Total Reward in the UK in the Public and Private Sectors.

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Abstract

Recent controversy has surrounded the relative value of public and private sector remuneration. We define a comprehensive measure of Total Reward (TR) which includes not just pay, but pensions and other 'benefits in kind', evaluate it as the present value of the sum of all these payments over the lifetime and compare it in the UK public and private sectors. Our results suggest that TR is equalized over the lifecycle for men while women have a clear TR advantage in the public sector by the end of their career. We suggest that the current controversy over public-private sector pension differentials and the perennial issues of public/private sector pay gaps requires a life time perspective and that the concept of TR is appropriate.

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"The pension system is only an alternative to paying a higher salary to those rendering existing services and leaving them subsequently to look after their own superannuation allowance."

Sir Josiah Stamp (1880-1941) "Wealth and Taxable Capacity." 1922, Ch. II, p.57.

"The true reward which an occupation offers to labour has to be calculated by deducting the money value of all its disadvantages from that of all its advantages; and we may describe this true reward as the net advantages of the occupation."

Alfred Marshall (1842-1924) "Principles of Economics." 8th ed., Bk. II, Ch. IV, 2, p.73.

1. Introduction

Recent controversy has surrounded the relative value of public and private sector remuneration in the UK. In the current recession and fiscal debt crises, there has been huge pressure to cut public sector remuneration. Many countries have already done this in nominal terms (e.g. Greece and the Republic of Ireland) and most countries will be doing this in real terms over the next five years. At the same time there has been growing concern about the ageing population and the burden of the pension obligations to public sector workers in the future. As any manipulation of public sector compensation (in terms of pay or pensions or other conditions of service) will have immediate consequences for fiscal budgets, workforce composition, delivery of services, inequality and relative remuneration it is necessary to carefully evaluate any proposed changes in any element of the total remuneration package. It is also important to be clear what this calculation tells us about public/private sector remuneration relativities as this is a perennial comparison fraught with pitfalls.

There is almost universal agreement that any debate about remuneration should include pay and pensions and all other forms of benefits in kind. There is no agreement on how this should be calculated. Although there has been a lot of work on selected aspects of the value of pensions across sectors (e.g., Disney et al. 2009) there has been relatively little on the evaluation of broader concepts of compensation. Indeed—although the notion of 'Total Reward' (TR) seems of have become fashionable in Human Resource Management circles there is no consensus of specifically what TR includes and leaves out. Often (see Greenhill, 1990 and Balsam, 2002) 'Total Remuneration' or the 'compensation package' (for

executives) is said to include: salary, bonus, stock options, stock grants, pensions and other compensation. This literature tends to exclude: hours of work, holiday entitlements, job security (in terms of the probability of being made unemployed) and does not attempt to enumerate future benefits in present value terms or to adopt a life cycle perspective on this evaluation. These would all seem to be important considerations for an economic evaluation of Total Reward.

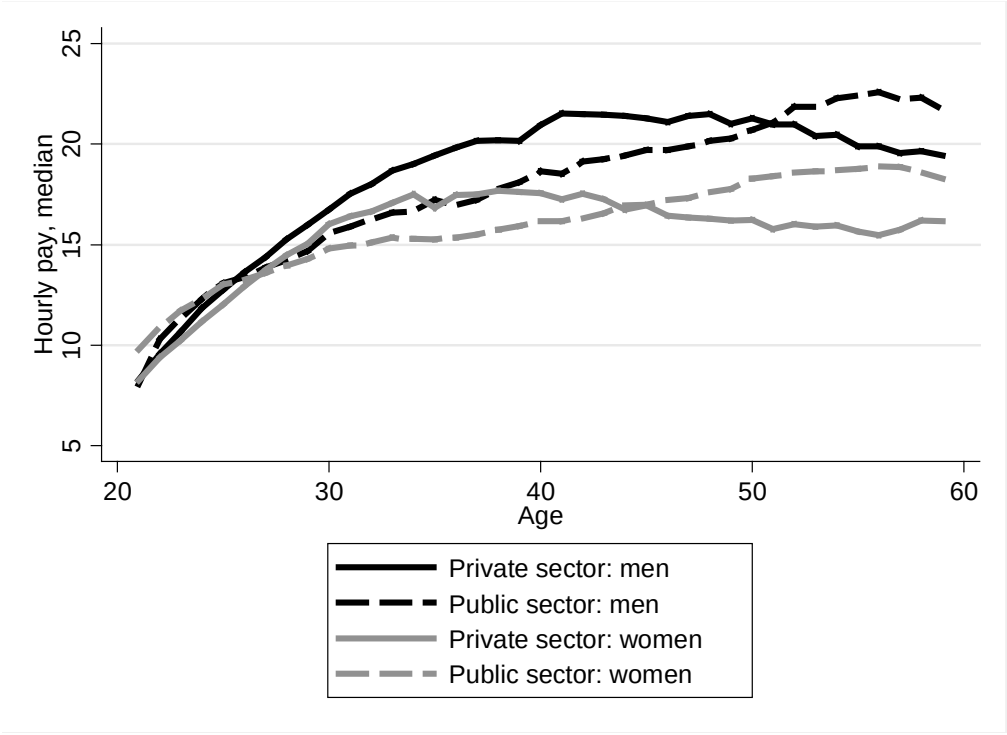
This paper provides a conceptual method for the measurement of Total Reward and proceeds to estimate the TR structure for the private and public sector in the UK. For the purposes of this paper we will define TR in a sector for an average career as the total financial benefits and in kind compensation, evaluated in money terms over the life cycle. This will include conditions of work like: working hours, paid holidays and unemployment risk as well as direct financial remuneration both now and deferred as pension payments in the future. We take into account current earnings, pensions, hours of work, paid holidays, employer provided health insurance, the likelihood of unemployment and the lifetime pattern of pension contributions. We do this by pooling the largest available sources of data on public and private sector employees and examining how they differ, on average, across the life cycle. This meant we used all of the following data in our analysis: the Annual Survey of Hours and Earnings (ASHE), the Labour Force Survey (LFS), the English Longitudinal Survey of Ageing (ELSA), and the British Household Panel Survey (BHPS). Each of these data sets provides different data on the various components of pensionable pay. We provide a Data Appendix to this paper which includes a list of all the available data which pertain to our evaluation of Total Reward.

The first contribution of this paper is to estimate the level of total compensation of the highly educated in the private and public sectors in the UK. The average earnings profile in the public sector depicted in Figure 1 starts off at a higher entry level than in the private sector.[1] Later in the life cycle stronger wage growth means that the private sector earnings profile rises above the public profile. While both profiles level off at later ages, the private sector profile even declines below the public profile. This shape of the private and public sector profiles has led researchers to impose a quadratic functional form on age-earnings profiles (cp. Disney et al., 2009). When performing the analysis on employer-reported earnings (ASHE data), we consistently find inverted u-shaped median age-earnings profiles (Figure 1;

[1] Of course, all calculations behind this figure are in real terms and net of the sector specific growth rate in the economy.

the age-earnings profile using LFS data can be found as Figure A1[2] in the Appendix).[3] Basically, the question is whether initially low but steeper private sector earnings profiles produce the same Total Reward as public sector profiles which (on average) start off higher but progress at a slower growth rate?

Figure 1: Age-earnings profiles using semiparamtric median quantile regression



Note: Hourly wages are employer reported as actual earnings over actual working hours (including overtime). Real values deflated to 2009 before netting out average annual growth in each sector. Source: ASHE 1997 to 2009 (ONS), own calculations.

To answer this question we define the concept of Accumulated Lifetime Total Reward (ALTR). Besides earnings and pension accruals, we include four non-wage and non-pension components in the

[2] Median earnings are substantially lower when using LFS rather than ASHE data. While the LFS is increasingly plagued by non-response from high-income earners (Bell, Elliot, Scott, Ada and Roberts, 2006) the ASHE does not sample employees who fall below the NI contribution threshold (low income earners). As we restrict our sample to higher educated individuals, we expect the first source of bias to be stronger than the second one.

[3] Two aspects of the age-earnings profiles deserve some closer attention. First, given the potentially larger variation of earnings in the private than in the public sector at each age, it would be useful to know whether the two profiles are really different from each other. In our standard analysis we reduce the problem of establishing comparability from two sample means (Belman and Heywood, 2004) by using median earnings. To detect whether the mean earnings between sectors are significantly different we construct 95% confidence intervals. While earnings differences are insignificant at the beginning and end of the working career, private sector employees do have an earnings premium at mid age (Figures A2 and A3). Second, like the previous literature we use cross-sectional earnings data. We are aware of the fact that these profiles might potentially differ from true lifetime profiles for compositional reasons. Especially older workers who were made redundant and find it difficult to enter a new job (for reasonable pay) and who face a relatively short period until reaching the retirement age often enter early retirement (Chan and Stevens, 2001). Nevertheless, this approach mimics the perspective of the government which aims at keeping average public sector remuneration comparable to the private sector.

valuation of Total Reward.[4] So, the second contribution of this research is that we are the first to evaluate the contribution made to Total Reward by: Hours of work, paid holidays, employer-provided health insurance and the probability of employment.[5] After accounting for imperfections of the labour market (the risk of unemployment), the intuition is that Total Reward in both sectors should be equal for very similar workers performing equal work. Therefore, in some sense, we perform this complex valuation exercise in order to provide a simple test of the theory of compensating differentials. The idea is a logical extension of the Rosen (1974) 'equalizing differences' framework in which each individual would attempt to choose the sector which maximised their lifetime TR (or utility).[6] In such a framework it makes sense that the different alternative careers would end up have equal TR when calculated in present value terms over the whole lifecycle. If this was not the case then individuals would all wish to work in the same sector which would of course necessitate a realignment of at least one element of TR to bring the economy back into equilibrium with appropriate amounts of people wishing to go into each sector. Our third contribution concerns the valuation of pensions. Unlike the earlier literature on pension valuation that computes the value of prospective one-year accruals in defined benefit (DB) and define contribution (DC) schemes (e.g., Disney et al., 2009; Crawford et al., 2010), we account in greater detail for the complexities of the private and state components of the pension system in the public and private sectors. Specifically, we compute the level of total accruals at each age over the life cycle and compare a typical ('average') public sector employee (with more than 90 percent of DB coverage) with a private sector employee (with a mixture of DB, money purchase and state earnings-related pensions).

This paper produces three empirical findings: First, we compute the value of non-monetary Total Reward components in the UK at around 15 to 20 percent of total earnings—a non-negligible fraction. Second, we find that the level of Total Reward differs substantially across the public and private sector for most of the life cycle. The fact that total compensation is so different even after accounting for

[4] Evidence from the USA suggests that in-kind benefits are more common (Heywood, 1991) and more generous (Quinn, 1982) in the public sector.

[5] Initially, we also included employer-provided training days. Due to potential double counting and the difficulties in assessing their 'value' for employees we decided to remove training days from our TR measure. As employer provided training intensities are quite low, we refer the interested reader to Figure A4 in the Appendix for a comparison across sectors. Interestingly, the incidence of training varies across the life cycle with high training rates at young ages in the private sector and at mid career in the public sector. High training intensity among recent graduates in the private sector seems to reflect the importance of job specific skills.

[6] For early empirical investigations of the framework see Duncan (1976), Brown (1980), Woodbury (1983), Montgomery, Shaw and Benedict (1992) and Montgomery and Shaw (1997).

earnings, pensions, fringe benefits, work load as well as the risk of unemployment, has direct implications for the self-selection of employees across sectors. Third, the Total Reward profiles of the two sectors cross for women who are better off in the public sector for most of their lifetime. For men, the private sector offers higher rewards almost until retirement, when lifetime Total Rewards in the public and private sectors become equalised. This finding suggests some support for the lifecycle version of the 'equalizing differences' story but also raises important questions about how early-career remuneration might affect graduates' sector choice.

The remainder of this paper is structured as follows: Section 2 outlines the methodology of evaluating the Total Reward packages in both sectors. An overview of all data sets that will be employed and all TR components is provided in section 3. Section 4 presents the results on Total Reward over the life cycle. Section 5 concludes.

2. Defining Total Reward

Our measure of Total Reward comprises two standard variables, earnings and pensions, as well as an array of new components. With regard to pensions we add to the previous literature by accounting in great detail for the complexities of the pension system. For instance, we shed light on most components of the UK pension system simultaneously (state pension, state earnings-related pension and various occupational pensions) and estimate the level of pension wealth from different sources.[7] With respect to benefits in kind, we propose simple valuation methods, yet are able to show the importance of fringe benefits in the Total Reward package.

