The Value of Teachers' Pensions

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by

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Executive Summary

As private sector employers have moved away from providing final salary defined benefit (DB) pensions to their employees, attention has increasingly focused on the public sector's continued provision of such pensions and the value of these pension promises to public sector employees. The estimated underlying liabilities of such plans have increased sharply in recent years, at least in part due to unanticipated increases in longevity. This has led to reforms of all the major public sector pension schemes, the net result of which has been to reduce the level of benefits offered by the schemes (predominantly to new, rather than existing members).

This paper examines, in the context of the Teachers' Pension Scheme (TPS), how much the pension promises are worth and what effect the change in scheme rules has had on them. This paper also addresses a number of other issues that are important when valuing DB pension rights and their relation to overall remuneration. First, how increases in current pay feed through into pension values. Second, how the age profile of earnings affects the profile of pension accrual. Finally, how the value of pension rights in DB schemes compares to that in a stylised defined contribution (DC) scheme.

The figures presented in this paper relate specifically to the composition of members and the specific scheme rules of the TPS. However, the issues raised apply equally to other DB schemes, both public and private sector. The main conclusions of this paper are as follows:

How much are teachers' pension promises worth?

- The median value of discounted accrued pension rights amongst current teachers is 2.12 times their current salary. (In other words, if the teacher with the median level of accrued rights currently had a salary of £30,000 a year, this figure – 2.12 times salary – implies that his or her accrued pension rights are worth £63,600). Accrued rights are worth more for older teachers as they typically have higher tenure within the scheme and are closer to retirement: those aged forty and over have median rights worth 4.86 times salary (under the old scheme rules), while median accrued rights amongst those aged under forty are just 0.95 times salary.

- When considering the value to a teacher of working an additional year, it is most useful to think about how the value of an additional year's worth of pension rights compares to the current pay received over the same period. Assuming that the headline pay award for teachers is normally equal to the RPI, median annual pension accrual (net of the employee contribution to the scheme) is 14.7 per cent of current salary to teachers under the old TPS rules. Because of the specific design of DB pension schemes, combined with the fact that teachers' pay is, on average, found to increase with age, annual pension accrual is highest for those teachers that have been in the scheme the longest and those with the highest year-on-year pay growth.

- The value of the pension promise depends significantly on the intertemporal discount rate that is used in the calculations. This is true not only of the figures presented in this paper but also of the estimates by, for example, the Government

Actuary's Department of the total liabilities of public sector pension schemes. The baseline estimates presented in this paper assume a real discount rate of 2½ per cent per year. Sensitivity analysis to alternative (higher and lower) discount rates is also provided.

What difference will the new scheme rules make?

- If the pension rights of existing members had been accrued under the new TPS rules, the median value of rights would instead have been worth 1.82 times current salary – in other words, 14.2 per cent less than they are worth under the old scheme rules. The new scheme rules reduce the level of benefits most for those with shorter life expectancies (for example men rather than women), as the new rules provide a slightly higher annual pension income but do not pay this income until 5 years later than under the old scheme rules.

- Under the new scheme rules, median annual pension accrual would be 11.2 per cent of salary (or 23.7 per cent less than under the old scheme rules).

To what extent can these reductions be regarded as offsetting increases in benefits arising from faster than anticipated increases in life expectancies over recent decades?

- Increases in life expectancy over the last quarter of a century mean that the median annual accrual of pension rights in the TPS under the old scheme rules is now worth one percentage point of current salary more than it would have been to members 25 years ago.

- The cut in the level of pension benefits that the new TPS rules have introduced is much larger than this, however. Median annual pension accrual would be 3.5 percentage points of salary lower under the new TPS rules than under the old rules with current life expectancies.

How do headline pay awards feed through into pension values?

- The values of DB pension rights depend, by their nature, on the salary of the scheme member at the point that he or she leaves the scheme. Headline pay awards, therefore, impact on the value of each year's pension accrual. Higher headline pay awards translate into higher pension accrual and vice versa. However, because of the rules of DB schemes, the value of pay awards in the total remuneration package are amplified by their effect on accrued pension rights.

- If we consider for illustrative purposes a scenario in which headline pay awards normally increase pay in line with the RPI, then an increase in headline pay of 2 percentage points above the RPI is found to boost accrued pension rights by a greater amount. Defining total remuneration as current salary plus additional accrued rights, this figure is increased by 6.6 per cent with a RPI+2% award. This happens because pension calculations at retirement are based on an individual's 'final' salary in the pension scheme. Thus, higher pay this year not only increases the value of remaining in the scheme for one extra year but also increases the level of pension benefit implied by all existing years of membership of the scheme.

- The converse is also true. For example, for 2008–09, the teachers' pay award was 2.45 per cent, while inflation for much of the period exceeded that period, peaking at 5.0 per cent in September 2008. A fall in real pay of 2.55 per cent, from this example, is found to lead to an average drop in remuneration, relative to a benchmark of an RPI increase in pay, of just over 8 per cent for those covered by the new TPS rules and just over 9 per cent for those covered by the old TPS rules.

- In general, these revaluations of the salary base on which pensions are calculated arising from fluctuations in pay awards around trend are of less relevance for younger individuals who expect to remain in the TPS for some time, because higher than average pay awards one year may be offset by lower pay awards in future years (and vice versa). However, for an individual close to leaving the scheme, for example due to retirement, these calculations illustrate how pay awards received in the final years of TPS membership have a large effect on the value of his or her pension.

What difference would a different profile of pay growth make?

- Previous work has shown that rates of growth of pay of public sector workers are almost linear over the working life, in comparison to the pay profiles by age of private sector workers, which exhibit greater curvature (i.e. slowing or even falling real growth later in the working life). These different profiles have implications for the value of annual pension accruals at different ages in different types of pension schemes. In particular, public sector pay profiles result in pension accruals in DB schemes such as the TPS being heavily weighted towards older ages.

- If teachers age-earnings profiles had a shape closer to that of typical private workers (i.e. more like an 'inverted U'), the accrual of pension rights would be smoothed out across the life cycle. Under this assumption, median annual pension accrual for those teachers aged under 40 (14.7 per cent of salary) would be almost the same as for those aged 40 and over (15.1 per cent of salary). An important caveat here is that differential earnings profiles in the public and private sectors may be a direct result of the different pension scheme arrangements in these sectors (or vice versa). Specifically given the way in which pension entitlements accrue in DC schemes, which are more common in the private than the public sector, members of DC schemes are better off if their earnings peak earlier in their careers because a higher proportion of their lifetime contributions would then be invested earlier.

How does accrual in a stylised DC pension compare to accrual in the TPS?

- Two alternative DC scheme designs are considered in this paper. One assumes a simple 10% employer contribution for all scheme members. The other is modelled on the Civil Service Partnership Scheme, which offers higher employer contributions on average than private sector DC schemes and in which the employer's contribution rate is higher for older members.

- Overall, average pension accrual (net of the employee contribution) in the simple stylised DC pension scheme, at 7.1 per cent of current salary, is found to be lower than average pension accrual in the TPS under either the scheme rules applying to existing

members or those applying to new members. This finding is, however, highly sensitive to the choice of employer contribution rate: in this case we take a scheme into which the employer contributes 10 per cent, and the employee 6.5 per cent, of gross salary.

