

**The optimal allocation of
pension risks in employment
contracts**

David McCarthy

Outline



- The pension decision
- Pensions in complete markets
- Incomplete markets
- Model calibration
- Results
- Conclusions

The pension decision

- **Employers**
 - Wish to minimise total compensation cost (possibly adjusted for risk)
 - Budget constraint
 - Need to keep employees happy in their jobs relative to their alternatives
 - Participation constraint (expressed in utility terms)
 - Can choose to pay in cash and pensions

The pension decision

- **Employees**
 - Rational utility maximisers
 - Labour supply is constant
 - All workers identical
 - Productivity
 - Preferences
 - No moral hazard or response to incentives in compensation

Rationality and economic analysis

- Irrationality only defined relative to models of behaviour
 - Need a base-line rational case to deviate from!

The pension decision

- Needs a context in which to take place
 - Specific capital, labour markets
 - Sources of uncertainty
 - Employee decision variables

Pensions in complete markets

- **If markets are complete, this means that**
 - All risks can be perfectly hedged by buying and selling traded securities
 - There are no transactions costs, portfolio restrictions, or moral hazard
 - Short selling allowed in unlimited quantities
 - We also assume no taxation (for now)

Pensions in complete markets

- In complete markets, ...
 - ... pension contract is irrelevant
- Workers can buy their pensions from their employers or a third party at the same price
- Employers could “undo” any pension they were paid by selling it

Pensions in complete markets

- If there is an optimum pension contract, it must be because capital markets are incomplete or because labour markets are imperfect
 - Sources of market incompleteness and labour market imperfections affect existence and type of optimum pension contract

Employees and incomplete markets

- Taxation
- Untraded risks (incl. pension default risk)
- Annuity market access / compulsory annuitisation
- Liquidity constraints
- Portfolio restrictions
- Transactions costs

Employers and labour markets

- Taxation
- Retention benefits
- Sorting effects
- Productivity effects
- Pensions and retirement behaviour
- Transactions costs
- Pension risk

Model of employee preferences: asset returns

Table 3.2 Asset return assumptions

Assumption	Value
Risk free rate	2.0% p.a.
Equity risk premium	5.0% p.a.
Equity dividend yield	3.0% p.a.
Standard deviation of equity returns	20.0% p.a.

Model of employee preferences: income taxes

Table 3.4 Marginal income tax rates before retirement

Tax bracket (working)	Tax rate
£0 - £4,745	0%
£4,746 - £6,765	10%
£6,765 - £36,145	33%
£36,146 and above	40%

Table 3.1 Marginal income tax rates after retirement

Tax bracket (retirement)	Tax rate
£0 - £6,950	0%
£6,950 - £8,970	10%
£8,971 - £38,350	22%
£38,351 and above	40%