In the valuations of pension entitlements we follow the previous literature (Gustman et al 2000). For our purposes we define pensions as the bundle of retirement related payments from different sources (general and earnings-related state pension, occupational pensions). Public sector pension schemes are generally easier to analyze as they are based on general rules which researchers can collect from publicly

[7] We cannot account for more than one occupational pension (however, the fraction of employees holding several occupational pensions is small). We also ignore private pensions as we are interested in the level of job-related remuneration.

available reports (PPI Pension Primer, 2008).[8] The parameters of private occupational pensions are individual specific and must be retrieved from the data. The asset value of a defined benefit (DB) pension is evaluated as the sum of the discounted DB benefit values from retirement until death. For this computation, knowledge about retirement dates and life expectancy levels at retirement is required. The actual benefit value will depend on the pension plan details provided by different employers (i.e. accrual rates, accrual base, initial vesting period, lump sum options, survivors' benefits) as well as specific employee details like levels of past earnings and number of years of service. The asset value of the earnings-related state pension is computed as the discounted sum of benefits, which are computed according to the formula which was in place during the last years of the State Earnings Related Pension Scheme (SERPS). The asset value of a defined contribution (DC) plan is provided by adding up the employer and employee contributions which are paid into the plan and applying real interest rates to the accumulated fund. The fund is then used, on retirement, to buy an annuity—which will yield a stream of earnings until death. Most group personal and stakeholder pensions are similar 'money purchase' schemes. The distinction between DB (and SERPS) and DC is important: DB and SERPS are practically risk sharing arrangements where the employer (or state) bears most of the risk to fund pensions. Employees are left with the risk of scheme closure or bankruptcy (for instance like in the Maxwell pension scandal).[9] In contrast, the employee bears the entire investment risk of his or her individual pension fund in money purchase schemes. In the following analysis we ignore the difference in 'investment risk' between schemes.

The data requirements to calculate the TR level for the average public versus. private sector pensioner are exacting. Ideally, they would require us to know all of the lifetime earnings for the individual as well as contribution rate information. We will need to assume that the life cycle earnings profile can be approximated by looking at the cross section age earnings profile for the most recent cohorts for whom we have data. However it should be understood that this is not the same as a true lifetime earnings profile.

[8] Public sector pension systems are subject to reforms in recent years, but most of them are only phased in now or in the future, so these reforms do not distort our comparison for those who are already members of a scheme today.

[9] The Pension Protection Fund is partially compensating for pension scheme bankruptcy. Since its establishment in April 2005, the PPF has taken over 177 schemes with around 50,000 members (as of August 2010 (see also http://www.pensionprotectionfund.org.uk)).

The total value of a person's wage payment at time (or age) *t* (including pension) is:

$$w_t(1 - e_t - N) + \ CP_t^{\mathrm{K}} \qquad (1)$$

where: w_t is wage at time *t*, e_t is the rate of employee contribution to pension at time *t*, N is the rate of National Insurance and other statutory stoppages and CP_t is the present discounted value of accumulated pension rights at point *t*.[10] Let the K superscript denote whether a person is in a DB scheme, a DC scheme or the State Earnings Related Pension (SERPS) scheme—a brief overview of pension schemes is given in Table A1 of the Appendix. We take the perspective of a representative individual in each of the sectors and assume for simplicity that the fraction of private and public sector workers in BD, DC schemes and SERPS accords to the overall membership fractions in each sector. Hence the average Total Reward function for the both sectors is computed as a weighted average of workers in the DB and DC schemes as well as SERPS, averaged over the period 1997 to 2009.[11]

Assuming a person is in a DB pension scheme which is based on terminal salary value at time *T*, then the accumulated value of such a pension up to time *t*, CP_t is:

$$CP_t^{DB} = \sum_{t=T}^{T+D_1} \delta^t \gamma \ell w_T \ + \sum_{t=D_1}^{D_1+D_2} \frac{1}{2} \delta^t \gamma \ell w_T \ + \sum_{t=65}^{65+D_1} \delta^t SP_t + \ \delta^t \beta \gamma w_T \qquad (2)$$

where: D_1 is the person's year of death[12,13], D_2 is the partner's year of death, δ is the discount rate, SP_t is the level of State Pension at time t, γ is the cumulated years in the scheme, ℓ is the loading of the scheme and the last term in equation (2) is the lump sum paid in most DB schemes where β is the lump sum fraction. As the lump sum payment is tax-free, we recomputed its hypothetical value as if it was gross before tax; the applicable income tax rate is 20 percent, as annual pension incomes of our typical pensioners fall below the higher rate cut-off at GBP 37,400 (as of 2009/2010). It should be noted that the terminal salary is the best out of the previous three years, which is the standard rule in most DB

[10] We abstract here from the issue of pension indexation (for a sector comparison, see Pesando, 1984).

[11] Public sector enrollment comprises 90.1% DB, 2.5% DC and 6.3% SERPS, while the corresponding private sector numbers are 31.4%, 31.4% and 36.2% (Figures A9 and A10).

[12] We assume that a partner's pension would start instantly from the time of death of a spouse.

[13] For the time being we assume that there is no difference in the longevity of public or private sector workers. Life expectancies are gender-specific cohort values that are up-rated by a premium fraction for social class I and II. We intend to investigate this using occupation specific mortality rates in the future.

schemes.[14] The basic State Pension becomes payable in full after 30 qualifying years; below this threshold, every year pays 1/30th of the full entitlement.[15]

Now consider the person who pays into a DC scheme. Their accumulated value of their pension at year *t*, will be:

$$CP_t^{DC} = \sum_{t=T}^{T+D_1} \delta^t \varrho \left[\sum_{r=1}^{R} [e_t + m_t] w_t \{1+x\}^R \right] + \sum_{t=65}^{65+D_1} \delta^t SP_t \qquad (3)$$

where: D_1 is the person's year of death, e_t is the rate of employee contribution to pension at time *t*, m_t is the rate of employer contribution to pension at time *t*, ϱ is the sex specific indexed annuity rate, δ is the discount rate, SP_t is the level of State Pension at time *t*, *r* is the index for the number of years worked from 1 to R, and *x* is the real annual rate of return on the investment income derived from the DC pension contributions. It is assumed that members of a DC scheme take out their contract at age 21 and will buy an annuity at age 60. At this age, they are entitled to draw 25 percent of their final transfer value as a tax-free lump sum. The remaining three quarters of the fund buy an annuity which is assumed to be the second best open market gender-specific annuity available at the market.[16] To reduce further complications, we assume that members are non-smokers and that all annuities are single-life products in levels without guarantee term. The mechanism behind the calculation of the NPV of DC pension income is set out in Table A2 and Table A3 in the Appendix for men and women separately. The ratio of the NPV of the pension stream over the value of the annuity is very close to 1, but women's pension stream seems to earn them some returns from buying the annuity. This could be due to the fact that we are assuming 'single' contracts for married women (in order to reduce complexity); pension providers might assume shorter life expectancies for single women thus providing them with slightly higher returns.

[14] In our computations, this rule applies from age 23.

[15] The number of qualifying years was reduced to 30 on the 6th April 2010. Earlier, and for persons born before 6 April 1945 (men) and 6 April 1950 (women), 44 (men) and 39 (women) years were required.

[16] The fund value is rounded to the nearest pound. Annuity rates change over time. The values taken here are as of September 2010. The annuity tables are taken from the Consumer Financial Education Body (http://www.moneymadeclear.org.uk/tables/bespoke/Annuities).

For an employee who has not contracted out of the compulsory state earnings-related pension, we value the pension in the following way:[17]

$$CP_t^{SERPS} = \sum_{t=T}^{T+D_1} \delta^t \chi_{Tt} \frac{Y_T}{Y_t} \{\widetilde{W}_t - LEL_t\} + \sum_{t=65}^{65+D_1} \delta^t SP_t \qquad (4)$$

where $\widetilde{W}_t = \max(w_t, UEL_t)$

Y_T/Y_t gives the indexation used for revaluing earnings below the upper earnings limit (*UEL*) to the retirement year (everything in 2009 values). *LEL* stands for the lower earnings limit which was GBP 5,044 per year in 2009. The expression in brackets gives the net earnings value that is multiplied by the accrual factor χ and summed over all contribution years.

Due to the complexities of the UK pension system we have to make some (non-crucial) simplifying assumptions in order to perform our calculations of work related pensions:[18] Both DB and DC pension holders are assumed to draw their pension at age 60, while the state pensions (SP and SERPS) can be drawn at the normal retirement age of 65 (Banks and Smith, 2006).[19] The pattern of retirement ages does not differ significantly across sectors as revealed by a non-parametric Kolmogorov-Smirnov distribution test[20]—see Figures A11 and A12.[21] Given our focus on the highly educated we assume that both the public and the private sector person have the same entitlement to the state pension. The generosity of the pension benefits depends on some measure of personal earnings in DB schemes. The accrual fraction is assumed to be 1/60th in private sector DB schemes and 1/80th in public sector DB

[17] Here, we abstract from the fact that SERPS was introduced only in 1978 and that new entrants to the Second Tier State Pension enrolled in the S2P from 2002 on. We set the accrual factor to 0.2 for 69 percent of years and 0.25 for the remaining working years in order to reflect the reduction in accrual factors in 1988. We have to make this simplification because there is no suitable large scale data source following individuals' pension membership histories over time. We believe the introduction of S2P does not cause any substantial bias as the change from SERPS to S2P was meant to support low income earners, while the pension generosity for the highly educated has changed only marginally.

[18] We assume away additional personal pension plans or other savings policies.

[19] Everybody is assumed to retire at age 60 and we ignore the possiblity of working at later ages. For evidence on working beyond the retirement age in the UK, see Meadows (2006).

[20] The Kolmogorov-Smirnov test investigates the hypothesis that the public and private sector retirement age distributions are not significantly different. The p-value of the test statistics for the combined test is 0.253 for men and 0.231 for women. Also, all one-sided tests cannot reject equality.

[21] In money purchase schemes, there is no official earliest pension draw age, so accruals could theoretically be used to buy an annuity at any age. State pension rights are accumulated through the payment of NI contributions and pensions become available after a minimum of 30 years with NI contributions.

schemes.[22] Public sector DB schemes are assumed to provide 3/80th lump sum per year of tenure, and the private sector DB schemes are assumed not to provide a lump sum payment. All DB schemes and SERPS are assumed to have a payment for the surviving spouse of half of the pension entitlement. Survivor's benefits are only valued for men, as their spouses life statistically longer.[23] A comparison of our parameter assumptions with those made in papers that evaluate pension schemes (Leslie, 2008; Disney et al., 2009) is given in Table A4 in the Appendix.

Now we can add in the other components to Total Reward. Let the person in question work a different number of hours per year. If we now assume that the wage rate given above is an hourly wage rate then we can write the total pay equation from (1) as:

$$H\{w_t(1 - e_t - N)\} + CP_t^K \tag{5}$$

where *H* is the average total hours worked per year.

Now adding in the value of benefits in kind, paid holidays and health insurance—denoted BK_t, as well as the possibility that the person in question could be made unemployed at any time *t*, the value of Current Total Reward (CTR) is:

$$CTR_t = E_t[H\{w_t(1 - e_t - N)\} + BK_t] + E_t\, CP_t^{\mathrm{K}} \tag{6}$$

where E_t is the probability of remaining in employment at time *t*.

We now finally define what we mean by Total Reward. We suggest that Total Reward at each given age τ, should comprise *accumulated* earnings up to that time plus the *accumulated* wealth of a pension scheme (up to each given age τ), evaluated from the career start (t=21). So we can define the Accumulated Lifetime Total Reward (ALTR) in money terms at age τ as:

$$ALTR_\tau = \sum_{t=21}^{\tau} \delta_{21}\, E_t[H\{w_t(1 - e_t - N)\} + BK_t] + \delta_{21}\, E_t\, CP_t^{\mathrm{K}} \tag{7}$$

[22] 1/80th accrual fraction was applicable in the NHS, Teacher and Local Government Pension Schemes before the pension reforms in 2007 and 2008 (Steventon, 2008). As the changes applied only to new entrants, our estimates reflect the actual situation for most employees quite realistically.

[23] We assume there is no difference between the marriage behaviour or longevity of the spouses in the public and private sector.

