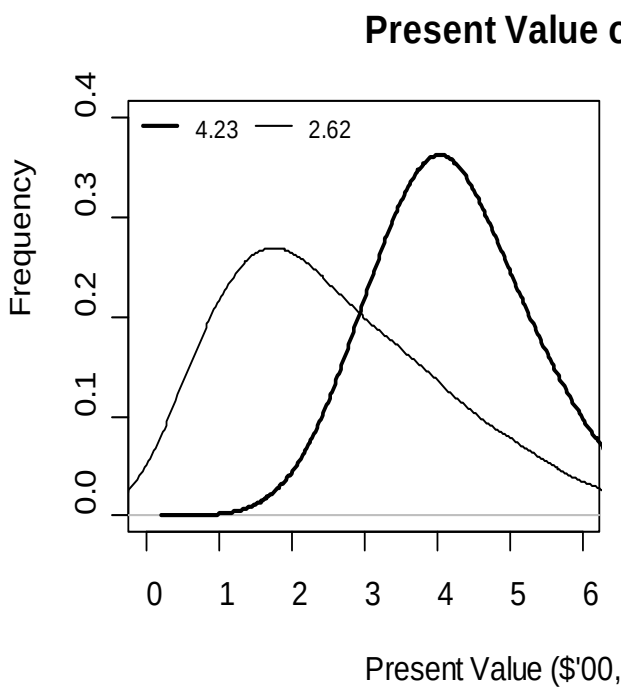
Results – more defensive investment (IS2)