- Annuity capital and equity capital gains deemed to be tax free

Model of employee preferences: mortality shock

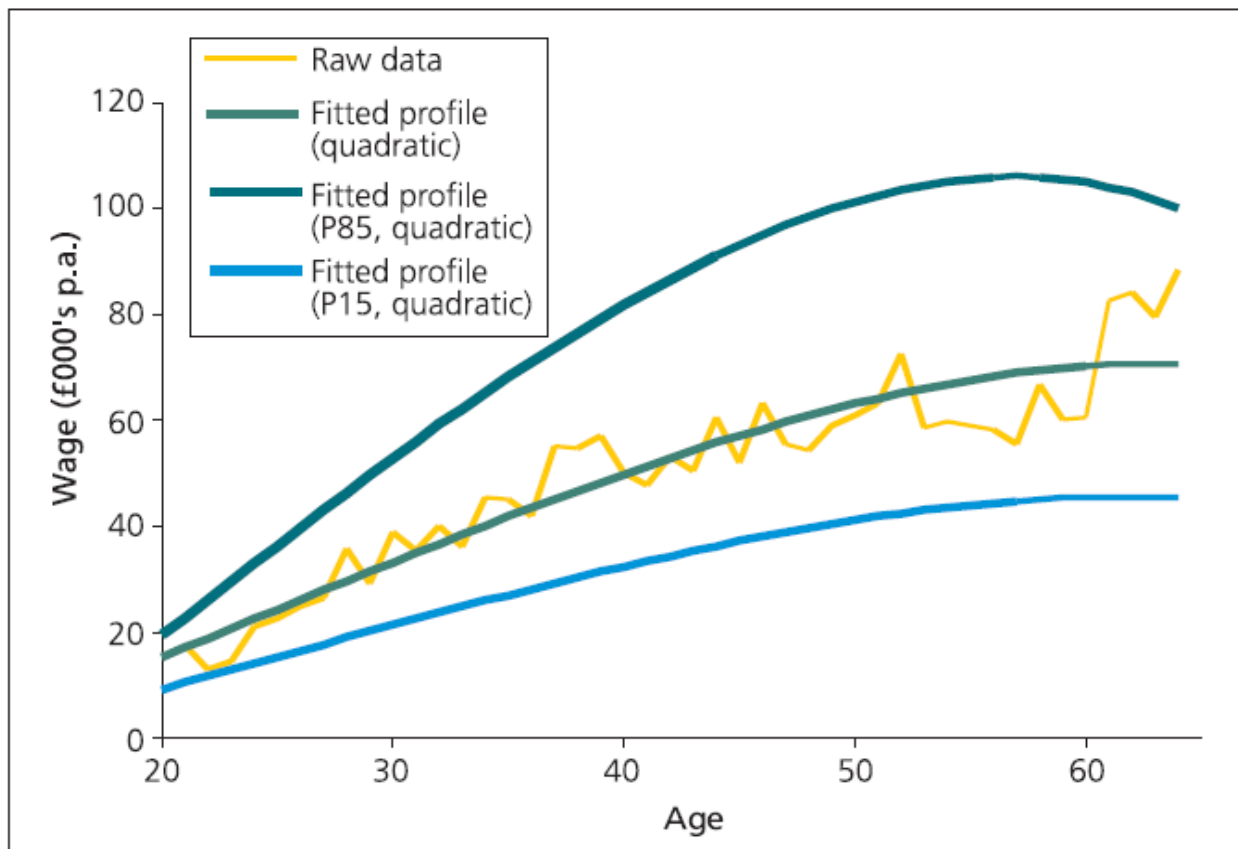
Table 3.3 Mortality shock assumptions

Scenario	Shock size*	Probability
1	-1.0%	0.2
2	-0.5%	0.2
3	0.0%	0.2
4	0.5%	0.2
5	1.0%	0.2

Note: The shock size is multiplied by the number of years between the pension decision and retirement to simulate mortality uncertainty accruing from year to year.

Model of employee preferences: wages

Figure 3.1 Fitted age-wage profiles, male, degree or equivalent, median, 15th and 85th percentiles.