At this point[24], some caveats of our analysis have to be kept in mind: First, our entire analysis is based on a gross evaluation rather than a net of taxes calculation. (Despite the fact that taxes play an important role in employers' decisions which benefits to provide (Rosen, 1986).) We chose to base our calculations on gross valuations since all DB final salary calculations use these gross valuations and also because in calculating ALTR the tax regime is the same for both public and private sectors. While the relevant cost category for an employer is the Total Reward of a worker, the tax preferential treatment of many fringe benefits (e.g., pensions) induces a trade-off between earnings and benefits from the employee's perspective. Second, a central theme in the literature on compensating differentials concerns union membership, a topic that is entirely omitted from our analysis. Unions may have a direct impact on pay and working conditions and thus potentially affect the level and composition of Total Reward. Third, for data reasons our analysis excludes several numerous groups, like the self-employed—most notably for the public sector GPs. The data also exclude the Armed Forces and least earning individuals who do not pay any NI contributions.[25] The latter, however, is of little relevance given that we focus our estimation on higher educated employees. In subsequent research we plan to use these data to analyse various distinct occupations with a large enough sample to be meaningful. For the purpose of outlining the concept of TR we focus on the public and private sectors as two large groups. This perspective comes closest to the current policy debate. Also note that we use the ONS official definition of the public sector which omits certain key groups who are paid from tax income—like university lecturers, FE lecturers and teachers in some schools. Fourth, at present we do not evaluate the monetary value of other conditions of work like: stress, control over time, autonomy, flexibility, work pressure and other working conditions.

We make no attempt to control for women's participation decision across the life cycle. Clearly one reason for the marked decline in women's earnings in the second half of the life cycle in the private sector is that many women take time out of the labour market for family reasons. As a result there may be depreciation in their human capital and they may suffer loss of career advancement for internal labour market reasons. We abstract from these issues by simply focusing on women who are working full time.

[24] Note that it would be fairly straightforward to rewrite ALTR in terms of utility – by recasting the calculation in terms of financial reward per hour and making some assumption about the trade off between labour and leisure.

[25] Employees who do not pay any NI contributions are not sampled in ASHE. Beyond that threshold, the representativity of ASHE with respect to low-income earners has been substantially improved (Ormerod and Ritchie, 2007).

No provision is made for the fact that higher earnings early in the working life in one sector may increase private savings and asset accumulation. While we acknowledge that the timing of remuneration over the working life may differ between sectors and thus influence individual wealth, we ignore this fact because our principal interest rests on work-related remuneration. We are also implicitly ignoring the possibility that state investment (in human capital terms, for instance) is different between public and private sectors.

A final caveat is the treatment of diverse kinds of risks (for a detailed analysis in the pension context see Blake, 2006). Attitudes towards risk (risk aversion) and time preferences (discount factor) may differ between public and private sector employees.[26] Furthermore, the risk associated with being a member of either a DB or a DC scheme (bankruptcy risk, interest risk) may differ. Up to this point we are assuming constant discount rates across both sectors and ignoring potential differences in the other risk components.

3. Data

Data requirements for this research are high: For a careful comparison of Total Reward schemes we need four kinds of information: age-earnings profiles, employer and employee pension contributions, working conditions (unemployment risk and working hours) as well as detailed knowledge of monetary and non-monetary fringe benefits. The analysis will be based on the comparison of highly educated public and private sector full time employees aged 21 to 59 years in age-gender-region cells (see the data section in the Appendix).

For the estimation of the age-earnings profiles we use the ASHE data which contain highly reliable employer reported earnings information. Earnings of private and public sector employees are taken as hourly pay data from the ASHE (1997-2009)—where the bonus pay of private sector employees is included. As educational information is missing in ASHE, we map the age specific education-occupation matrix developed by Dolton, Makepeace and Marcenaro-Gutierrez (2010) into the data. We

[26] For instance, deferred compensation might be used to specifically attract workers with low discount rates (Lumsdaine and Mitchell, 1999).

follow Disney et al. (2009) in estimating these profiles net of sector-specific average earnings growth[27] and in real terms (2009 gross values) using median regressions.

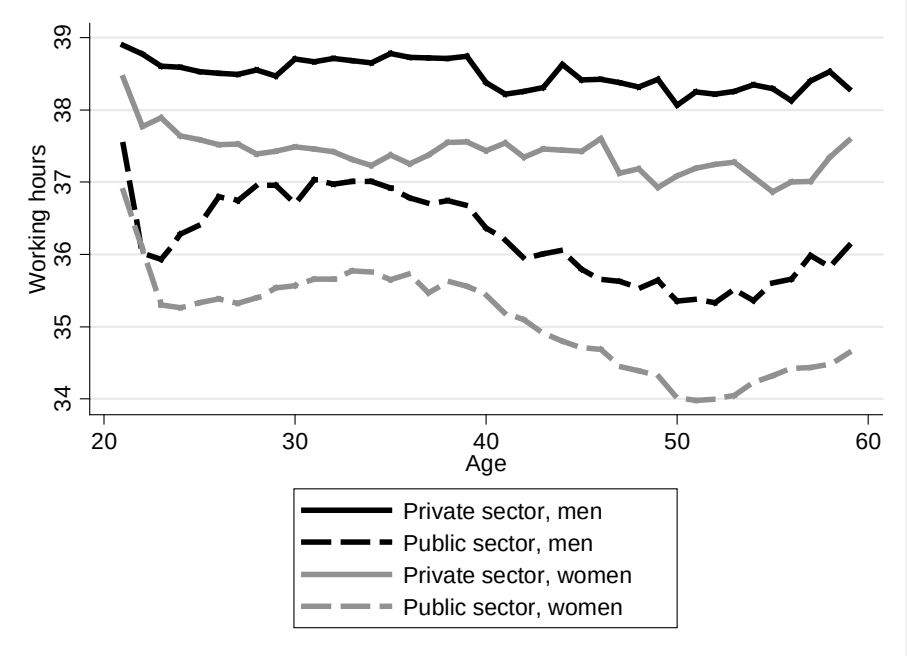
For consistency reasons, we use employer-reported working hours in our analysis.[28] As a general observation, the number of working hours is substantially higher in the private sector. While men work on average 38 to 39 hours, their public sector counterparts work on average 35.5 to 37 hours per week, with some substantial variation over the life cycle (Figure 2). The overall pattern of working hours profiles of women is very similar, with on average one hour less of work. It should be noted that we are considering only full-time employees.[29] Employee-reported working hours (available from the LFS) are substantially larger, especially for public sector employees, who claim to work on average three (women) to four (men) hours more than reported by their employers (see Figure A5 in the Appendix). The overall lifetime working time pattern with a reduction in working hours at older ages for public sector employees is similar in the LFS and ASHE data. Therefore, the presented Total Reward results are not sensitive to the use of the measure of working hours.

[27] This annual growth ranges from minus 1.94 percent in the private sector in the crisis year 2008/09 to plus 4.84 percent in the private sector in 2000/01.

[28] A further amendment in the future might be to include unpaid overtime work as part of the cost of working.

[29] The full-time information is reported by the employer and the hours reported in the ASHE data range between 25 and 99. Observations with working hours above 100 were removed from the sample rather than imputed. This procedure led to an exclusion of 0.01 percent of observations.

Figure 2: OLS regression estimation of actual working hours, 1997-2009



Note: Actual working hours are paid working hours as reported by the employer. Hours range from 25 to 100 (cutoff; no outlier treatment for those reporting more than 100 hours). Source: ASHE 1997 to 2009 (ONS), own calculations.

Crucial data for the computation of pension wealth are pension membership, scheme parameters (reviewed below), pension contributions and scheme tenure. The ASHE data provides information on membership in a range of occupational pensions as well as pension contribution rates paid on behalf of the employer and the employee (contribution rates are only available for the years 2005-2009). The previous literature has often assumed sector-specific constant rates for pension contributions. We account for a substantial difference in pension contribution across sectors and across the life cycle by using employer-provided information on employer and employee contributions to different pension schemes in both sectors. Employers normally pay National Insurance Contributions (NIC) on behalf of their employees. In exchange for these NIC, pension entitlements to the state pension are generated. If an employee chooses to join an occupational pension scheme (independently of whether this is a DB or money purchase scheme), NIC can be reduced (contracting-out). In a way, NIC are traded for contributions to the occupational pension scheme. While employer contributions for most occupational pension schemes are at 14 percent and employee contributions at 6 percent in the public sector,

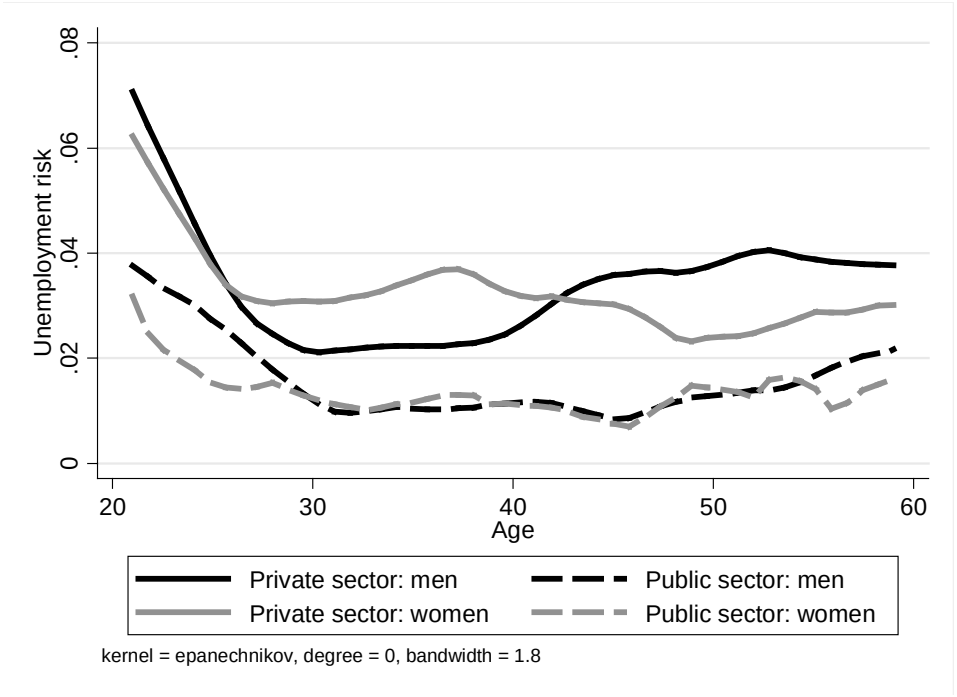
contributions vary substantially in the private sector.[30] Private sector employer contributions are very low at young ages (around 5 percent) and rise up to 14 percent. Employees contribute on average 4 to 6 percent of their pensionable pay (Figures A6 and A7).

We do not make any explicit assumptions about job and pension scheme tenure, but assume that individuals remain a member of their current scheme throughout their entire active working life. Rather than taking tenure membership from the data (in a continuously changing pension system), we prefer allowing for career breaks by adjusting age-earnings profiles by the probability of unemployment.[31] Unemployment risk is derived from the five-quarterly longitudinal LFS files, and is defined as the risk of switching from employment to unemployment status (ILO definition) between the first and any of the following four quarters. Differences in unemployment risk are important in the valuation of Total Reward as spells of unemployment provide no work remuneration and produce gaps in the contribution histories to pension schemes. This said, it is important to note that unemployment affects different pension schemes differently. For instance, an unemployment spell reduces a DC pension through lower overall contributions, while it lowers a DB pension through lower earnings and lower scheme tenure. In our analysis, we account for these complexities by treating all pension schemes separately. Conventional wisdom holds that employment relations in the private sector are less stable compared to the public sector. This notion has also received support from recent research (Cappellari, 2002). Using LFS longitudinal data, Figure 3 further confirms this result. Unemployment risk in the private sector is substantially higher than in the public sector. Also, while the risk of becoming unemployed within the consecutive year is—with the exception of the early twenties—stably low in the public sector (around 1 percent), it is substantial at very young ages (6 to 7 percent) and from 45 years onwards (4 percent) in the private sector.

[30] The rate of 6 percent applies for the NHS, Teachers' and Local Government Pension Schemes. The two smaller Police and Fire schemes have a rate of 11 percent, while the Civil Service has 3.5 percent. Between 2006 and 2008 there were reforms to the contribution rates of new entrants, which are ignored here.

[31] As Disney and Whitehouse (1996) have shown, expected scheme tenure is one of the most important determinants for valuing total accruals.

Figure 3: Non-parametric kernel estimation of forward-looking unemployment risk



Note: Unemployment risk is defined as the probability of a status change from employed (quarter 1) to ILO unemployed in the prospective four quarters. Source: Pooled five year longitudinal LFS from 1997:Q1 to 2009:Q1, own calculations.