- If a 'lifestyling' investment strategy is pursued, so that individuals switch from a more riskier investment portfolio when young into safer assets as they near retirement, then younger individuals can expect higher returns, leading to younger members of a stylised DC scheme having, on average, higher pension accrual than older members. This is in stark contrast to a DB scheme such as the TPS where average accrual is found to be greater for older individuals than younger individuals.

- If instead we take the rules of the Civil Service Partnership Defined Contribution pension, in which the employers contribution increases with age and contribution rates are on average higher than that assumed above, then average pension accrual is found to be 10.6 per cent of current salary. This is only slightly below the average accrual under the TPS rules for new members. Moreover the relative benefit to younger members of receiving a higher average investment return is, on average, more than offset by the lower initial employer contribution.

1. Introduction

The majority of public sector workers, and a minority in the private sector, are covered by final salary defined benefit pension (DB) plans.[1] These provide members with an annual pension income in retirement based on their years in the plan and a measure of earnings typically taken towards the end of their active plan membership. The estimated underlying liabilities of such plans have increased sharply in recent years, at least in part due to unanticipated increases in longevity.

Many private sector employers have reacted to this increase in expected costs by moving away from DB pension provision and instead offering their employees defined contribution (DC) pensions. In DC schemes, members have their own 'pot' into which contributions are made, and then invested, in order to build a fund that is used to provide an income in later life (typically, but not always, through the purchase of an annuity). Therefore, whereas in a final salary DB scheme both investment and longevity risk are, at least formally, borne by the employer, in a DC scheme these risks are, again at least formally, borne by the individual. By 2007, two-thirds of private sector DB pension plans were closed to new members, and the numbers covered by such plans has been steadily declining throughout most of the period since 1979. In contrast, within the public sector large scale moves away from final salary DB provision have not occurred, and growth in public sector employment has meant that coverage of the workforce by such plans has been increasing since the mid 1990s.[2] As a result, the expected underlying liabilities of public sector DB plans have grown considerably in recent years.[3]

Though there have been only limited moves away from final salary DB provision in the public sector, the rules of public sector schemes have recently been reformed. Following reports from the Cabinet Office (2000) and the Department for Work and Pensions (2002 and 2003), a number of changes have been implemented which are expected both to help facilitate an increase in retirement ages and to reduce the future cost to the taxpayer relative to the benchmark of unreformed plans. These reforms vary from plan to plan but have often involved an increase in the Normal Pension Age (NPA)[4] for new entrants and a cap on future employer (i.e. taxpayer) contributions. For example, the three largest public sector DB plans – the NHS pension plan, the Teachers' Pension Scheme (TPS) that applies in England and Wales, and the Principal Civil Service Pension

[1] Data from the Office for National Statistics suggest that in 2007 around three-quarters (76.5 per cent) of public sector employees and one-sixth (17.0 per cent) of private sector employees were a member of an occupational DB plan. See Table 8.3 of Bozio and Johnson (2008) for more details.

[2] For coverage of DB plans in the public and private sector see Figure 1 of Disney, Emmerson and Tetlow (2007), and pages 114 to 117 of Pensions Commission (2004). Data on private sector plan closures from National Association of Pension Funds (2008). For a description of the key differences between public and private sector pension arrangements see, for example, Pensions Policy Institute (2005a).

[3] For the latest official estimates see Box 4.3 of HM Treasury (2008a). For a discussion of both official and alternative estimates see, for example, Section 3.3 of Chote, Emmerson and Tetlow (2008), Hawksworth (2006), Record (2006, 2008), and Yeo (2006).

[4] This is often referred to as a 'Normal Retirement Age', but it is the age at which an individual stops contributing to the pension plan, which is not necessarily the age of retirement. It also not the State Pension Age, which is the age from which the state retirement pension is payable regardless of when, or whether, the individual retired.

Scheme (PCSPS) – have all had their NPA for new entrants increased from age 60 to age 65.[5] In 2005, the Treasury estimated that the present discounted value of the net saving to the taxpayer from these reforms, which also included changes to ill-health retirement provisions and to employee contribution rates, would total £13 billion. They estimate this is in the fact the same as would have been saved had the reform simply increased the NPA to age 65 for future accrual of both new *and* current members, and that 85 per cent of the cost saving would be from the changing provisions for new entrants rather than current plan members. To put this in context the estimated saving of £13 billion represented 2.8 per cent of the contemporaneous official estimate of total projected public sector pension liabilities (£460 billion).[6]

Like other elements of employee remuneration, pensions are offered in order to attract and retain staff of suitable quality. Therefore, arguably, when considering public sector pensions, at least as important a question as the total taxpayer liability is their value to members. In particular, it is important to examine how this compares to what similar workers in the private sector receive and consequently how the overall remuneration packages of public sector workers compare to those for similar private sector workers. This will be an important determinant of both the recruitment and the retention of staff and ultimately therefore the quality of service provided.[7] Just as comparisons of headline pay rises are taken into account in discussions surrounding pay settlements, so too should be the extent to which the evolution of pension accrual in the public sector differs from that among similar workers in the private sector. Furthermore – as is shown and quantified in this paper – headline pay increases understate the true increase in remuneration from both pensions and pay among those who are members of final salary pensions. This is in contrast to DC pension arrangements where a headline increase in pay also reflects the headline increase in total remuneration from both pay and pensions.

Previous analysis (see Disney, Emmerson and Tetlow, 2007) suggests that accrual of rights in DB pension plans represents a significant proportion of overall public sector worker remuneration. Furthermore, this research suggests that among members of final salary DB plans the proportion of remuneration received in deferred pay (i.e. pensions) is, on average, significantly higher in the public sector than in the private sector. In large part, this is due to the rules of public sector DB pensions providing relatively higher pension benefits than such schemes in the private sector. However, an important further factor is differences in the shape of age-earnings profiles. Specifically, among those aged 40 and over, earnings profiles are found, on average, to be steeper in the public sector

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[5] New entrants from 1st April 2008 in the NHS pension plan, from 1st January 2007 in the TPS and from 30th July 2007 in the PCSPS.

[6] Sources: House of Commons Hansard Written Answers, 25th October 2005 Column 314W (http://www.publications.parliament.uk/pa/cm200506/cmhansrd/vo051025/text/51025w30.htm); 11th November 2005 (http://www.publications.parliament.uk/pa/cm200506/cmhansrd/vo051111/text/51111w04.htm); and 25th June 2007 (http://www.publications.parliament.uk/pa/cm200607/cmhansrd/cm070625/text/70625w0089.htm); Evidence to the Treasury Select Committee by the then Chancellor of the Exchequer Gordon Brown on the 8th December 2005 (http://www.publications.parliament.uk/pa/cm200506/cmselect/cmtreasy/739/5120807.htm). For a discussion see, for example, Section 8.4 of Bozio and Johnson (2008) and Pensions Policy Institute (2005b).

[7] For analysis of the impact of teachers' pay on teacher retention in the UK see Dolton and van der Klauuw (1995 and 1999); for analysis on the impact of nurses pay on nurses vacancy rates and hospital performance in the UK see Hall, Propper and Van Reenen (2008).

than in the private sector. This makes, on average, the value of the annual accrual of pension rights (measured as a share of current pay) higher for this group of public sector workers. In this paper, individual teacher's yearly earnings growth is estimated using empirical earnings profiles. Therefore, the shape of the age-earnings profile will be important for the comparisons made in section 5.