Model of employee preferences: wage risk

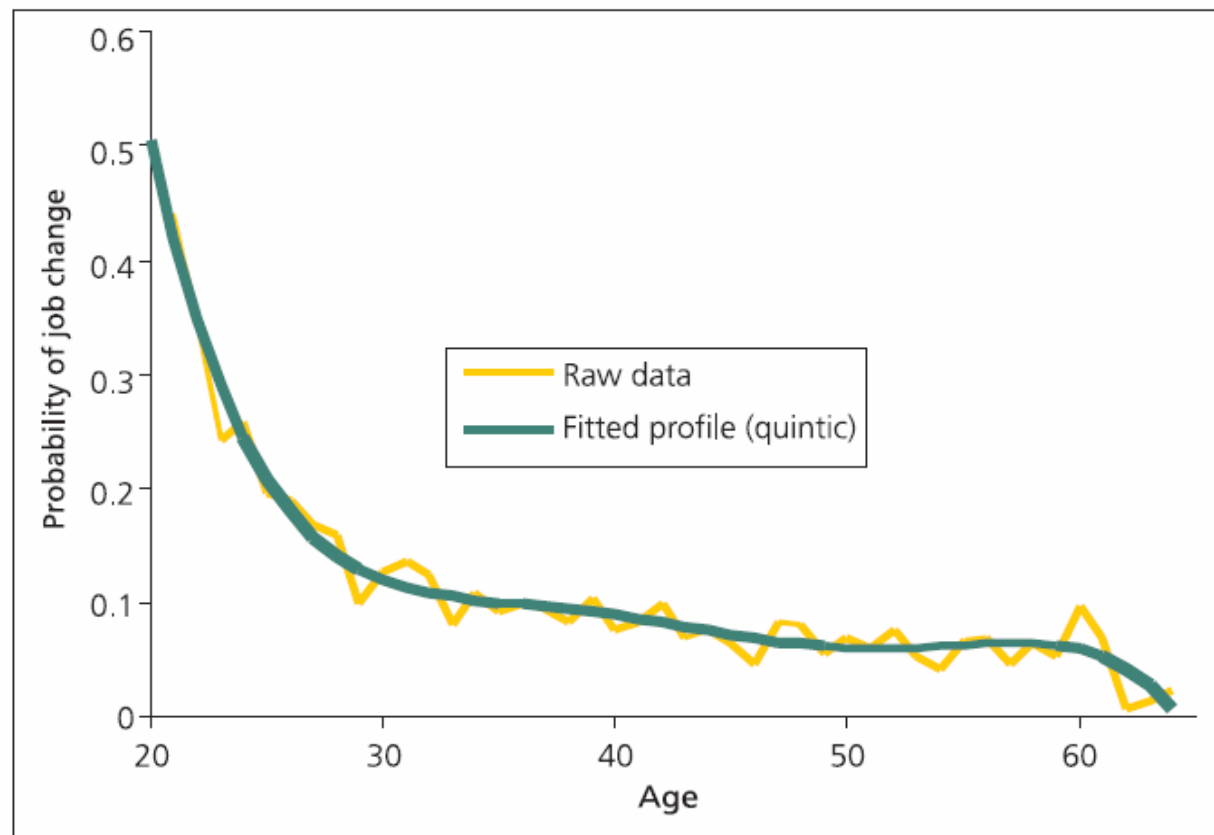
Table 3.6 Estimated wage shock standard deviations

Age group	Male		Female	
	Degree or equivalent	GCSE grades A-C or equivalent	Degree or equivalent	GCSE grades A-C or equivalent
20-24	0.183	0.272	0.429	0.387
25-29	0.446	0.362	0.381	0.386
30-34	0.421	0.436	0.317	0.417
34-39	0.480	0.410	0.360	0.380
40-44	0.421	0.396	0.309	0.322
45-49	0.394	0.553	0.391	0.337
50-54	0.464	0.372	0.331	0.467
55-59	0.337	0.436	0.523	0.228
60-64	0.373	-	-	-
All ages	0.428	0.418	0.363	0.364

Note: Data shows estimated standard deviations of workers of different categories from the LFS, conditional on being in full-time work and reporting wages in both March 2003 and May 2004. Wages adjusted for productivity changes, changes in price levels and fitted quadratic median age-wage profiles for each educational category and sex. Estimators not reported where there are fewer than 5 observations in a cell.

Model of employee preferences: job change

Figure 3.2 Raw and fitted annual probability of changing jobs by age (male and female, all educational attainments)



Model of employer preferences

- **Simplified preferences**
 - Care about expected value and variance of pension costs
 - Difficult to calibrate
 - Takes account of NI contribution exemption on pensions costs
- **No account taken of labour force effects of pensions**

Understanding the results

- Presented in the form of risk-adjusted total compensation costs
 - Split between
 - Wages
 - Expected pension cost
 - Pension risk adjustment

Understanding the results

- When choosing between different pension scheme types, employer will choose the one with the overall lowest risk-adjusted cost
 - Need to factor in labour-force benefits too!