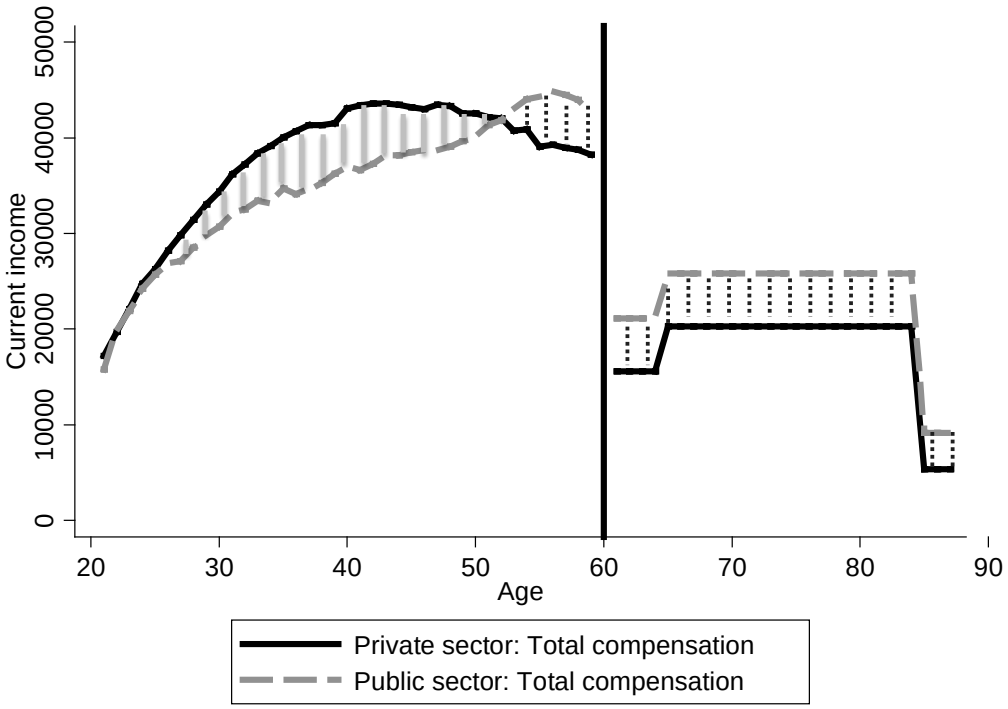
Regarding benefits in kind we evaluate employer provided health insurance by the fraction of employees within the private and public sector who report to hold a private health insurance that has been paid for by the employer. The ELSA survey collects information on full private health insurance cover, e.g. BUPA (not additional dental or friendly health plans), for those aged 50 and above. Since the sample sizes are small we first map occupation specific sector affiliations from ASHE into ELSA and then pool all observations irrespective of age and gender (and ignoring educational levels). Twelve percent of public sector employees do have private health insurance cover, while 27 percent of private sector workers do. Of those who do have private health insurance cover in their own name, 2.3 percent in the public sector (N=299) say it is paid for by the employer, while 4.7 percent of private sector workers (N=553) do receive a private health insurance from their employer. It seems that the plans for private workers are more generous (222.9 GBP as of 2009) than for public workers (141.7 GBP as of 2009). Information on paid holidays is retrieved from the quarterly LFS (2005-2008). In addition to fixed number of public holidays, employers offer a varying number of paid holidays. There are substantial differences between public and private sector employees (Figure A8): While the former enjoy 30 to 35

paid holidays, the latter are limited to 20 to 27 holidays. The entitlement of paid holidays increases with age in both sectors. Paid holidays are valued at the daily wage rate.

4. Evaluating Total Reward

The main challenge of this paper lies in the measurement of Total Reward.[32] In order to make the Total Reward package comparable across sectors, we limit our analysis to men and women with higher education or a degree. We do this for several reasons. Firstly, because a high fraction of the less well educated do not have occupational pensions schemes; secondly, because previous analysis for the less well educated shows that such a comparison is relatively uninteresting as public sector wages dominate comparable private sector earnings over the whole life cycle and thirdly because this comparison of the highly educated is really where most of the media attention has focussed on.

Figure 4: Illustration of Total Reward differences between public and private sector



Note: This profile is for illustration purposes only. Data for men. Lump-sums are re-annuitized in order to reduce kinks in the figure. State pensions are payable from age 65. Men die at age 84; between 85 and 87, some pension schemes pay survivor benefits. Own calculations.

[32] We evaluate Total Reward in terms of money and so assume that each person has a utility function which is linear in money and is not risk averse.

Figure 4 illustrates the general idea of Total Reward. The figure shows real annual remuneration for public (dashed) and private sector (solid) males from career start to death. This income measure comprises earnings, benefits and pensions. While the two curves start off quite similar at age 21, private sector employees soon develop an income advantage of roughly 5,000 GBP per year which persists almost up to the age of 50. From age 53 onwards, public sector males are better off, including during their retirement age.[33] In order to study which sector rewards its employees better, one has to compare the excess areas which are highlighted by two different shadings. Of central interest is the question how much *present value* an individual can generate from employment over the life cycle. We therefore suggest that Total Reward at each given age τ, should comprises *accumulated* earnings plus the *accumulated* wealth of a pension scheme (up to each given age τ), evaluated from the career start (t=21).[34] This approach has previously been considered for the analysis of career choices (Willis and Rosen, 1979; Dolton, 1990; Leslie, 2008). We call the measure which makes entire compensation careers comparable across different sectors or occupations Accumulated Lifetime Total Reward (ALTR).[35] We consider ALTR as a sorting device into different economic sectors and thus hope to shed light on the incentive mechanism through which workers self-select into specific occupations and sectors. The existing literature either focuses on earnings potentials and self-selection into specific occupations (e.g. Dolton, 1990) or the public sector as a whole (e.g. Disney and Gosling, 1998). The current research attempts to provide a more comprehensive evaluation based on Total Reward while analyzing the public and private sectors as a whole.

Our ultimate goal is to provide an empirical estimate of Total Reward at any given age and to compare employees in the public and private sector. The valuation of different Total Reward components suggests that private sector workers have lower pension contributions, fewer and less valuable fringe benefits and harsher employment risks. Evidence on earnings is rather mixed with an apparent dominance of the private sector earnings profile at mid-career and a clear advantage of public sector employees at

[33] It should be noted that this does not imply an optimal switching point from the private to the public sector. The reason is that a switching employee would most likely not receive the counterfactual earnings. Also, the portability of fringe benefits across sectors is probably limited (cp. Mitchell, 1982). We plan to address the question of sector switching in our future research.

[34] It is possible to evaluate ALTR at any age. As long as future years are discounted by the same rate as past years are uprated, the relative position of the two sectors will remain unaffected; the absolute level of Total Reward will obviously change.

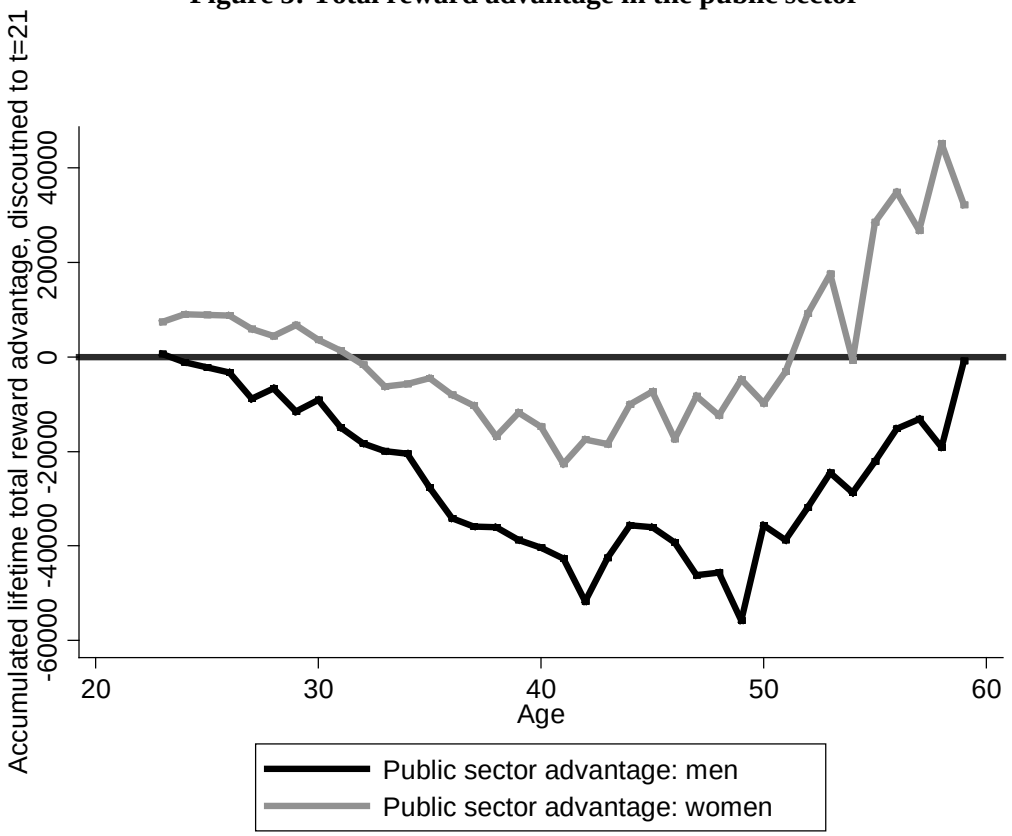
[35] While ALTR is a concept that compares the current stock of earnings and pension wealth, it is also possible to employ a flow version, in terms of changes in accrual values. This can be informative about the gain from staying in employment or in a specific job for another year (on employees' retirement decisions see, e.g., Disney et al., 2009).

later stages of the working life. Private sector employees, however, work more hours per week implying potentially larger annual earnings throughout the entire working life. In order to value the Total Reward across sectors at every point in time (age), we add up all components as described earlier.

The value of benefits in kind as a fraction of annual earnings ranges between 15% in the private sector and 20% in the public sector. These shares are relatively stable over the life cycle indicating that benefit growth keeps pace with earnings growth. The effect of unemployment on aggregated pension wealth is increasing over the life cycle. While it accounts for a fifth of annual earnings at career start, the value of accumulated lost pension wealth adds to 80% of the final annual salary shortly before retirement.

When expressing the public sector Total Reward premium as the difference of public sector ALTR minus private sector ALTR in monetary values for men and women (Figure 5), we find that the monetary advantage from working in either sector at the career start is very close to the line of equality. This line is constructed such that the age specific difference in ALTR between sectors is zero. Up to the mid/late 40s, the Total Reward in the private sector is gaining an advantage in the order of magnitude of 60,000 GBP for men (10% of ALTR) and 20,000 GBP for women (5% of ALTR). At older ages, the gap is narrowing and women reach the point of equalised differences again at age 53 with growing public sector ALTR advantage until retirement. The discounted net present value of the public sector premium at age 59 for women is substantial—between 30,000 and 40,000 GBP (or 5% of their pre-retirement ALTR). For men, the situation is quite different: The large private sector gains are reduced until age 59, where ALTR for public and private sector men is exactly equal. Given the public perception of too generous public sector remuneration this finding is quite astonishing. Yet, it is in line with estimates across the distribution of earnings which suggest that there is a private sector advantage for employees at the upper deciles (Blackaby et al., 1999).

Figure 5: Total reward advantage in the public sector



Note: The profiles are constructed as the difference of public minus private sector Total Reward.
Source: Total Reward matched cell data set, own calculations.

As no data are available, assumptions were necessarily made about discount factors and real interest rates. Our choice of an interest rate of 2 percent has been based on the fact that expectable returns from financial market investments were falling over the past twenty years.[36] Other recent UK studies on pensions have also assumed such a low interest rate (Crawford et al., 2010). One might argue that older employees have enjoyed substantially higher interest rates over much of their working life, so that higher interest rates might apply. A rise in the interest rate obviously favours private sector employees more than public sector employees as DC schemes are virtually absent in the public sector.[37]

[36] Annuity rates have been falling since the 1970s as a consequence of low long term yields and the rise in longevity (cp. Cannon and Tonks, 2004).

[37] For some sensitivity checks on discount factors and interest rates see the Data Appendix.

5. Conclusions

This paper evaluates the Total Reward of highly educated employees in the public and private sector in the UK across the life cycle. It provides for the first time a comprehensive measure of various monetary and non-monetary work related benefits in addition to earnings and pension accruals. The analysis suggests that there is not equality of Total Reward profiles between the two sectors at every point in time. Yet, the Accumulated Lifetime Total Reward for men is equalised between public and private sectors over the life cycle suggesting that the private sector earnings advantage at younger ages is counterbalanced by the more generous benefits associated with public sector pension schemes. This result implies that male university graduates who choose employment in either of the two sectors based on their potential early career reward prospects might get a biased signal with respect to lifetime reward. Women seem to be better off in the public sector at almost any point of the life cycle profile. If workers in both sectors were exposed to similar levels of workplace disamenities (e.g., stress or mortality risk) our results would imply a too high compensation in the public sector for women but adequate public sector remuneration for highly educated men. We propose that this confirms a concept of life cycle compensating differentials and argue that the equalisation of remuneration differentials must be examined over the entire working life. Taken together our results imply that it is possible to achieve a 'lifetime equalising difference in Total Reward' which balances the early career advantage of being in the private sector by the long run advantage of being in the public sector later in the career. Indeed this balance means that although the 'spot evaluation' of Total Reward is almost always different in the public and private sector there is a balance and an equalising difference in lifetime Total Reward.