Our method of modelling accrued pension rights and additional pension accruals from further years of service differ from most other actuarial calculations that have been used in evaluating public sector pensions. Most existing studies use *projected benefit* methods by which, taking a representative individual as the base, earnings growth is projected forward under certain assumptions (typically involving a linear age-earnings profile) to derive projected additional benefit rights to a time horizon under alternative assumptions about mortality, retirement date and real earnings growth (see for example, Watson Wyatt, 2006, 2008a).

Such methods pay less attention to the impact of *accrued pension* rights, which depend on past actual age-earnings profiles and tenures within the pension plan. It is typically argued that calculations of incremental rights conditional on accrued rights involve substantial data requirements. However, accrued rights affect projected benefit rights indirectly, insofar as accrued rights given pension tenure will affect the individual's earnings profile on which prospective rights are calculated. Our method provides some evidence on which to measure this effect of accrued on projected pension benefits.

Using our regression-based estimates of age-earnings profiles, coupled with evidence on completed pension tenures by age and sector, we are able to provide evidence on accrued rights (which is not usually provided side-by-side with stylised projections) and to attach greater precision to our calculation of incremental pension rights. In particular, we show that it is simplistic to model projected age-earnings profiles as linear functions, given the high degree of non-linearity exhibited by our earnings profiles, and the differences in these functions across sub-groups. Thus we believe that our additional information gives a more precise measure both of the trajectory of teachers' salaries, and also of the increments to projected pension benefits that will arise from those increases in earnings.

Specifically, this paper examines in detail the value of the pension provision to teachers in the public sector in England and Wales who are members of the TPS. At least in terms of number of pension plan members and size of estimated taxpayer liabilities, the TPS is, in the UK public sector, second in importance only to the NHS pension plan. Reforms to the TPS were introduced from 1st January 2007 but the most significant cost saving reforms were implemented in full only for new entrants. This paper presents findings on how the annual accrual of pension entitlement compares to current pay, and how this has changed in the light of the recent reforms. The paper also highlights the extent to which consideration of a headline pay award on current pay understates the impact on total remuneration from pay and pensions for those who are members of the TPS. It also shows how the level of benefits provided by the TPS is affected by differences between the pay profiles observed for teachers compared to those observed for graduates working in the private sector. Finally, the paper contrasts the benefits

offered by the TPS with a typical DC pension plan since these are now often the only type of pension arrangement on offer to new entrants within the private sector.

The paper is structured as follows. Section 2 summarises the TPS rules both before and after the recent reforms came into force. An important component of the value of annual pension accruals is the assumption made about future earnings growth. Section 3 describes the data from the New Earnings Survey (NES) and the Annual Survey of Hours and Earnings (ASHE), which are used to estimate the evolution of teachers' pay. Section 4 discusses the methodology for estimating the value of accumulated pension rights and prospective pension accrual under both final salary DB and DC arrangements. Since expected earnings growth is an important ingredient in calculating pension accrual this section also presents simulated earnings trajectories for teachers. Results on both accumulated pension entitlements and one-period pension accrual, under both the pre-reform and post-reform TPS rules, under different assumed discount rates, different scenarios for earnings growth, different pay profiles, and under the rules of a representative private sector DC plan are presented in section 5. Section 6 concludes.

2. The Teachers' Pension Scheme

The TPS is a final salary DB pension plan into which all teachers aged between 18 and 70 in maintained schools in England and Wales are enrolled automatically. In other words, they have to make an active decision not to be a member of the pension plan.[8] The plan is 'contracted-out' which means that members of the TPS do not accrue any additional entitlement to the State Second Pension. As of 31st March 2006 there were 600,124 active members of the TPS and 409,691 deferred members, while 489,931 individuals were receiving a pension from the TPS (of which 455,361 were TPS members and 51,186 were dependants of deceased TPS members). For many these pensions in payment were significant: the average (mean) annual TPS pension in payment in 2006–07 was £11,429 for male members, £7,992 for female members, and £3,409 among those receiving a dependant's pension from the TPS.[9]

From 1st January 2007 onwards different rules apply to accrual within the TPS for 'existing members' (i.e. those who had started accruing entitlement before 1st January 2007) and for 'new members' (i.e. those who began accruing entitlement on or after 1st January 2007). In addition, for existing members, slightly different rules apply to pensionable service before and after 1st January 2007. Since the new plan rules reduce the expected net cost to the taxpayer, the pension benefits provided to members by the new scheme rules are lower overall than those offered under the previous rules. However, some of the changes that have been made will make very little difference to the vast majority of members.

A summary of the key changes that are significant overall and considered explicitly in the analysis in this paper is provided in Table 2.1. Overall the largest reduction in the benefits provided by the plan results from the increase in the NPA from age 60 to age 65 for new members. Specifically, this means that while those who joined before 1st January 2007 will continue to be able to draw a full pension from age 60, those who joined from 1st January 2007 onwards cannot draw an unreduced pension until age 65. This change in NPA brings the TPS rules for new members more into line with the majority of private sector DB pension plans. However, taken alone it results in a significant reduction in the level of benefit offered: for example a new plan member who draws an unreduced pension from age 65 will receive pension income for five fewer years, and will have made employee pension contributions for five more years, than an existing member who is able to draw an unreduced pension from age 60. Thus the value of the annual accrual of pension rights will be greater for existing plan members than for new plan members.

There are two other reforms to the plan rules highlighted by Table 2.1. First, the measure of 'final salary' has been changed to be the better of last year's pensionable pay and the average of the best three consecutive years out of the last ten years (revalued

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[8] Prior to 1st January 2007, while full-time teachers were automatically enrolled, part-time teachers had to make an active decision to join the TPS. Under the Pensions Bill 2007–08 (http://services.parliament.uk/bills/2007-08/pensions.html) which received Royal Assent on the 26th November 2008 the majority of employees aged between 22 and the State Pension Age are to be automatically enrolled into a private pension arrangement.

[9] Teachers' Pension Scheme (2007).

using the RPI) instead of being the best annual pay from the last three years. One group who will benefit from this change is those who receive reduced pay for more than three years before retirement; for example, an individual who chooses a lower paid, lower responsibility, role for five years up to retirement. Second, while existing members accrue a pension worth 1/80th of 'final' salary per year plus a lump-sum worth 3/80ths, by default new members will accrue a pension worth 1/60th per year (i.e. more generous) but with no lump-sum. However new members are able to choose a higher lump sum (up to a maximum of 35 per cent of their annual pension, which is deemed equivalent to the HMRC legal maximum of 25 per cent of the pension fund) in return for a lower annual pension. Overall, the new arrangements for accrual and lump sum are more generous than the old ones – in particular, under the new arrangements an individual choosing to take a 3/80ths lump sum would receive an annual pension worth more than 1/80th.[10] New members with high life expectancies (or with dependants with a high life expectancy) will be able to benefit from taking the higher annual pension with no lump sum, while those with particularly low life expectancies will be able to benefit from being able to take a larger proportion of their pension as a lump sum.[11]

Table 2.1. Headline TPS rules affected by latest reform.