Final salary schemes

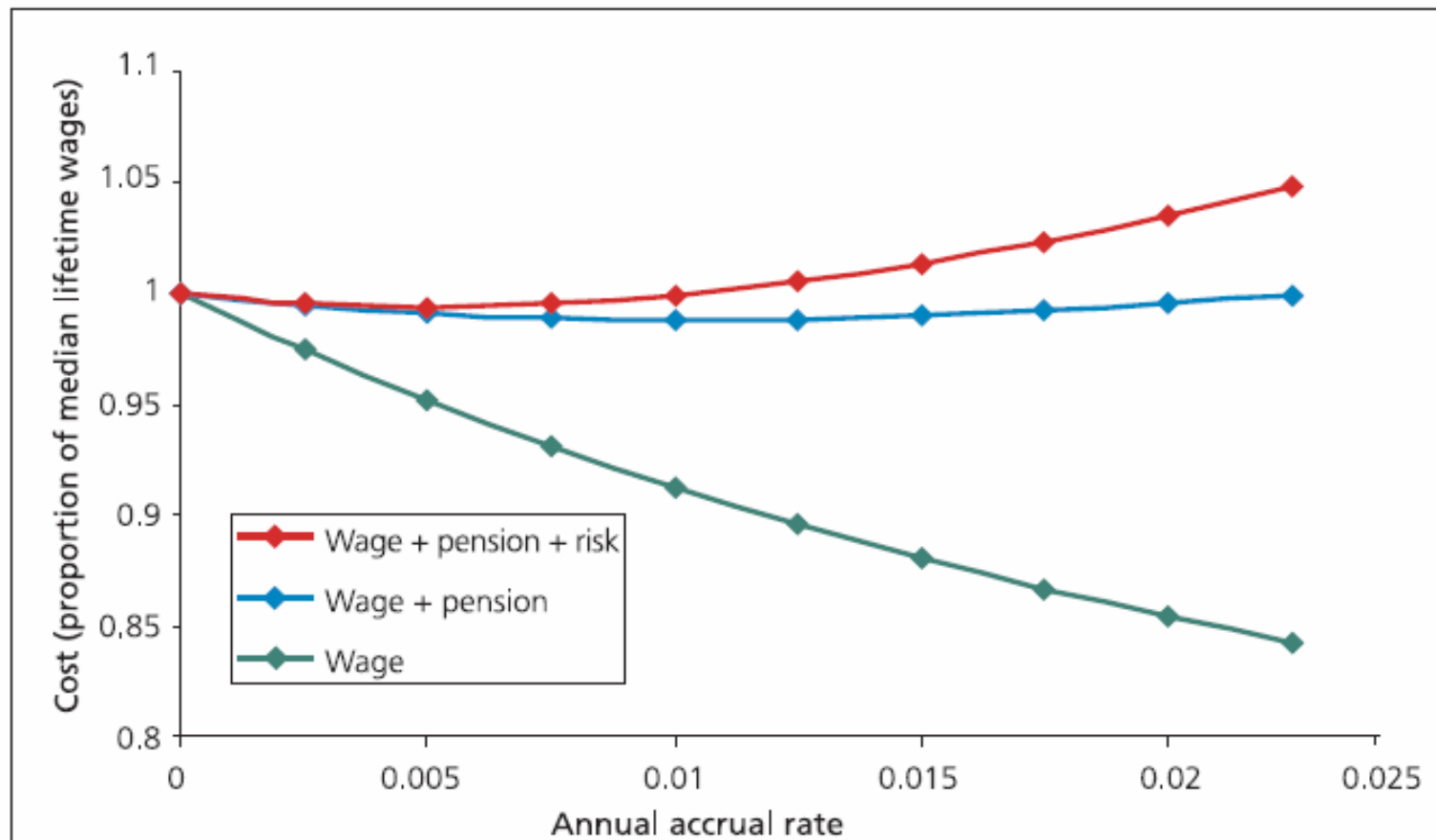
Table 5.1 Final salary pension scheme: total compensation cost divided between wages, expected pension cost and pension risk adjustment for a professional male aged 35 with private wealth £10,000