Contributions — IS — IS 90% and 70% lines
Base — Base 90% and 70% lines

Funding — IS - Actuarial — IS - Wind-up
Base - Actuarial — Base - Wind-up



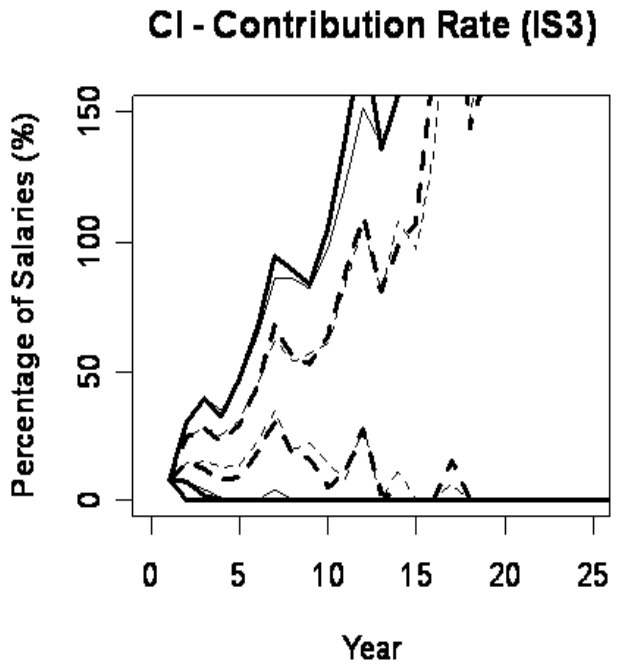


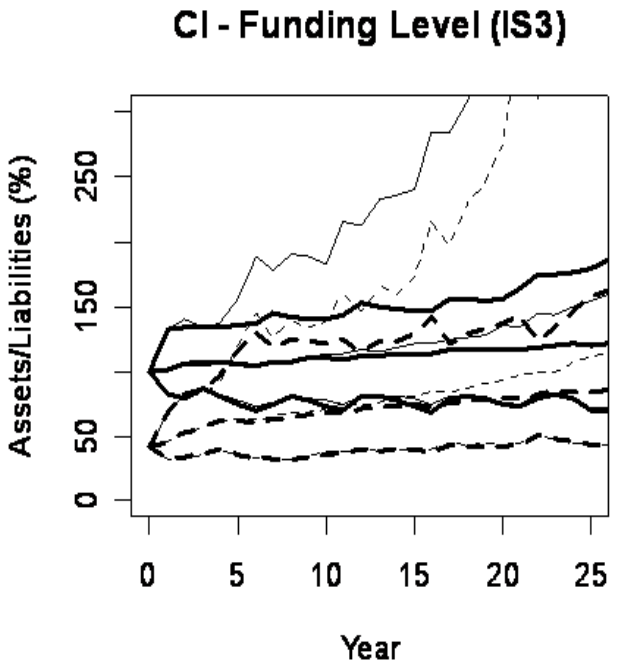


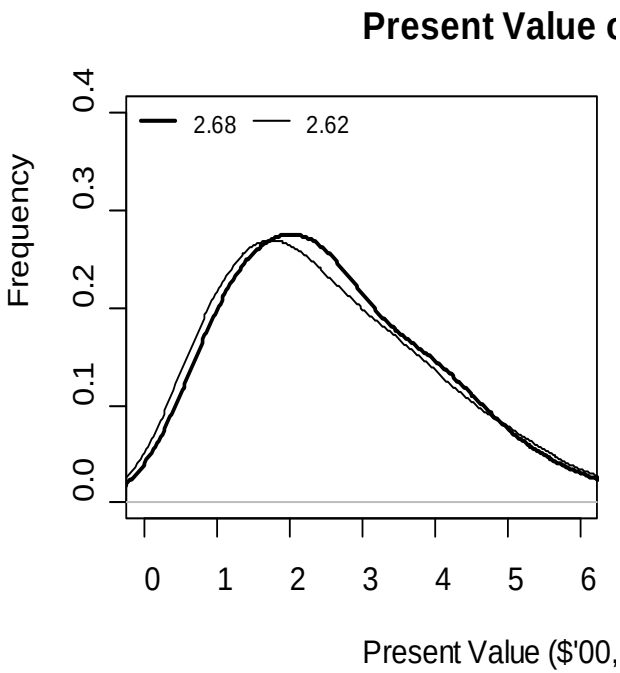
Note – the figure in the plot is the average

Results – reduce investment risk as surplus increases (IS3)

Contributions	IS	IS 90% and 70% lines
	Base	Base 90% and 70% lines
Funding	IS - Actuarial	IS - Wind-up
	Base - Actuarial	Base - Wind-up



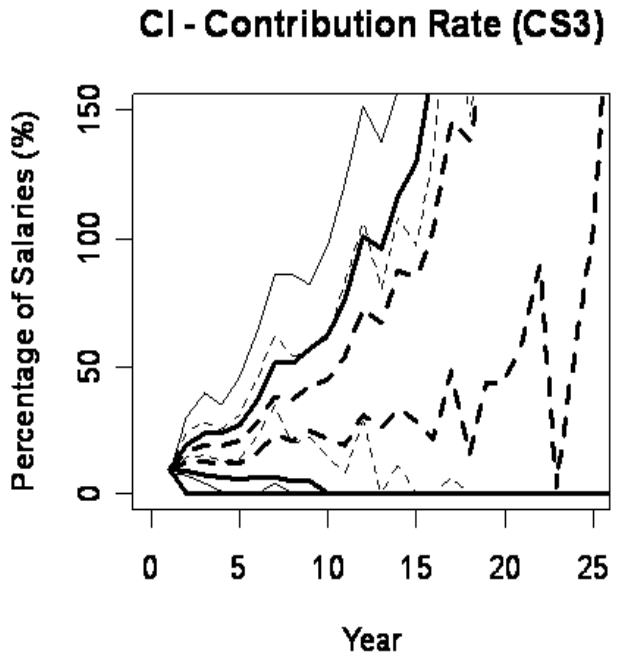


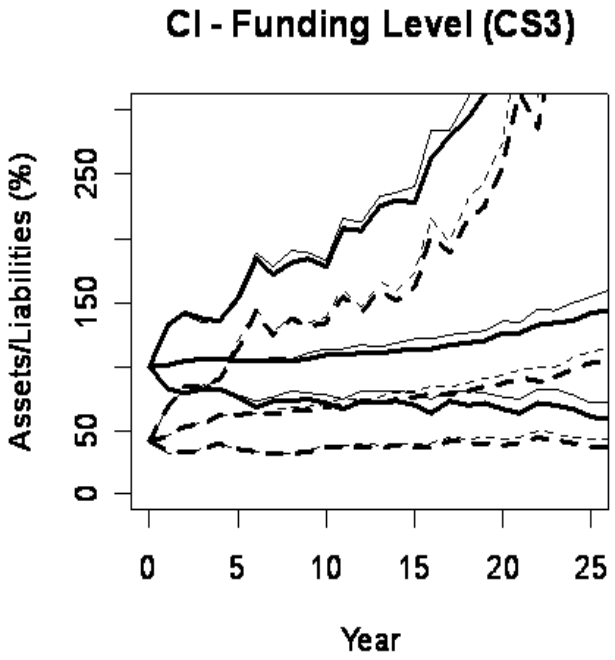


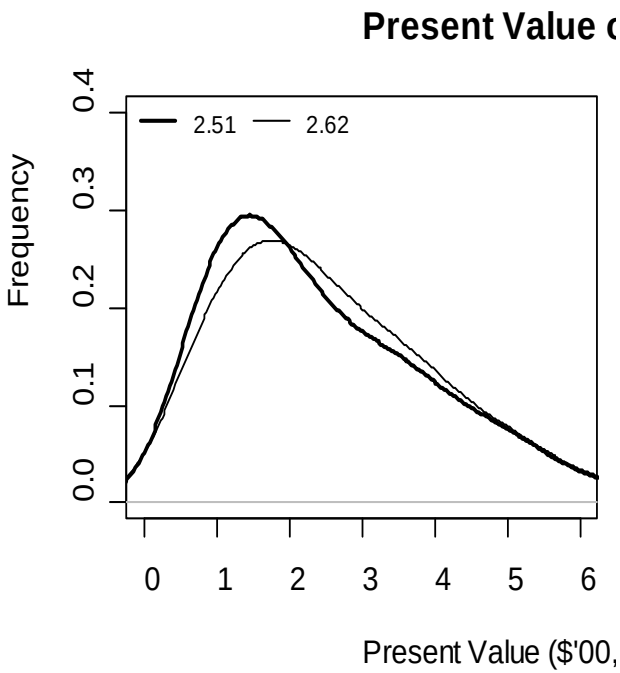
Note – the figure in the plot is the average