	Accrual up to 1st January 2007	Accrual from 1st January 2007 onwards	
		Existing members	New members
Normal Pension Age	60	60	65
Accrual fraction	1/80th	1/80th	1/60th
Default lump sum	3/80th	3/80th	None
Measure of final salary	Best annual pensionable pay in final three years.	Better of: last year's pensionable pay; and average of best 3 consecutive years' (RPI revalued) pay out of last 10.[a]	Better of: last year's pensionable pay; and average of best 3 consecutive years' (RPI revalued) pay out of last 10.[a]
Dependent's pension	1/160th	1/160th	1/160th

[a] Pensionable pay for the last ten calendar years is revalued to current prices using the RPI.
Source: Full plan details available on the TPS website (http://www.teacherspensions.co.uk/index.htm). A useful summary is available on the Government Actuary's Department website (http://www.gad.gov.uk/Documents/TPS-Key_Features_Pre_and_Post_1_Jan_07.pdf).

Finally, all TPS members from 1st January 2007 onwards have been required to make a 6.4 per cent of earnings contribution towards the plan, which is higher than the 6.0 per cent member contribution that was previously payable. This means that the value of the

[10] Under the new rules the annual pension is reduced by £1 for every £12 taken in lump-sum. Someone choosing to take a lump-sum worth 3/80ths under the new arrangements will find their pension reduced to 1/60th less (3/80)*(1/12) which is equal to (13/12)*(1/80) – i.e. greater than 1/80th.

[11] Assuming a 5 per cent annuity rate then a lump sum of 3/80ths and an annual pension of 1/80th means that the lump-sum in the pre-reform TPS was worth 3/23rds of the total pension (i.e. less than one-quarter). Existing members can, in respect of pensionable service after 1st January 2007, choose to take a lump-sum larger than 3/80th in return for a lower annual pension income. So low life expectancy members of this group could also benefit under the new plan rules relative to the old rules.

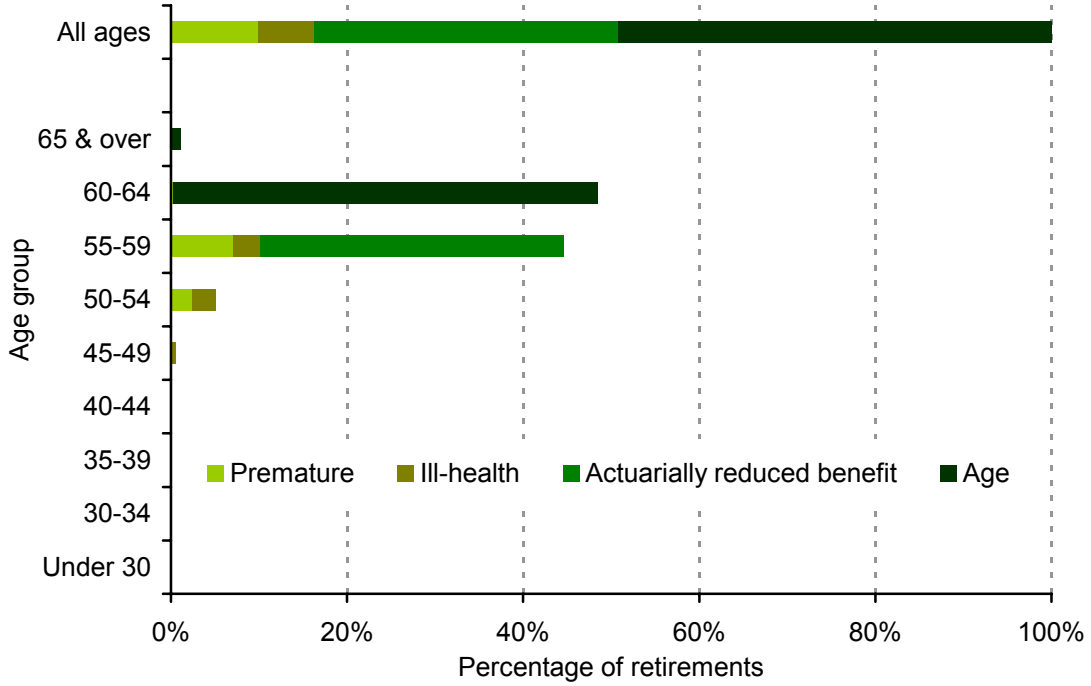
annual accrual of pension over-and-above the member's own contribution paid will have been lower since 1st January 2007 than it otherwise would have been (even ignoring all the other changes to the plan rules). Furthermore in future the employer contribution is to be capped at 14.0 per cent of earnings (unless the increase in the required employer contribution is brought about by a technical change to, for example, the discount rather than a revision to, for example, life expectancy). Any residual between this employer contribution and the contribution rate per member deemed, by the annual valuation exercise, to be necessary will be made up by the member's contribution. To the extent to which this cap bites in future (the employer contribution is currently 14.1 per cent), the member contribution rate will grow further, whereas previously any residual contribution needed was made up by the employer.

These changes are all reflected in the results presented in section 5. It should be noted, however, that other changes that are not considered in the analysis in this paper will be very significant but only for a minority of individuals. For example, future accrual of provisions for ill-health retirement have in some cases been reduced substantially for both existing and new members. Those with more than two years of service who develop a health condition which means that, while they can work, they are unable to work as a teacher will now receive a lower income from the pension scheme than they would previously have done, and in some cases substantially less. The vast majority of teachers do not, however, make use of these ill-health provisions and so are likely to be unaffected by the changes. As shown in Figure 2.1 five-sixths (83.7 per cent) of teachers who retired in 2006–07 did so either at the NPA or with an actuarially reduced pension. The remainder received an enhanced pension either on the basis of being in ill-health (6.5 per cent) or employer efficiency (9.9 per cent).[12]

Some of the other reforms to the TPS will represent a significant increase in the level of benefits provided for a small number of individuals. Death in service benefits have been increased by 50 per cent – from two times earnings to three times earnings – and future accrual of dependant's pension has been extended to certain nominated cohabiting partners outside of both marriage and civil partnership. Another change that in principle should only be able to benefit members is the introduction of phased retirement provisions enabling those aged 55 and over to draw some of their pension while continuing to work as a teacher.

[12] Prior to April 1997 ill-health retirement could be claimed as long as an individual was unable to teach for the foreseeable future. This changed from April 1997 so that an individual now needs to prove that they are permanently unable to teach. Around twice as many teachers in England received an ill-health pension in the years immediately before this reform compared to immediately after this reform (see Figure 1 of Bowers and McIver (2000) and Annex E of HM Treasury (2000)). From November 1997 LEAs were made to finance part of the additional cost of retirements prior to age 60. This change was associated with the number of teachers taking early retirement falling by four-fifths (see Chart 7.1 of Smithers and Robinson (2000)). Actuarially reduced pensions were introduced from 31st March 2001.

Figure 2.1. Teacher retirements, by type of pension award, 2006–07.



Source: Table H3 of Department for Children, Schools and Families, *School Workforce in England (including pupil: teacher ratios and pupil: adult ratios)*, January 2007 (Revised) (http://www.dcsf.gov.uk/rsgateway/DB/SFR/s000743/index.shtml).

For research into teachers' and head teachers' understanding of the changes to the TPS, and how they report they will respond to these changes, see Peters, *et al*, (2008). Analysis of the experiences of women in the TPS can be found in Foster (2007). The findings of the latest official actuarial review of the TPS – which includes estimates based on both the old and the new scheme rules – can be found in Government Actuary's Department, (2006).