Final Salary Pension Annual Accrual Rate	Wage Cost	Expected Pension Cost	Pension Risk Adjustment	Total Compensation Cost
0.0000	1.000	0.000	0.000	1.000
0.0025	0.974	0.020	0.001	0.995
0.0050	0.951	0.039	0.003	0.994
0.0075	0.931	0.058	0.007	0.995
0.0100	0.912	0.075	0.011	0.999
0.0125	0.896	0.093	0.017	1.005
0.0150	0.880	0.109	0.024	1.013
0.0175	0.867	0.125	0.031	1.023
0.0200	0.854	0.141	0.040	1.035
0.0225	0.843	0.157	0.049	1.048
Pension design parameters				
Expected pension cost per 1% accrual				8.27
Pension variance per 1% accrual				10.88
Employer risk aversion				25
Optimal Pension Properties				
Optimal pension accrual rate				0.005
Optimal total compensation cost				0.994

Notes: The second column is estimated using the model of employee preferences described in the text. The pension risk adjustment is estimated using the model of employer preferences described in the text. The optimal pension accrual rate is that accrual rate at which the employer's total cost of compensation is minimized. Figures may not add due to rounding.

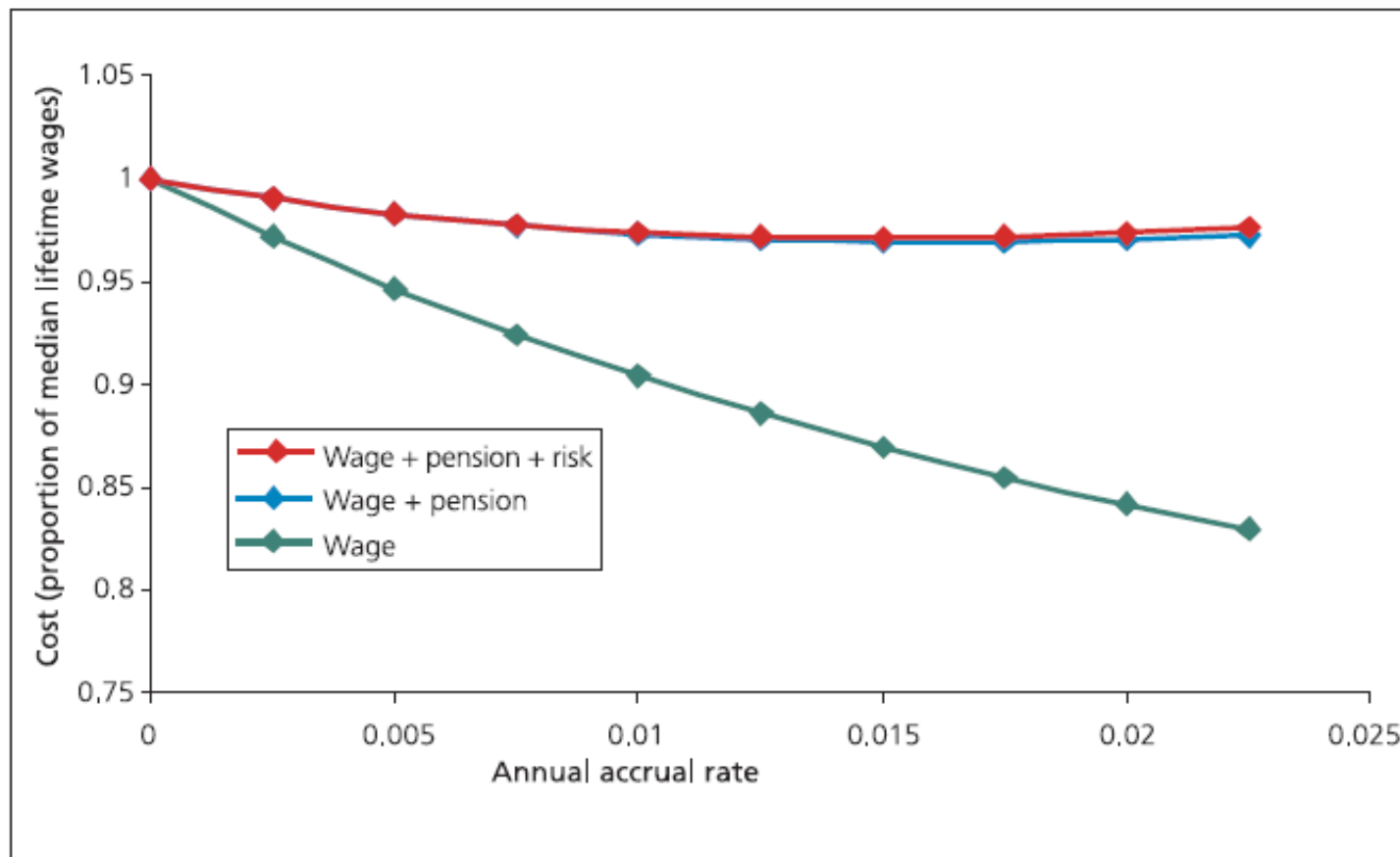
Final salary schemes

Figure 5.1 Final salary pension scheme: total compensation cost divided between wages, expected pension cost and pension risk adjustment for a professional male aged 35 with private wealth £10,000