The paper also stresses the importance of benefits in kind and the role of workload in the valuation in Total Reward. While a substantial literature deals with pensions as part of work-related remuneration, fringe-benefits, working hours and unemployment risk have not been studied comprehensively. Our results suggest that these employment aspects are economically important, and again more valuable in the public than in the private sector. Such a conclusion means that any discussion of public/private sector pay differentials or public/private sector pension differences is really inappropriate considered in isolation. What should be considered is Total Reward in the two sectors as measured over the lifecycle.

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Appendices – Not intended for publication

Data Appendix – Not for publication

Data sets used:

We use the maximum number of available quarterly LFS data and pool them for obtaining measures of the following variables:

- Public holiday entitlement: October to December quarters from 2005 to 2008.
- For the computation of unemployment rates (ILO definition), we exploit the pooled five-quarterly short panels of the LFS from 1997:Q1 to 2009:Q1 (with the exception of 2005:Q3 and 2008:Q4, in both of which the information on economic activity status is missing). Unemployment risk is defined as the probability to move from dependent employment in quarter one to unemployment in one of the subsequent four quarters.

In order to estimate age-earnings profiles, the most reliable (employer-reported) earnings data are in the Annual Survey of Hours and Earnings (ASHE), of which we use the years 1997 to 2009. The ASHE data have two structural breaks, in 2004 and 2006, two years for which an old and a new data version exist. For the computations we used the new version (best compatible with subsequent years) for both years. In the years 2007 and 2008 the sample size was reduced by 20 percent, but in 2009, the previous sample size of 1 percent of all employees with National Insurance Contributions was restored (Summary Quality Report for ASHE: 4). Our earnings measure includes bonus payments.

In ASHE, employers report employer and employee pension contributions alongside the pensionable pay. From this information, it is straightforward to compute the pension contribution rates on behalf of the employer and the employee. Age-earnings profiles are deflated to the base year 2009 and are computed after netting out annual average sector growth (cp. Disney et al., 2009).

To compute retirement ages by sectors, we pool all four available waves from the English Longitudinal Survey of Ageing (ELSA) and the waves G (1997) to Q (2007) from the British Household Panel Survey (BHPS). In the BHPS, public vs. private sector affiliation is reported by the respondents. As sector affiliation is missing in the ELSA data, we mapped sectors according to occupations. For occupations that have more than 75 percent public sector affiliation in ASHE, we coded the entire occupation in ELSA as public, while we coded occupations with more than 75 percent private sector

workers in ASHE as entirely private in ELSA. Occupations that were more equally distributed between sectors were omitted from the ELSA sample.

Similarly, employer-sponsored health insurance plans were retrieved from ELSA. It should be noted that these data sample only individuals aged 50 and above.

Sample:

The target sample for our valuation exercise are full-time employed men and women, aged 21 to 59 with high education (degree or with higher education below degree but above A-level). The public and private sector definition is according to the ONS.

Sensitivity analysis for discount factors δ and real interest rates x:

Discount factor	Interest rate	Men Age at equalised ALTR	Men Public sector ALTR premium at retirement	Women Age at equalised ALTR	Women Public sector ALTR premium at retirement
3%	2%	59	0.0%	52	4.3%
3%	3%	(-)	-0.1%	52	3.8%
3%	4%	(-)	-1.3%	55	3.0%
2%	2%	56	2.3%	49	6.9%
2%	3%	59	1.6%	51	6.2%
2%	4%	59	0.7%	52	5.3%
4%	2%	(-)	-1.9%	52	2.6%
4%	3%	(-)	-2.4%	55	1.9%
4%	4%	(-)	-2.9%	55	1.3%

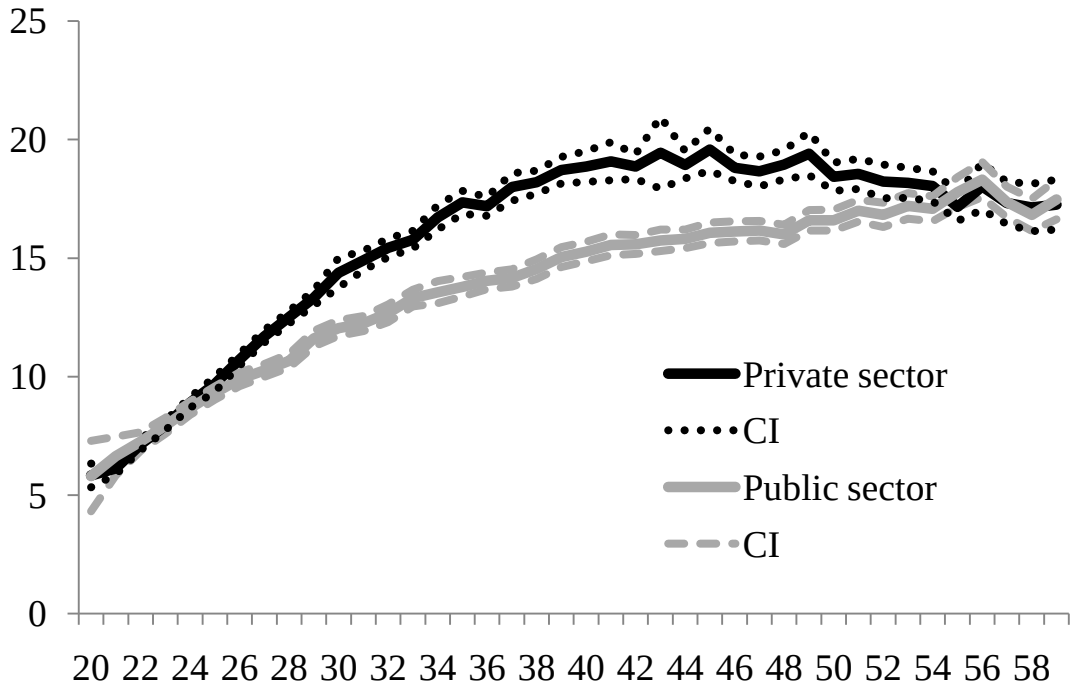
Note: The minus symbol indicates that the public sector ALTR is always below private sector ALTR. Source: Total Reward matched cell data set, own calculations.

As we are continuously assuming the same parameters for public and private sector employees, a manipulation of the discount rate only affects the relative weight of future pension income in today's Total Reward. A lower discount rate favours the public sector as it gives more relative weight to pensions which are more generous in the public sector. Overall, the manipulation of discount and interest rates does not change our general findings of roughly equalised ALTR over the life cycle for men and a public sector ALTR premium for women.

Figure A1: Hourly pay, LFS data, smoothed by local polynomial

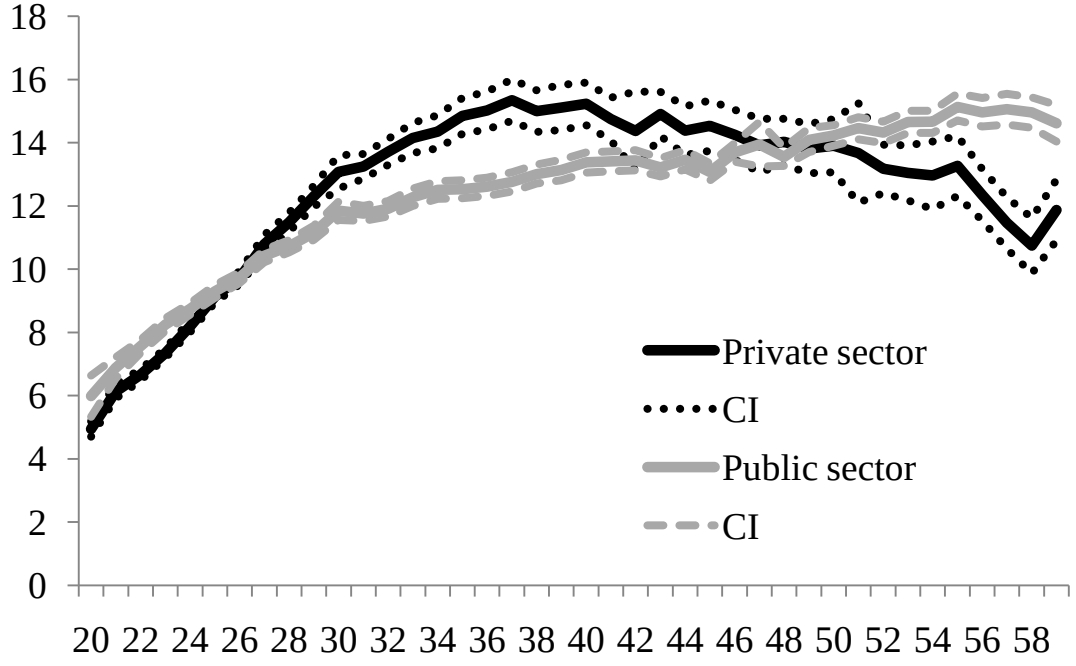
Source: LFS, own calculations.

Figure A2: Mean age-earnings profile with 95% confidence interval, men, LFS



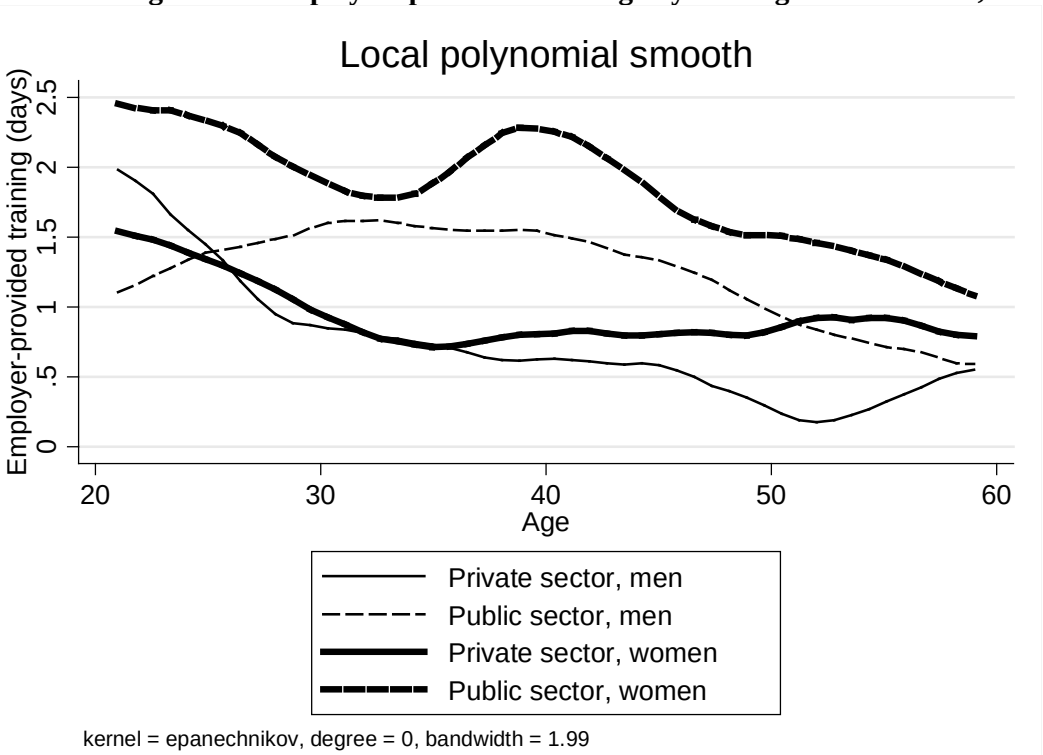
Source: LFS, own calculations.