3. Data

The base population, for whom the value of pension accruals are simulated, is the population of primary and secondary school teachers recorded in the Database of Teacher Records (DTR) as of March 2007. Table 3.1 shows the sample sizes and distribution of ages for four groups: men and women, primary and secondary school teachers. The sample sizes show that in the data there are slightly more secondary school teachers than there are primary school teachers, and that 87 per cent of primary school teachers, and 61 per cent of secondary school teachers, are women. On average (looking at both the mean and median age) teachers are in their early forties, with half of teachers being aged between their early thirties and their early fifties. The distribution of female teachers' ages is slightly younger than that of male teachers.

Table 3.1. Age distribution of public sector teachers in March 2007, by sex and sector (England and Wales only).

	Mean	p25	Median	p75	Sample size
All					
All	40.6	31	40	50	442,581
Primary school	40.5	31	40	51	213,243
Secondary school	40.7	31	40	50	229,338
Aged under 40	30.9	27	31	35	213,926
Aged 40 and over	49.7	45	50	54	228,655
Men					
All	41.2	32	41	51	116,970
Primary school	40.6	32	40	50	28,074
Secondary school	41.4	32	42	51	88,896
Aged under 40	31.3	27	31	35	53,711
Aged 40 and over	49.6	45	50	54	63,259
Women					
All	40.4	31	40	50	325,611
Primary school	40.5	31	40	51	185,169
Secondary school	40.3	31	40	50	140,442
Aged under 40	30.8	27	31	35	160,215
Aged 40 and over	49.7	45	50	54	165,396

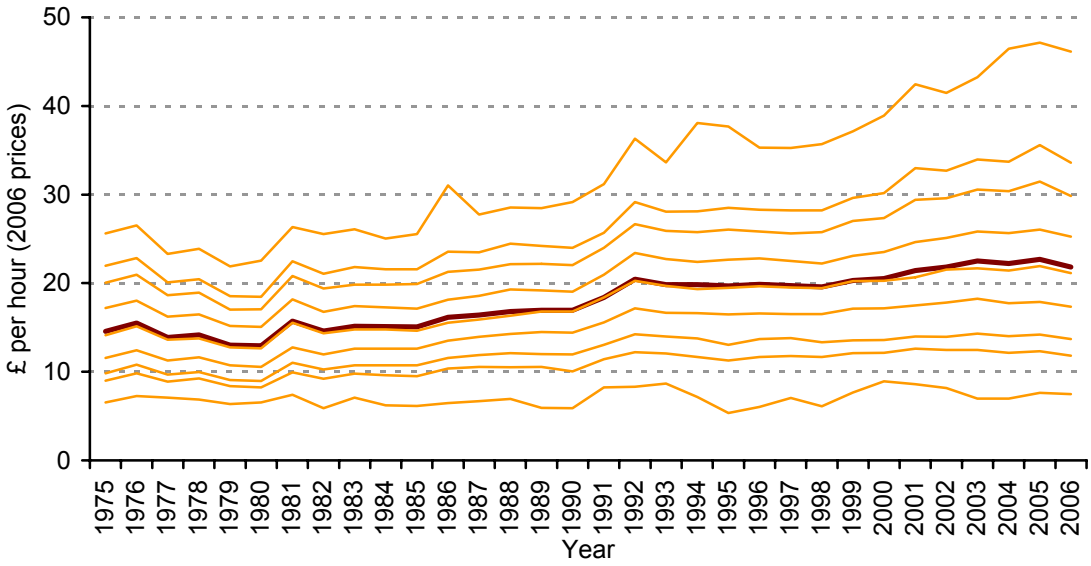
Note: Primary and secondary school teachers aged 23 to 59 only.
Source: DTR, March 2007.

A key component in estimating pension accrual within a final salary DB plan is expected earnings growth. In order to estimate how earnings might be expected to evolve, this paper makes use of data from the New Earnings Survey (NES) and its successor, the Annual Survey of Hours and Earnings (ASHE). Together these surveys provide data

from 1975 to 2006 (inclusive) for a sample of 1 per cent of all employees in the United Kingdom on an annual basis. The data include, amongst other things, details of the type of job done, the sector and region of employment, weekly earnings and weekly hours. Importantly for the purposes of this paper, the data include a large sample of public sector teachers in England and Wales – approximately 1,000 male and 2,800 female teachers in each of the most recent years of the survey. The total sample size for each year split by sex and whether the teacher is employed in the primary or secondary sector is given in Appendix Table B.1.

Figure 3.1. Distribution of hourly earnings (£ 2006 prices), 1975 to 2006.

Lighter lines denote the 1st, 5th, 10th, 25th, 50th (median), 75th, 90th, 95th and 99th percentile of earnings respectively, while the darker line denotes mean earnings



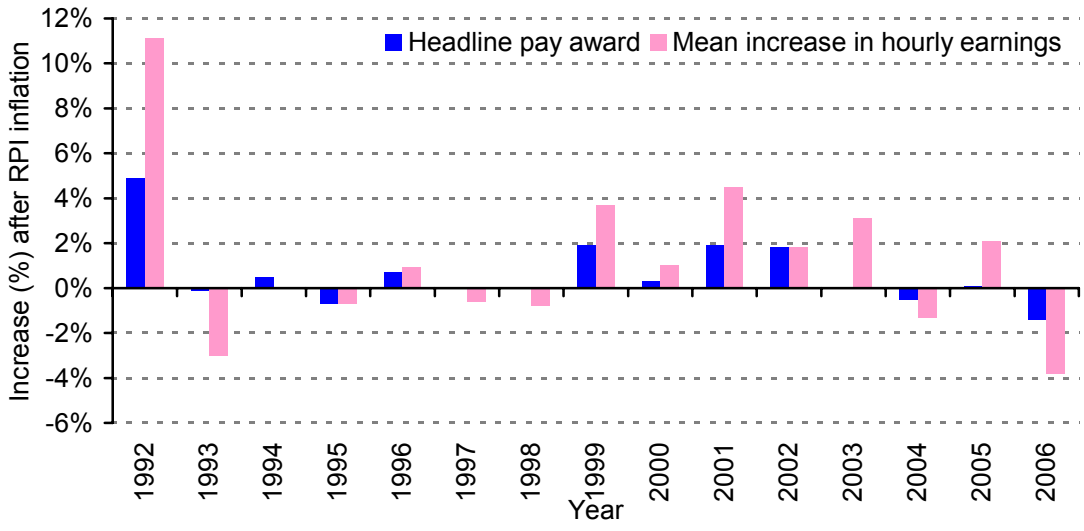
Notes: Earnings revalued to 2006 prices using the RPI. Sample size varies between 3,500 and 5,300 per year.

The age-earnings profiles for teachers are estimated using data from the ASHE for the years 1996 to 2006 (inclusive) – see subsection 4.2. Data is available from ASHE/NES on weekly earnings and weekly hours for all employees from 1975 to 2006 (inclusive). Figure 3.1 shows some summary statistics on the distribution of hourly earnings (inflated to 2006 prices using the Retail Price Index (RPI)) of teachers in England and Wales over this whole period. Mean and median earnings in each year are almost identical, suggesting that there are no significant outliers in the teachers' earnings distribution. This is to be expected given that teachers' pay scales are set centrally, but it is reassuring in that it also suggests that the ASHE/NES data on weekly earnings and hours are relatively free of measurement error. The distribution of earnings is found to have had widened over time. For example, the ratio of overall hourly earnings at the 99th percentile to those at the 1st percentile is found to be over six in recent years, compared to less than four in the late 1970s and very early 1980s.