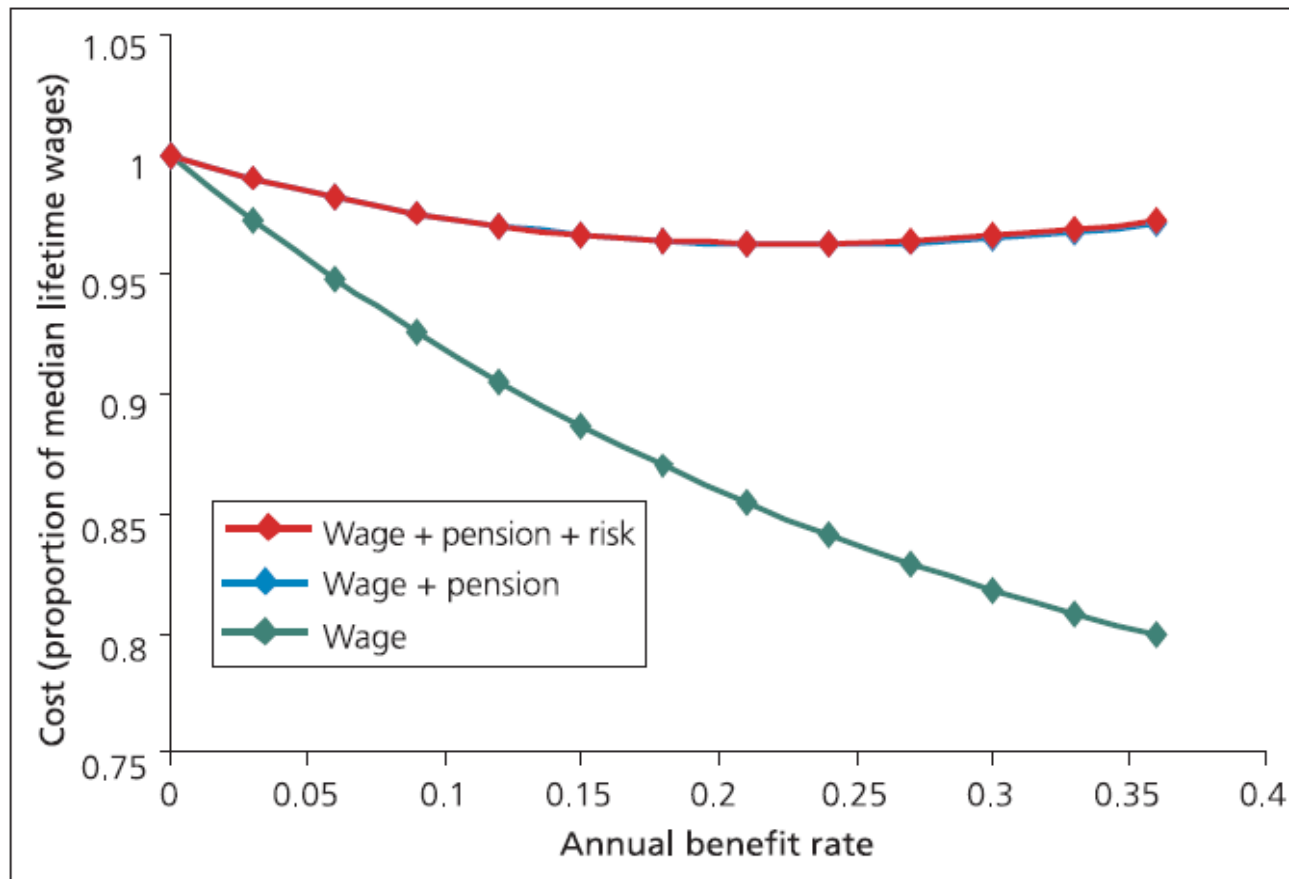
Career average schemes

Figure 5.2 Career average pension scheme: total compensation cost divided between wages, expected pension cost and pension risk adjustment for a professional male aged 35 with private wealth £10,000