Results – aggregate funding (CS3)

Contributions	CS		CS 90% and 70% lines	
	Base		Base 90% and 70% lines	
Funding	CS - Actuarial		CS - Wind-up	
	Base - Actuarial		Base - Wind-up	







Note – the figure in the plot is the average

Funding Level regressions

$$FLR = \beta_0 + \beta_1 i_{diff} + \beta_2 w_{diff} + \beta_3 q_{diff} + \beta_4 m_{diff} + \beta_5 r_{diff}$$
$$+ \beta_6 i_{chng} + \beta_7 FL_{diff} + \beta_8 I \times FL^2_{diff} + \varepsilon$$

- *FLR* - % change in funding level over the year
- i_{diff} – actual investment return less discount rate
- w_{diff} – actual less expected salary increases
- q_{diff} – actual less expected pension increases
- m_{diff} – actual less expected mortality rate
- r_{diff} – actual less expected withdrawal rate (lump sums)
- i_{chng} – % change in liability discount rate
- FL_{diff} – funding level last year less 1
- I – equal to one if $FL_{diff} > 0$ or zero otherwise
- FL^2_{diff} – (funding level last year less 1)^2

Regression Results – base scenario

- Done in year 2 and year 21 to test differences

	Actuarial						Wind-up					
	t = 2			t = 21			t = 2			t = 21		
	Coef	S.E.	SS	Coef	S.E.	SS	Coef	S.E.	SS	Coef	S.E.	SS
B_0	0.007	0.000	NA	0.038	0.001	NA	-0.108	0.009	NA	***0.002***	0.002	NA
i_{diff}	0.914	0.002	0.922	0.970	0.007	0.926	1.036	0.011	0.357	0.930	0.015	0.428
w_{diff}	-0.305	0.016	0.002	***0.009***	0.042	0.000	***-0.136***	0.079	0.000	***0.068***	0.095	0.000
q_{diff}	-0.671	0.016	0.028	-0.870	0.045	0.034	-0.224	0.088	0.001	***-0.135***	0.113	0.000
m_{diff}	1.009	0.263	0.000	***0.635***	0.329	0.000	***1.694***	1.323	0.000	***0.478***	0.728	0.000
r_{diff}	***0.115***	0.147	0.000	NA	NA	NA	***0.419***	0.743	0.000	NA	NA	NA
i_{chng}	NA	NA	NA	NA	NA	NA	1.030	0.010	0.602	0.603	0.009	0.478
FL_{diff}	-0.375	0.004	0.031	***0.003***	0.002	0.000	-0.127	0.018	0.004	0.035	0.004	0.007
FL^2_{diff}	0.927	0.016	0.014	0.002	0.001	0.004	NA	NA	NA	-0.004	0.002	0.000
		Total	0.996		Total	0.964		Total	0.964		Total	0.914

Coefficients in bold italics are insignificant at the 5% level.

Regression Results – lump sum only

- Wind-up liability not relevant for lump sums so not included

	Lump Sum - BD3						Base					
	t = 2			t = 21			t = 2			t = 21		
	Coef	S.E.	SS	Coef	S.E.	SS	Coef	S.E.	SS	Coef	S.E.	SS
B_0	0.004	0.000	NA	0.020	0.004	NA	0.007	0.000	NA	0.038	0.001	NA
i_{diff}	0.940	0.001	0.898	1.030	0.012	0.838	0.914	0.002	0.922	0.970	0.007	0.926
w_{diff}	-0.993	0.008	0.046	-1.012	0.072	0.031	-0.305	0.016	0.002	*0.009*	0.042	0.000
q_{diff}	*0.015*	0.009	0.000	0.176	0.077	0.000	-0.671	0.016	0.028	-0.870	0.045	0.034
m_{diff}	-1.278	0.220	0.000	*-0.235*	0.319	0.000	1.009	0.263	0.000	*0.635*	0.329	0.000
r_{diff}	*0.015*	0.028	0.000	0.274	0.064	0.001	*0.115*	0.147	0.000	NA	NA	NA
i_{chng}	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FL_{diff}	-0.418	0.002	0.047	0.047	0.002	0.042	-0.375	0.004	0.031	*0.003*	0.002	0.000
FL^2_{diff}	0.711	0.009	0.008	-0.003	0.000	0.008	0.927	0.016	0.014	0.002	0.001	0.004
		Total	0.999		Total	0.921		Total	0.996		Total	0.964

Conclusions

- Surplus a significant problem for closed schemes – more of a problem for pensions
- Reducing investment risk reduces surplus but increases future contributions
- Reducing the speed at which deficits are removed may lead to a slight overall reduction in contributions
- Investment returns by far the most important factor in predicting funding level changes

Future research

- Effect of alternative investment models
- Cash flow matching
- Changes to timing of wind-up
- Use of scheme surplus
- Effect of government insurance