We can validate the data another way, by comparing the annual increases in hourly earnings that are observed in the ASHE/NES data with the actual headline pay awards

(after actual inflation as measured by the RPI) given to teachers each year. These should only differ to the extent that the composition of teachers has changed from year to year and where there are no other significant sources of pay drift from, for example, overtime working, merit payments or allowances. Examples of factors that would change the composition of teachers over time include reform to pay scales or a change in the number of teachers on each pay scale. A comparison of the year-on-year increases in average (mean) teachers' pay from ASHE/NES with that implied by the headline awards, for the period since the introduction of the School Teachers' Pay Review Body in 1992 through to 2006, is presented in Figure 3.2 (both are shown after taking into account RPI inflation). This figure confirms that the average increases in average hourly earnings in ASHE/NES are typically relatively low in years with relatively low pay awards and are typically relatively high in years with relatively high pay awards. As a result the correlation co-efficient between the two series is +0.91. Looking at the differences in the most recent years of data a larger increase in estimated hourly earnings in the ASHE data than would be implied by the headline pay award is observed in 2001, 2003 and 2005 and a smaller increase that would be implied by the headline pay award is observed in 2004 and 2006. This pattern is perhaps caused by the introduction of the new three point 'Upper Pay Scale' from September 2000, with those on the scale being able to be able to apply to move up the scale (at least under normal circumstances) every two years, which led to relatively large proportions of teachers moving onto the first point in 2001, moving up to the second point in 2003, and to the third point in 2005.[13]

Figure 3.2. Comparison of headline teachers' awards and average (mean) increase in teachers' hourly earnings, 1992 to 2006.



Note: See Appendix Table B.2 for deadlines of the headline pay award for each year from 1992 to 2010.

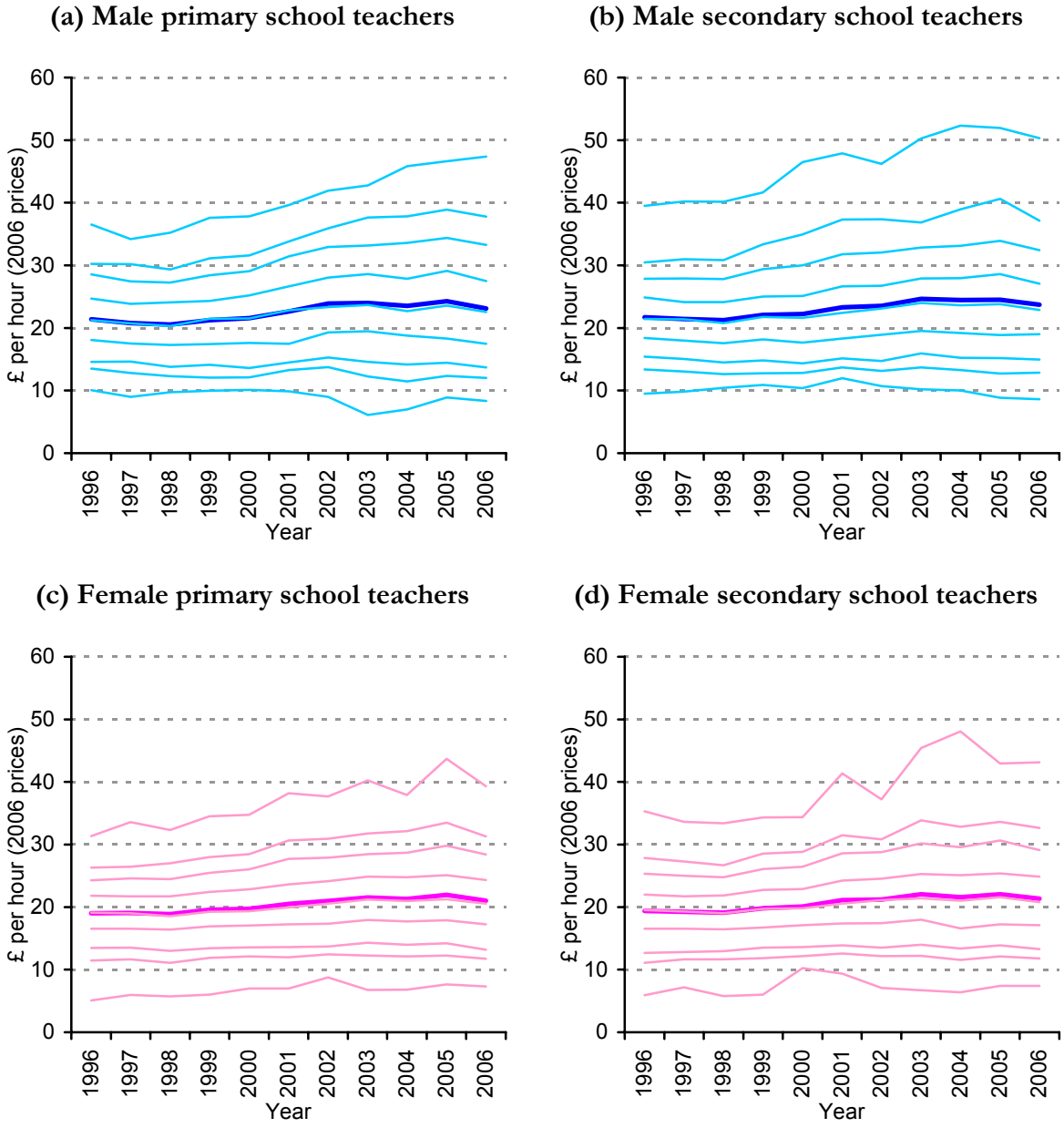
The ASHE/NES data contains information on both the sex of the teacher and whether they teach in the primary or the secondary sector. Therefore, the age-earnings profiles that are estimated using these data (see Section 4.2) are able to allow for possible

[13] For more details see Table on page 10 of Incomes Data Services (2008). For a discussion of the reform see Marsden and Belfield (2006).

differences in wage profiles by both these factors. Summary statistics on estimated hourly earnings by each of these four groups (male primary school teachers, male secondary school teachers, female primary school teachers and female secondary school teachers) over the period from 1996 to 2006 are presented in Figure 3.3. These show relatively few differences between the distribution of estimated hourly earnings among primary and secondary school teachers for either men or women, but do show slightly higher estimated hourly wages among men than among women in both the primary and the secondary sectors.