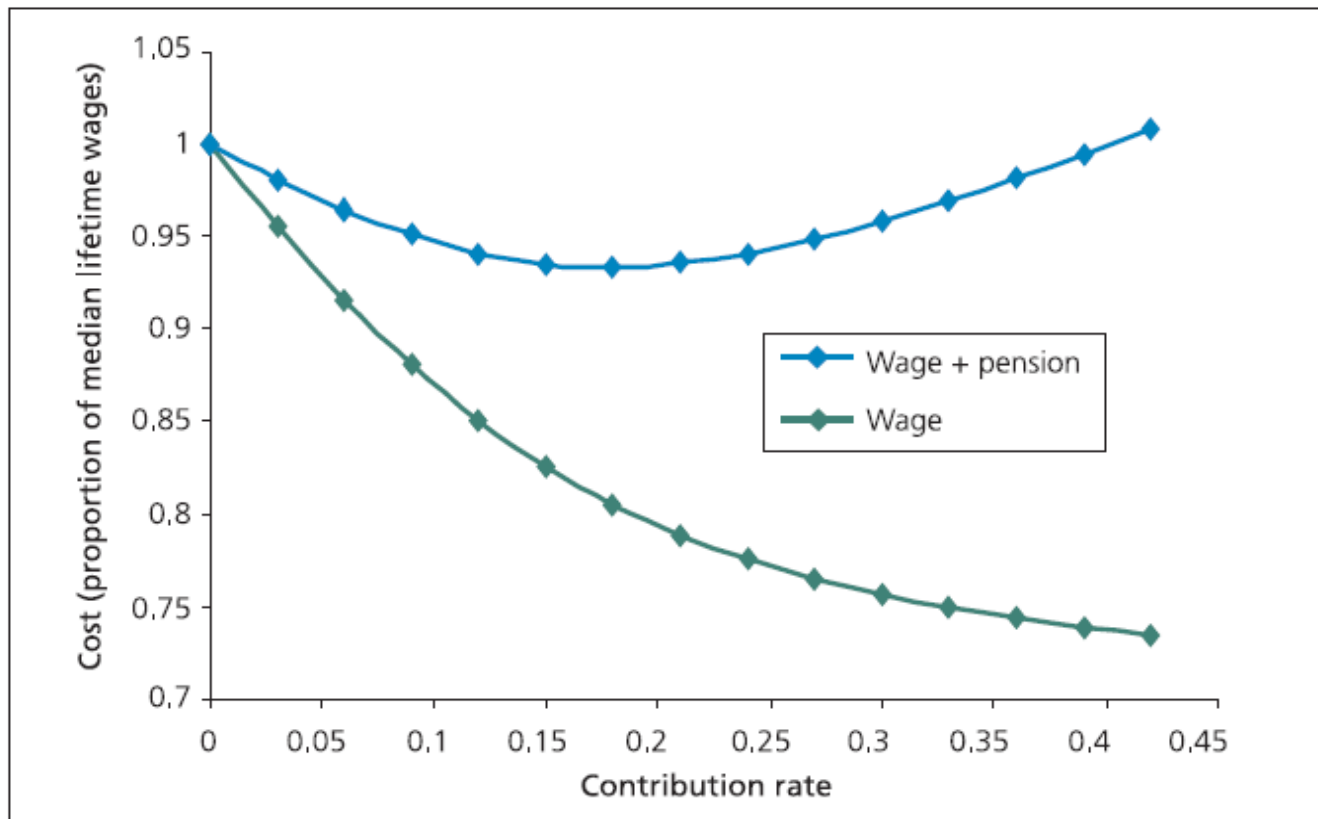
Cash balance schemes

Figure 5.3 Cash balance pension scheme: total compensation cost divided between wages, expected pension cost and pension risk adjustment for a professional male aged 35 with private wealth £10,000



DC schemes

Figure 5.4 Defined contribution pension scheme: total compensation cost divided between wages, expected pension cost and pension risk adjustment for a professional male aged 35 with private wealth £10,000



Comparing different scheme designs

- Look at total risk-adjusted cost at optimum
- Allow for labour market effects (these may of course affect optimum)

Optimum compensation costs compared

Table 1.2 Optimal cost of compensation with different pension plan types for 35-year old median-wage male worker, with a degree

Pension type	Optimal accrual/ contribution rate of pension	Cash Wages	Expected Pension Cost	Pension Risk Adjustment	Total optimal cost of compensation
No pension	0.000	1.000	0.000	0.000	1.000
Final salary defined benefit pension	0.005	0.951	0.039	0.003	0.994
Defined contribution pension	0.166	0.813	0.120	0.000	0.933
Cash balance pension	0.227	0.849	0.117	0.000	0.963
Career average defined benefit pension	0.015	0.870	0.100	0.002	0.971

Continued

Optimum compensation costs compared

Table 1.2 Continued