Figure A3: Mean age-earnings profile with 95% confidence interval, women, LFS



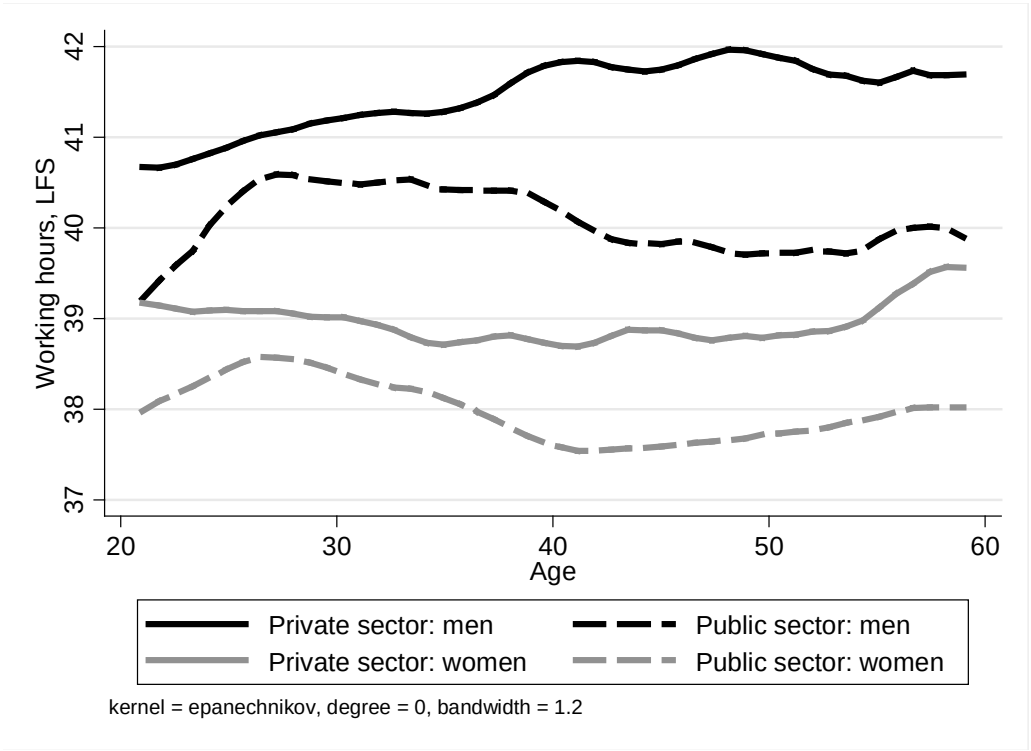
Source: LFS, own calculations.

Figure A4: Employer sponsored training days during last 12 months, 2000-2009



Note: Nonparametric kernel estimates. Values relate to previous 12 months. Training days are self-reported in time brackets and time brackets were replaced by middle values. Maximal training duration is one year (365) minus weekends (104) minus number of public holidays (8) minus paid holiday entitlement in the public and private sector. Source: LFS Q1 2000-2009 and Q2 2005-2009, own calculations.

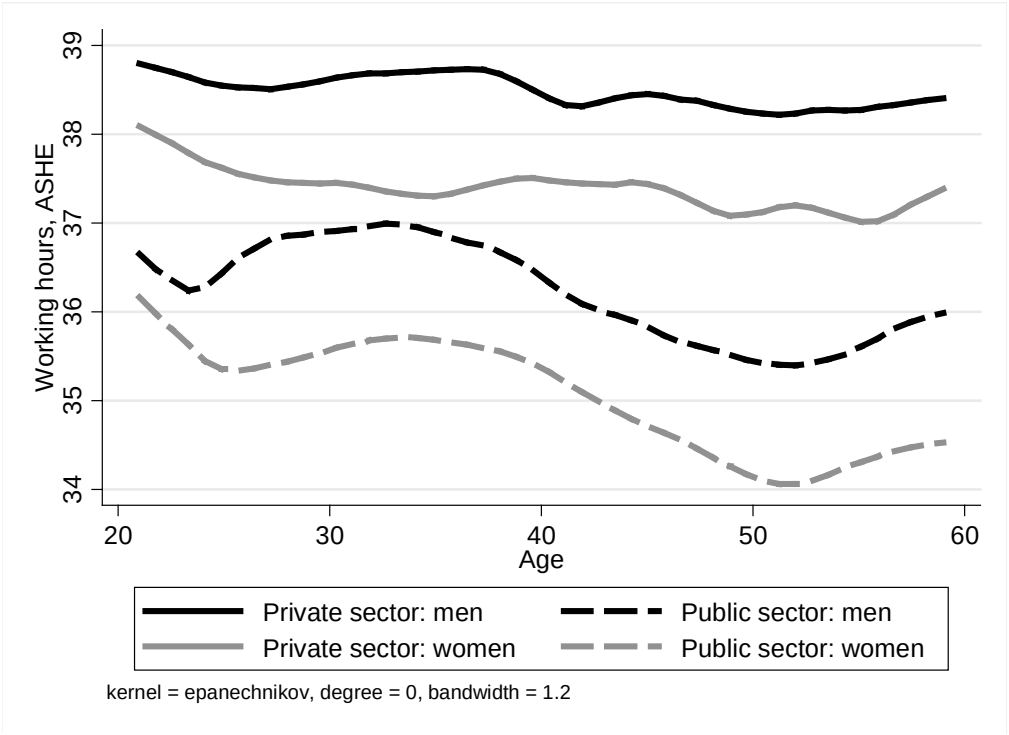
Figure A5: Working hours per week, LFS data, smoothed by local polynomial



Source: LFS, own calculations.

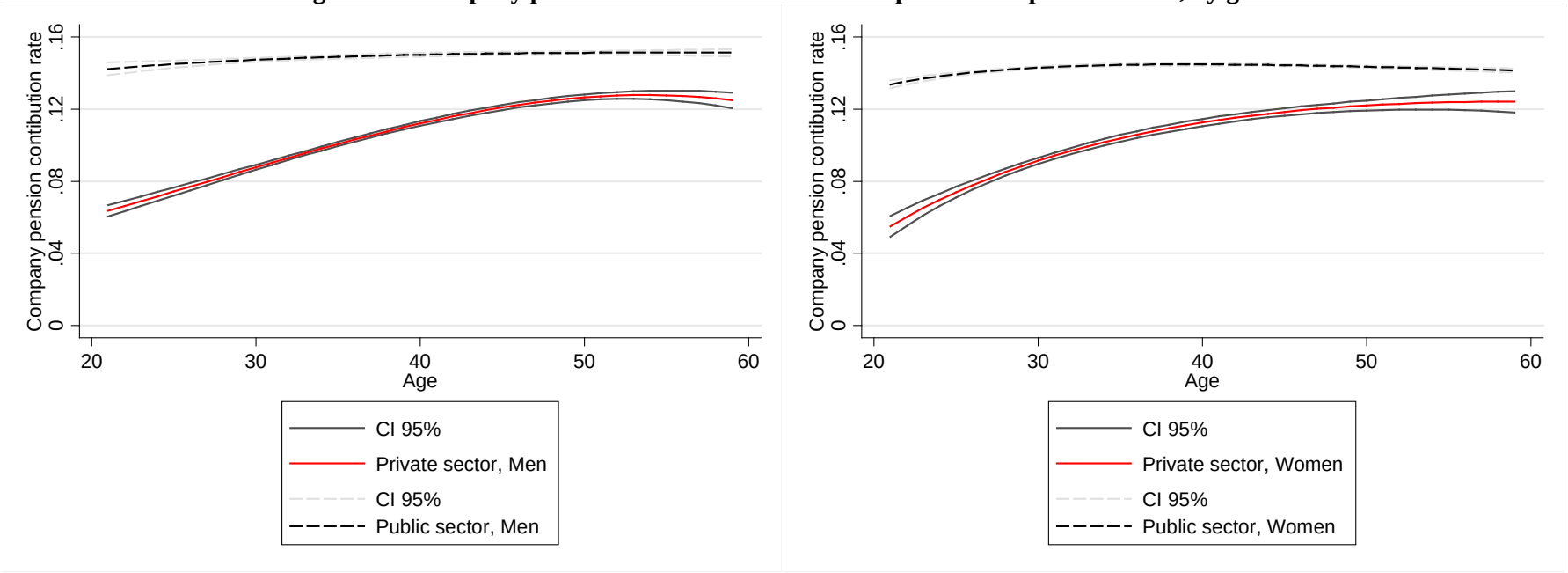
For comparison: Working hours per week, ASHE data, smoothed by local polynomial

[Replication of Figure 2]



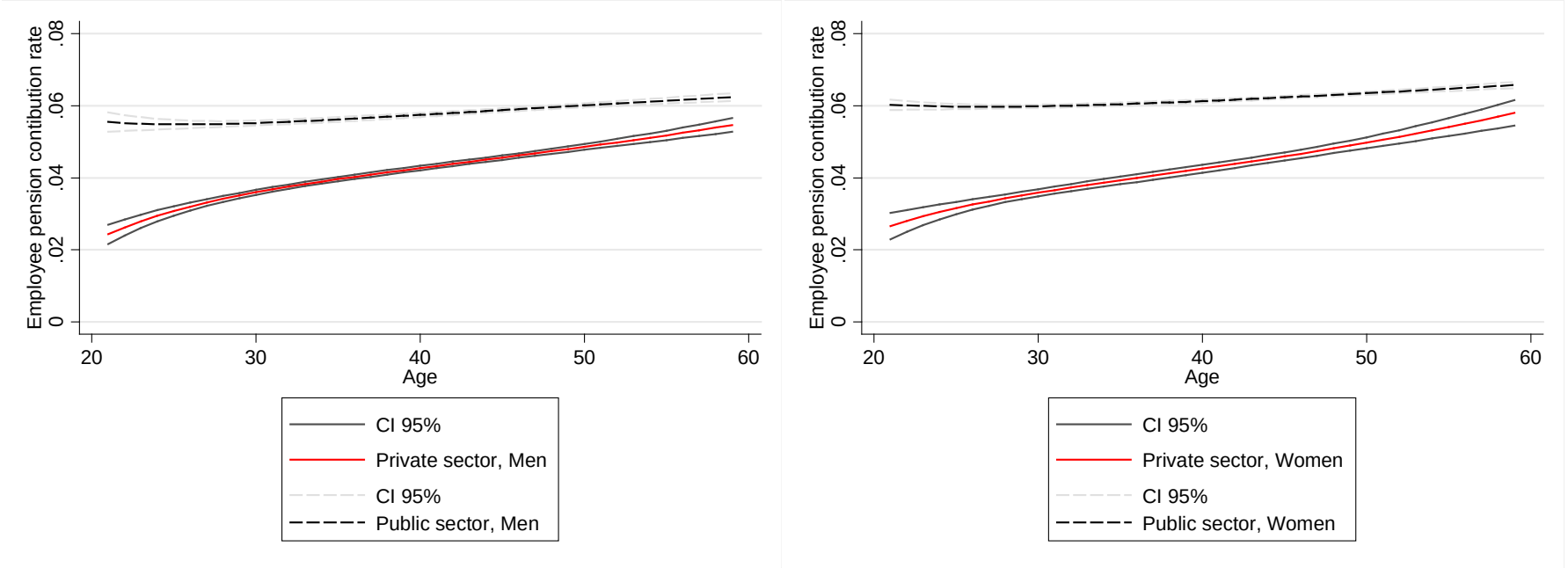
Source: ASHE (ONS), own calculations.

Figure A6: Company pension contribution rates in the private and public sectors, by gender



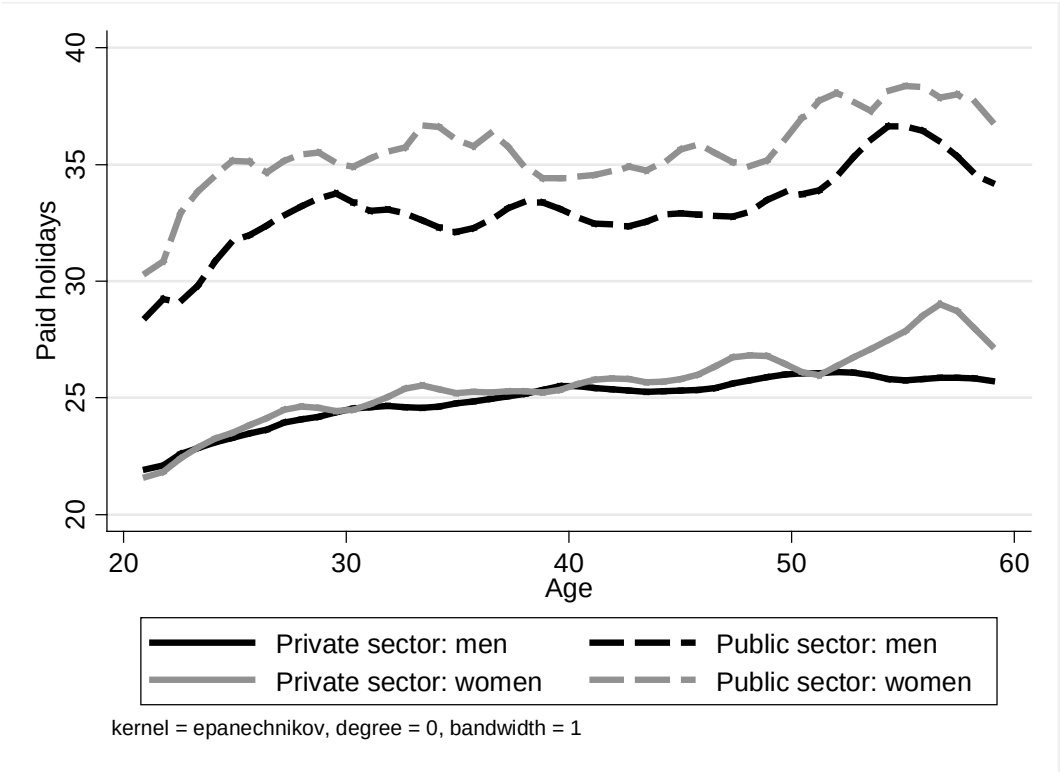
Note: Estimates are windsorised at 100% of gross pay. Source: ASHE 2005-2009 (ONS), own calculations.