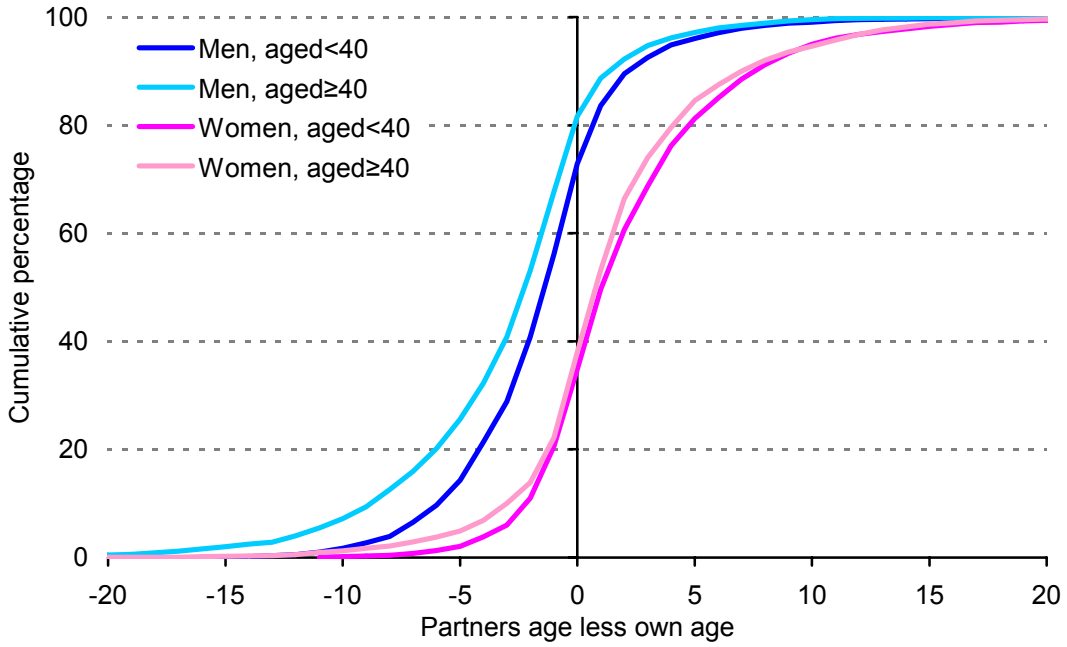
Figure 3.3. Distribution of hourly earnings (£ 2006 prices), 1996 to 2006.

Lighter lines denote the 1st, 5th, 10th, 25th, 50th (median), 75th, 90th, 95th and 99th percentile of earnings respectively, while the darker line denotes mean earnings



Notes: Earnings inflated to 2006 prices using the RPI. For sample sizes and underlying values see Appendix Table B.1.

Figure 3.4. Distribution of difference between own age and partners' age among UK graduates, by sex and whether aged below or above 40.



Note: See Table B.3 for further details.
Source: Authors' calculations using data from the Family Resources Survey 2003–04, 2004–05 and 2005–06.

The final key determinant of the expected value of pensions is how long individuals expect to live once they are in receipt of their pension (and how long they expect a surviving spouse to survive thereafter, if at all). For this, data on cohort life expectancies (i.e. ones that take into account projected improvements in mortality), which vary by both age and sex, are taken from the Government Actuary's Department.[14] These are adjusted upwards for the fact that those in social class II (which includes teachers) have in the past lived longer than average. The life expectancies of teachers' partners have also, similarly, been adjusted upwards. This increases the assumed life expectancies of men by 8.2 per cent and of women by 8.5 per cent.[15]

[14] Cohort life expectancy by age and sex is taken from the latest (2006) UK projections from the Government Actuary's Department (http://www.gad.gov.uk/Demography_Data/Life_Tables/Period_and_cohort_eol.asp).

[15] Between 2002 and 2005 life expectancy at age 65 among men in social class II was 18.0 years compared to 16.6 years overall, and for women in social class II life expectancy was 21.0 years compared to 19.4 overall. These data are taken from an update to Donkin, *et al*, (2002).

4. Methodology

This paper presents estimates of the value to members of the TPS of an additional year's pension rights. Section 4.1 describes in more detail the calculation of the value of accrued pension rights, and thus shows how the value of accruing a marginal extra year of pension rights under different plan rules can be assessed. A key input into the value of final salary DB pension rights is the expected path of future earnings. Therefore, Section 4.2 provides details of how the evolution of future earnings was estimated using the ASHE/NES data described in the previous section.

4.1. Estimating accrued pension rights

Pension schemes, in one way or another, provide members with an annual income from the date they retire to the point at which they die (and may or may not also provide an annual income to any surviving spouse or partner). In this paper, we express the value of accrued pension rights as the sum of this stream of income, taking into account the fact that an individual would rather have any income today than at some point in the future. To see that this is so, suppose an individual is offered £1 today or £1 in a year's time. He would obviously rather have £1 today than £1 in a year's time not least because he can invest his £1 today and in a year's time expect to get back more than £1.

To take into account the fact that income received sooner is worth more than income received later, we express the total value of pension rights as the discounted present value of the stream of pension income received from the date of retirement to death. This is an approach that has been used widely in other work (most recently in a UK context by Disney, Emmerson and Tetlow, 2007). This section sets out the approach taken to valuing accrued pension rights. Section 4.1.1 takes the case of final salary DB pension arrangements (such as the TPS), while Section 4.1.2 takes the case of DC pension arrangements.

4.1.1. The value of a defined benefit pension to members

The annual pension income received during retirement from a final salary DB pension plan depends on a measure of 'final' salary (see below), an accrual fraction and the number of years' tenure in the plan according to the following formula.

$$b_t = \alpha n_t y_t \qquad [1]$$

Where b_t = annual pension income from the NPA
α = accrual fraction
n_t = years' tenure up to year t
y_t = 'final' salary

For existing members of the TPS, the accrual fraction (α) is $1/80^{th}$ for each year's tenure, and members also receive a $3/80^{th}$ lump sum payable on retirement (also for each year's tenure). For new members the accrual fraction is $1/60^{th}$ but with no lump sum, though new members can choose to receive a lump sum in return for a lower annual pension by commuting up to 35 per cent of their pension income at a rate of £12

lump sum for each £1 pension income foregone. In order to aid comparison between pension values under the old and new scheme rules, it is assumed that under the new scheme members choose to receive a lump-sum of 3/80ths (i.e. the same as what it would have been under the old rules), with an appropriately reduced annual pension. As discussed in section 2, if an individual takes a 3/80ths lump sum under the new scheme rules, he will receive an annual pension income worth more than 1/80th of final salary. In other words, α is slightly higher under the new scheme rules than the old scheme rules, albeit from a later NPA.

Slightly different measures of 'final' salary are actually also applicable for service before and after 1st January 2007, as was shown in Table 2.1. However, given the information available from the ASHE/NES data (see Section 3), pay in the last year is used as the measure of 'final salary'.[16]

The lump sum is received at the point of retirement and then the annual pension income is paid to the plan member each year from the NPA until death (in addition, where applicable, a dependant's pension of half the member's annual pension is paid to any surviving partner until their death). If an individual leaves the plan before reaching the NPA, their annual pension income (received from NPA onwards) will depend on their final salary uprated by RPI to the date of retirement. Furthermore, once an individual starts drawing their pension, the amount received is also increased in line with inflation each year. In this paper, pension wealth is defined as the discounted present value of the lump sum plus the stream of pension income from retirement to death, as shown in equation 2. Employee contributions to the pension scheme are not deducted from this figure – in other words, figures for gross pension wealth are presented. Calculating the stock of pension wealth net of previous employee contributions would require assumptions about the profile of past earnings growth, since contributions in previous years will have been a fraction of earnings in any particular year. We therefore present the pension wealth figures gross of these employee contributions, in order to avoid introducing additional assumptions on top of those already discussed elsewhere in this section.

$$w_t = \delta^r \left(\frac{3}{80}\right) n_t y_t + \sum_{s=r}^{T} \delta^s \alpha n_t y_t + \sum_{q=T+1}^{T_p} \frac{1}{2} \delta^q \alpha n_t y_t \qquad [2]$$

Where δ = real intertemporal discount factor
r = number of years to retirement
T = year of member's death
T_p = year of partner's death (if later than member's)

The real intertemporal discount factor reflects the extent to which £1 today is worth more to an individual than £1 in a year's time. The intertemporal discount factor therefore takes a value of less than one, to reflect the fact that £1 in a year's time is

[16] If all pension plan members experience zero or positive real earnings growth each year, the assumption will be equivalent to the measure of 'final salary' that would actually be used by the plan.

worth less than £1 today – to be precise, in this model it is assumed to be worth £δ instead.