Pension type	Optimal accrual/ contribution rate of pension	Cash Wages	Expected Pension Cost	Pension Risk Adjustment	Total optimal cost of compensation
Career average defined benefit pension and defined contribution pension (simultaneous hybrid)	0.166* (DC) 0.000* (CA)	0.813*	0.120*	0.000*	0.933*
Career average defined benefit pension on salary below £30,000 p.a. and defined contribution pension on salary above that level (combination hybrid)	0.00 (DC) 0.02 (CA)	0.863	0.099	0.000	0.962

*Note: All figures are scaled so that the expected cost of a worker paid only in cash is 1.00. The analysis ignores the effects that pensions may have on worker behaviour, which may be especially important for defined benefit pensions. *If employers could offer workers both pure career average pensions and pure defined contribution pensions, they would find it most cost-effective to pay workers only with defined contribution pensions. The figures shown are the more accurate figures from the DC-only run, which the hybrid run suggests is optimal*

Conclusions

- Underfunded pensions are sub-optimal
- Career average pensions preferable to final salary pensions
- Older workers find pensions more attractive, in general
 - Insurance against mortality shock
 - Natural savings level higher as retirement looms

Conclusions

- DC schemes preferred to cash balance schemes
- Offering both career average and DC pensions offered little economic value
- DC pension optimal