Figure A7: Employee pension contribution rates in the private and public sectors, by gender



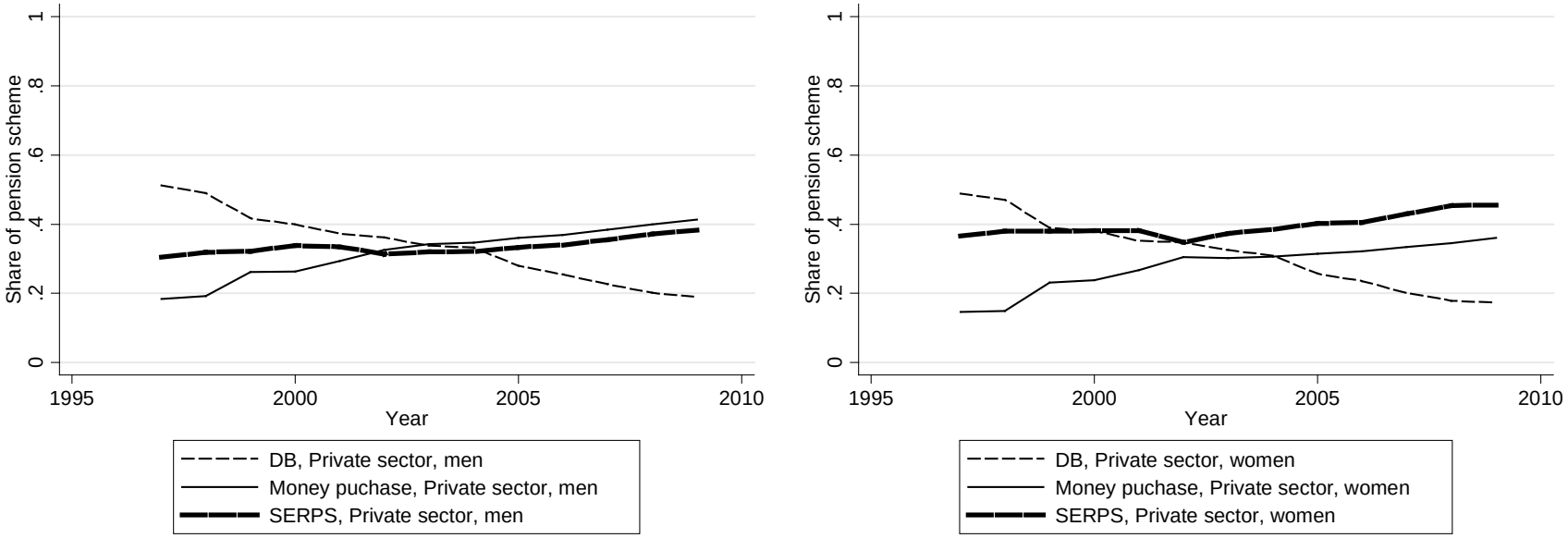
Note: Estimates are windsorised at 100% of gross pay. Source: ASHE 2005-2009 (ONS), own calculations.

Figure A8: Non-parametric kernel estimation of paid holiday entitlement, 2005-2008



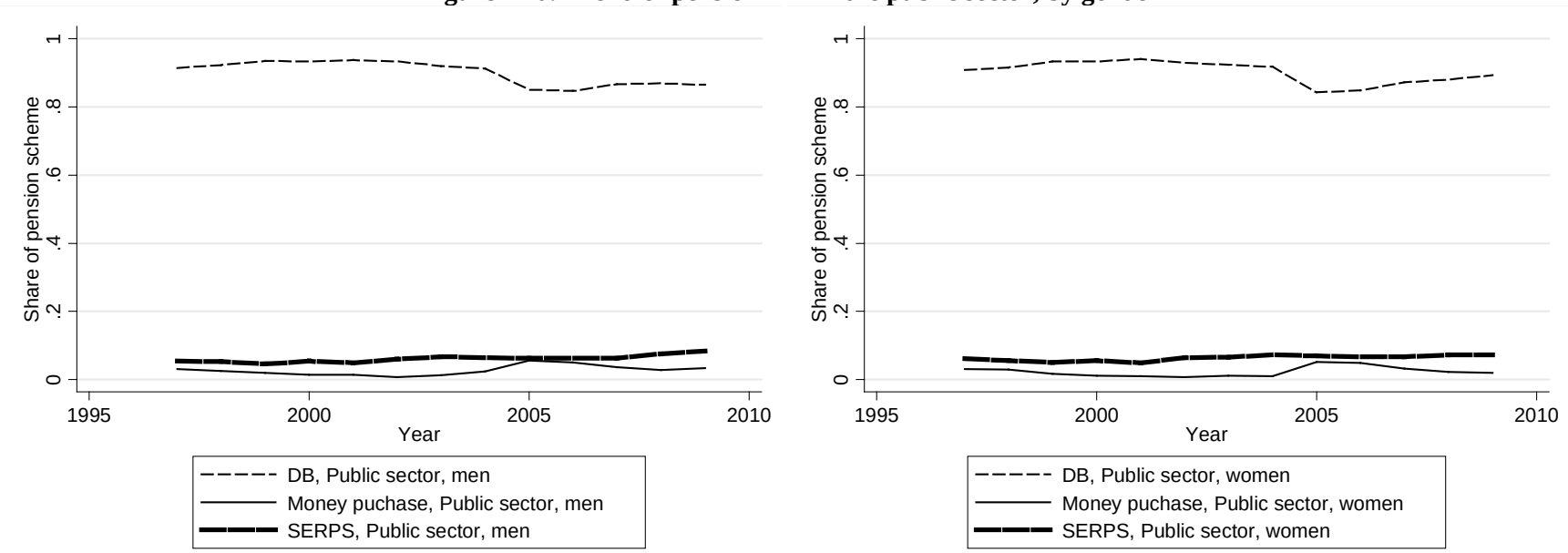
Note: Paid holiday entitlement is measured in days between zero and 96. Around 1 percent of employees in the public and private sector report to have zero holiday entitlement. The difference across sectors is insignifcant for women, but significantly higher in the private sector for men. Source: Quarterly LFS winter quarter from 2005 to 2008, own calculations.

Figure A9: Trend of pension mix in the private sector, by gender



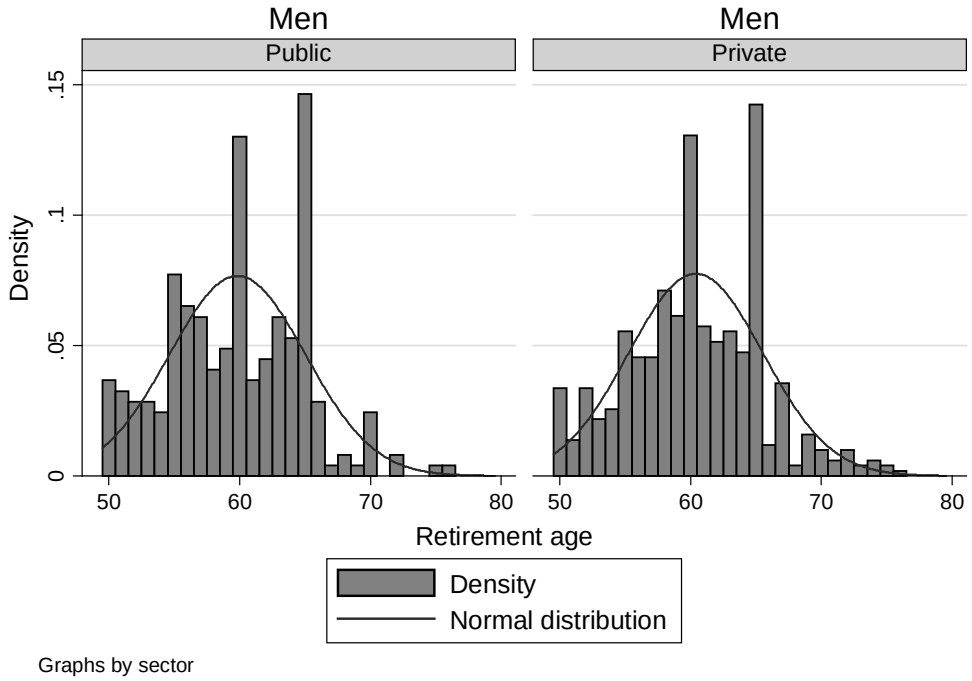
Note: DB stands for Defined Benefit occupational pension schemes, Money purchase comprises Defined Contribution, Stakeholder and Personal Group pensions. Source: ASHE 1997-2009 (ONS), own calculations. ASHE only provides information on the main pension scheme (ignoring potential personal private pensions).

Figure A10: Trend of pension mix in the public sector, by gender



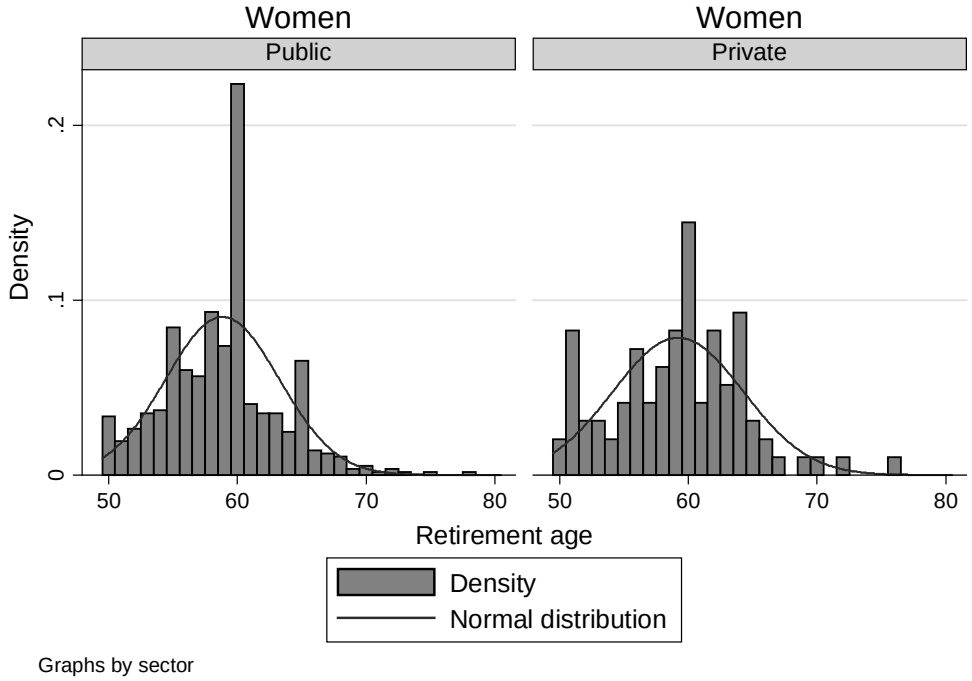
Note: DB stands for Defined Benefit occupational pension schemes, Money purchase comprises Defined Contribution, Stakeholder and Personal Group pensions. Source: ASHE 1997-2009 (ONS), own calculations. ASHE only provides information on the main pension scheme (ignoring potential personal private pensions).

Figure A11: Distribution of retirement ages, men, 1997-2007



Note: Pooled BHPS and ELSA data set. ELSA does not contain an indicator for economic sector, so this information was mapped into ELSA using an occupational matrix constructed from ASHE. Economic sector was imputed only for occupations where more than 75 percent of the workforce work in either the public or the private sector. ELSA data will thus underrepresent employees in occupations that are roughly equally distributed across sectors. Source: All four waves of ELSA, waves G to Q of BHPS, own calculations. Total sample size: 752.

Figure A12: Distribution of retirement ages, women, 1997-2007



See Note of Figure A 8. Total sample size: 665.

Table A1: Overview of pension schemes

Name	Contractual arrangement	Type
Defined benefit (DB)	Trust based	Run by the organisation, benefits are determined by the scheme rules, for example based on final or average salary
Defined contribution (DC)	Trust based	Run by the organisation, benefits are determined by contributions and investment returns, also known as money purchase
Group personal pension (for simplicity subsumed under DC)	Contract based	Facilitated but not run by the organisation, an arrangement made for employees to participate in a personal pension scheme on a grouped basis. This is not a single scheme, it is a collecting agreement
Stakeholder pension (for simplicity subsumed under DC)	Contract based	Facilitated but not run by the organisation, must meet certain conditions and be registered with The Pensions Regulator (TPR). Include employer-sponsored and other stakeholder pensions. Employers with 5 or more employees generally have to make a stakeholder pension available to their staff since 8th October 2001 in case they do not offer any of the other schemes).
State Graduated Pension, State Earnings Related Pension, State Second Pension (all for simplicity assumed as SERPS)	Implicit contract	The additional state pension was introduced to support the many employees who were not covered by any occupational scheme and thus left solely with the Basic State Pension. Through the payment of NI contributions, employees implicitly purchase pension 'rights'.

Source: The Pensions Regulator (http://www.thepensionsregulator.gov.uk/employers/different-kinds-of-pension-scheme.aspx)

Table A2: Computation of NPV of DC pension schemes, men

Men

Age	Pension wealth (A)	Max. tax free lump sum (25% A)	Annuity value (75% A)	Annuitised monthly benefit	Annuitised annual benefit (B)	Annual income at age 60	Tax rate at age 60	Re-grossed lump sum (C)	NPV of pension stream (D)	Total NPV (C+D)=(E)	Ratio of NPV to accumulated savings (E/A)	Ratio of (D) over annuity value
21	1428	356.90	1071	4.5	54	410.9	0	356.9	968.5	1325.4	93%	90%
22	2703	675.64	2027	9	108	783.6	0	675.6	1937.0	2612.7	97%	96%
23	5326	1331.42	3994	17	204	1535.4	0	1331.4	3658.9	4990.3	94%	92%
24	8161	2040.20	6121	27	324	2364.2	0	2040.2	5811.1	7851.3	96%	95%
25	11293	2823.14	8469	37	444	3267.1	20	3528.9	7963.4	11492.3	102%	94%
26	15016	3754.01	11262	51	612	4366.0	20	4692.5	10976.6	15669.1	104%	97%
27	18609	4652.22	13957	64	768	5420.2	20	5815.3	13774.5	19589.8	105%	99%
28	21764	5440.96	16323	75	900	6341.0	20	6801.2	16142.0	22943.2	105%	99%
29	24362	6090.50	18271	84	1008	7098.5	20	7613.1	18079.0	25692.1	105%	99%
30	28286	7071.47	21214	98	1176	8247.5	20	8839.3	21092.2	29931.5	106%	99%
31	32726	8181.38	24544	113	1356	9537.4	20	10226.7	24320.6	34547.3	106%	99%
32	36595	9148.85	27447	127	1524	10672.8	20	11436.1	27333.8	38769.8	106%	100%
33	40965	10241.27	30724	142	1704	11945.3	20	12801.6	30562.2	43363.8	106%	99%
34	45430	11357.45	34072	157	1884	13241.5	20	14196.8	33790.6	47987.4	106%	99%
35	50175	12543.76	37631	174	2088	14631.8	20	15679.7	37449.4	53129.1	106%	100%
36	54851	13712.82	41138	190	2280	15992.8	20	17141.0	40893.0	58034.1	106%	99%
37	59840	14960.12	44880	207	2484	17444.1	20	18700.2	44551.9	63252.0	106%	99%

38	64786	16196.48	48589	224	2688	18884.5	20	20245.6	48210.7	68456.3	106%	99%
39	70109	17527.26	52582	244	2928	20455.3	20	21909.1	52515.3	74424.3	106%	100%
40	75335	18833.76	56501	262	3144	21977.8	20	23542.2	56389.3	79931.5	106%	100%
41	80783	20195.75	60587	281	3372	23567.7	20	25244.7	60478.6	85723.3	106%	100%
42	86548	21637.10	64911	301	3612	25249.1	20	27046.4	64783.2	91829.6	106%	100%
43	92729	23182.26	69547	323	3876	27058.3	20	28977.8	69518.2	98496.0	106%	100%
44	99201	24800.14	74400	351	4212	29012.1	20	31000.2	75544.5	106544.7	107%	102%
45	104630	26157.58	78473	370	4440	30597.6	20	32697.0	79633.8	112330.8	107%	101%
46	111527	27881.75	83645	395	4740	32621.8	20	34852.2	85014.5	119866.7	107%	102%
47	117977	29494.28	88483	417	5004	34498.3	20	36867.8	89749.5	126617.3	107%	101%
48	124769	31192.30	93577	441	5292	36484.3	20	38990.4	94914.9	133905.3	107%	101%
49	131749	32937.30	98812	466	5592	38529.3	40	54895.5	100295.6	155191.1	118%	102%
50	138930	34732.60	104198	482	5784	40516.6	40	57887.7	103739.2	161626.8	116%	100%
51	144747	36186.80	108560	502	6024	42210.8	40	60311.3	108043.7	168355.0	116%	100%
52	152100	38025.08	114075	527	6324	44349.1	40	63375.1	113424.4	176799.5	116%	99%
53	159682	39920.45	119761	554	6648	46568.5	40	66534.1	119235.5	185769.6	116%	100%
54	167645	41911.13	125733	581	6972	48883.1	40	69851.9	125046.6	194898.5	116%	99%
55	176392	44098.10	132294	612	7344	51442.1	40	73496.8	131718.6	205215.5	116%	100%
56	184845	46211.25	138634	641	7692	53903.3	40	77018.8	137960.2	214978.9	116%	100%
57	192784	48196.05	144588	668	8016	56212.1	40	80326.8	143771.3	224098.1	116%	99%
58	200877	50219.23	150658	696	8352	58571.2	40	83698.7	149797.6	233496.4	116%	99%
59	209182	52295.60	156887	725	8700	60995.6	40	87159.3	156039.2	243198.5	116%	99%

Source: Total Reward matched cell data set, own calculations.

Table A3: Computation of NPV of DC pension schemes, women

Women

Age	Pension wealth (A)	Max. tax free lump sum (25% A)	Annuity value (75% A)	Annuitised monthly benefit	Annuitised annual benefit (B)	Annual income at age 60	Tax rate at age 60	Re-grossed lump sum (C)	NPV of pension stream (D)	Total NPV (C+D)=(E)	Ratio of NPV to accumulated savings (E/A)	Ratio of (D) over annuity value
21	2481	620.36	1861	7.5	90	710.4	0	620.4	1739.4	2359.8	95%	93%
22	4915	1228.66	3686	15	180	1408.7	0	1228.7	3478.9	4707.5	96%	94%
23	7840	1959.96	5880	25	300	2260.0	0	1960.0	5798.1	7758.1	99%	99%
24	10856	2713.91	8142	34	408	3121.9	20	3392.4	7885.4	11277.8	104%	97%
25	14035	3508.83	10526	46	552	4060.8	20	4386.0	10668.5	15054.6	107%	101%
26	17258	4314.57	12944	57	684	4998.6	20	5393.2	13219.7	18612.9	108%	102%
27	20545	5136.35	15409	68	816	5952.3	20	6420.4	15770.9	22191.3	108%	102%
28	24272	6067.98	18204	80	960	7028.0	20	7585.0	18554.0	26138.9	108%	102%
29	27477	6869.16	20607	90	1080	7949.2	20	8586.4	20873.2	29459.6	107%	101%
30	31449	7862.34	23587	103	1236	9098.3	20	9827.9	23888.2	33716.1	107%	101%
31	35136	8783.90	26352	115	1380	10163.9	20	10979.9	26671.3	37651.2	107%	101%
32	39186	9796.47	29389	128	1536	11332.5	20	12245.6	29686.3	41931.9	107%	101%
33	43648	10912.06	32736	143	1716	12628.1	20	13640.1	33165.2	46805.3	107%	101%
34	48192	12047.98	36144	159	1908	13956.0	20	15060.0	36876.0	51935.9	108%	102%
35	52666	13166.51	39500	174	2088	15254.5	20	16458.1	40354.8	56813.0	108%	102%
36	57091	14272.74	42818	188	2256	16528.7	20	17840.9	43601.8	61442.7	108%	102%
37	61732	15432.93	46299	204	2448	17880.9	20	19291.2	47312.6	66603.7	108%	102%

38	66044	16510.88	49533	218	2616	19126.9	20	20638.6	50559.5	71198.1	108%	102%
39	70482	17620.61	52862	233	2796	20416.6	20	22025.8	54038.4	76064.1	108%	102%
40	74975	18743.78	56231	248	2976	21719.8	20	23429.7	57517.2	80947.0	108%	102%
41	79788	19947.10	59841	264	3168	23115.1	20	24933.9	61228.0	86161.9	108%	102%
42	84747	21186.66	63560	281	3372	24558.7	20	26483.3	65170.8	91654.1	108%	103%
43	89545	22386.37	67159	297	3564	25950.4	20	27983.0	68881.5	96864.5	108%	103%
44	94361	23590.34	70771	318	3816	27406.3	20	29487.9	73752.0	103239.9	109%	104%
45	99648	24912.08	74736	336	4032	28944.1	20	31140.1	77926.6	109066.7	109%	104%
46	104751	26187.73	78563	353	4236	30423.7	20	32734.7	81869.3	114604.0	109%	104%
47	109628	27407.00	82221	369	4428	31835.0	20	34258.8	85580.1	119838.8	109%	104%
48	114929	28732.28	86197	387	4644	33376.3	20	35915.3	89754.7	125670.1	109%	104%
49	120426	30106.60	90320	406	4872	34978.6	20	37633.3	94161.3	131794.5	109%	104%
50	126060	31515.08	94545	425	5100	36615.1	20	39393.8	98567.9	137961.7	109%	104%
51	132133	33033.23	99100	445	5340	38373.2	40	55055.4	103206.3	158261.7	120%	104%
52	138720	34679.93	104040	465	5580	40259.9	40	57799.9	107844.8	165644.7	119%	104%
53	145903	36475.85	109428	489	5868	42343.9	40	60793.1	113411.0	174204.1	119%	104%
54	152023	38005.68	114017	510	6120	44125.7	40	63342.8	118281.4	181624.2	119%	104%
55	157736	39433.93	118302	529	6348	45781.9	40	65723.2	122688.0	188411.2	119%	104%
56	164187	41046.68	123140	550	6600	47646.7	40	68411.1	127558.4	195969.5	119%	104%
57	170715	42678.83	128036	572	6864	49542.8	40	71131.4	132660.7	203792.1	119%	104%
58	177396	44348.88	133047	595	7140	51488.9	40	73914.8	137995.0	211909.8	119%	104%
59	184469	46117.35	138352	618	7416	53533.4	40	76862.3	143329.3	220191.5	119%	104%

Source: Total Reward matched cell data set, own calculations.

Table A4: Parameter assumptions

Parameter	Disney et al. (2009)	Leslie (2008)	Main specification
Life expectancy	Age-gender cohort life expectancies (1997-2001); adjustment for differences in life expectancies by social class	85 (Pension multiplier at age 65 is 20)	Age-gender cohort life expectancies (2002-2006); adjustment for differences in life expectancies by social class
Wage growth	NA	0.02	0.02
Discount rate	0.03	0.04	0.03
Employee contributions	For final salary plans: Private: 4.6% Public: 3.9%	NA	From data
Discount back to age	NA	18	21
Real annual rate of return	NA	NA	0.02 (see Crawford et al., 2010)
Accrual factor	Public DB: $1/80^{th}$ Private DB: $1/60^{th}$		Public DB: $1/80^{th}$ Private DB: $1/60^{th}$
Additional lump sum	Public DB: $3/80^{th}$ Private DB: 0		Public DB: $3/80^{th}$ Private DB: 0
Inflation rate		0.02	
Retirement age	Private: 65 Public: 60	65	60; State pension age (SPA) 65
Vesting period	2 years (not used)	—	DB: 2 years
Job Tenure	12.2 (public), 9.5 (private) mean uncompleted pension plan tenures (self-reported BHPS)	Life cycle employment without unemployment risk (max. 48)	Life cycle employment adjusted for unemployment risk