Equation 2 shows that by remaining in the plan for an additional year, a teacher will increase his or her pension entitlement, in exchange for a contribution of a fraction of his or her salary to the scheme. The individual's pension entitlement increases for two reasons. First, his tenure in the scheme increases (i.e. n is higher). Second, assuming he experiences some real pay growth, the final salary at which his pension rights are valued (y_t) also increases. This latter point is explored in detail in section 5.3.

The marginal benefit of remaining in the plan for an extra year will be greater the longer the individual expects to receive the pension income for (in other words, the longer is the period from retirement, r, to death of the member, T, and death of the member's partner, T_p). This is shown in equation 3. The results presented in section 5 present this accrual (w_{t+1} less w_t), net of the employee pension contribution, in terms of its value relative to current pay.

$$\begin{aligned} w_{t+1} - w_t = {} & \delta^r \left(\frac{3}{80} n\{y_{t+1} - y_t\} + \frac{3}{80} y_{t+1} \right) \\ & + \sum_{s=r}^{T} \delta^s \left(\alpha n\{y_{t+1} - y_t\} + \alpha y_{t+1} \right) \\ & + \sum_{q=T+1}^{T_p} \frac{1}{2} \delta^q \left(\alpha n\{y_{t+1} - y_t\} + \alpha y_{t+1} \right) \\ & - \delta c y_{t+1} \end{aligned} \qquad [3]$$

Where c = employee contribution rate.

Estimates of pension wealth and pension accrual arising from the value of the dependents addition are included by using data on the distribution of partners' age (by both age and sex) among graduates observed in the FRS (see Figure 3.4 and surrounding text).

Pension wealth next year depends crucially on pay next year (y_{t+1}). So a key component in estimating the accumulation of pension wealth is the estimation of age-earnings profiles for teachers, which is discussed in Section 4.2.

Note that importantly there are two components to pension accrual. First (and perhaps most obviously), the addition of one extra year of pension membership (at the new level of earnings). Second, the revaluation of previous years of pension membership to the new level of earnings. This second component means that pension accrual depends in part on current pension tenure. Unfortunately, the ASHE/NES data do not contain any information on pension tenure. Therefore, each individual in the sample is assigned the mean pension scheme tenure recorded in the DTR for teachers of the same age and sex and working in the same sector.

4.1.2. The value of a defined contribution pension to members

In this paper, the value of a defined contribution pension is defined in an analogous way to that used to value defined benefit pensions: the discounted present value of the stream of pension income that will be received from the date of annuitisation of the pension fund until death. The value of an additional year's pension accrual is given by the expression in equation 4. An additional year's pension contribution is added to a pension fund, which receives a real investment return (x) until the point of annuitisation. At that point, an annuity is purchased (at rate ρ) which provides an annual income until death (at time T). In return for this extra stream of pension income, the employee gives up some fraction (c) of his current salary.

$$w_{t+1} - w_t = \sum_{s=r}^{T} \delta^s \Delta b_t - c y_t \qquad [4]$$

Where $\Delta b_t = \bar{c} \rho y_t (1+x)^r$

and ρ = gender-specific indexed annuity rate
δ = real intertemporal discount factor
x = real investment return
c = employee contribution rate
$\bar{c}$ = combined employer and employee contribution rate

As is the case for the value of final salary DB schemes, figures for the value of DC pension accrual in section 5.5 are expressed as percentage points of current salary. The results presented in section 5.5 make three assumptions about the parameters in equation 4. First, it is assumed that both employers and employees make a 5 per cent of salary contribution to the DC pension each year (that is, c is equal to 5 per cent and $\bar{c}$ is equal to 10 per cent). Second, it is assumed that individuals annuitise their pension fund at age 65 at the second best age- and gender-specific annuity rates quoted by the FSA in October 2008.[17] Third, specific assumptions are made about the investment return that individuals receive on their pension funds – this is described in more detail in section 5.5.

4.2. Simulating earnings growth

Estimating the value of an additional year's pension accrual depends crucially on making an assumption about the earnings growth that will be experienced by a teacher over the next year. Previous work (Disney, Emmerson and Tetlow, 2007) suggests that public sector employees experience a different profile of earnings increases over their lifetimes than do private sector workers. Therefore, the large sample sizes available in the ASHE/NES data are utilised to estimate age-earnings profiles for teachers using historic data specifically on public sector teachers' hourly earnings. Using data on hourly earnings avoids problems that can arise when estimating earnings profiles using annual earnings

[17] To take account of the fact that future annuity rates are likely to be reduced by expected future increases in longevity, it is assumed that all individuals actually have the post-65 life expectancy of current 65 year-olds.

data given the higher prevalence of part-time working amongst women and certain age groups.

Since the ASHE/NES data contains relatively large sample sizes, we are able to analyse statistically earnings profiles for four groups: male primary school teachers, male secondary school teachers, female primary school teachers and female secondary school teachers. This same split was used in previous analysis of teachers' pay using the NES (see Dolton and Chung (2004) and Dolton (2005)).

The following model was estimated separately for each of the two groups of men, where y_{it} is log hourly earnings, Z_t is a vector of year dummies and *age* is normalised such that it equals zero for those aged 30. These regressions were estimated using ordinary least squares. As the same individuals were observed in multiple years of the survey, standard errors were clustered at the individual level.

$$y_{it} = Z_t'\alpha + \beta_1 age_{it} + \beta_2 age_{it}^2 + u_{it} \qquad [5]$$

Earnings paths for women in both primary and secondary schools were found to display a different pattern before and after age 30 (shown in panels (c) and (d) of Figure 4.1). Therefore, the following model was estimated for primary and secondary school female teachers; it allows for a different functional form up to age 30 and after age 30.

$$\begin{aligned} y_{it} = Z_t'\alpha &+ 1[age_{it} \le 30]\gamma_1 age_{it} + 1[age_{it} \le 30]\gamma_2 age_{it}^2 \\ &+ 1[age_{it} > 30]\delta_1 age_{it} + 1[age_{it} > 30]\delta_2 age_{it}^2 + u_{it} \end{aligned} \qquad [6]$$

The full results of these models (estimated using data from 1996 to 2006) are presented in Table 4.1. For both primary and secondary school males a positive co-efficient is found on age and a negative co-efficient is found on age squared. The magnitude of these co-efficients implies that, on average, real terms hourly earnings increase up to about age 51 and then decline.[18] The co-efficients for primary and secondary school women are harder to interpret, but imply a relatively linear increase in hourly earnings with respect to age, with both cases showing that wages typically increase less quickly after age 30. Among secondary school women real hourly earnings appear to peak in the early 50s, whereas in contrast there is less evidence of any peak in the real hourly earnings of primary school women. These findings are shown more clearly in panels a-d of Figure 4.1, which shows the results from the quadratic age specifications (equations 4 and 5) overlaid on the results from regressions estimated with a full set of age dummies.[19]

[18] This is because both 0.0292 / (2 * 0.0007) and 0.0299 / (2 * 0.0007) are approximately equal to 21, and since the regressor is age less 30 this implies a turning point in log earnings with respect to age around age 51.

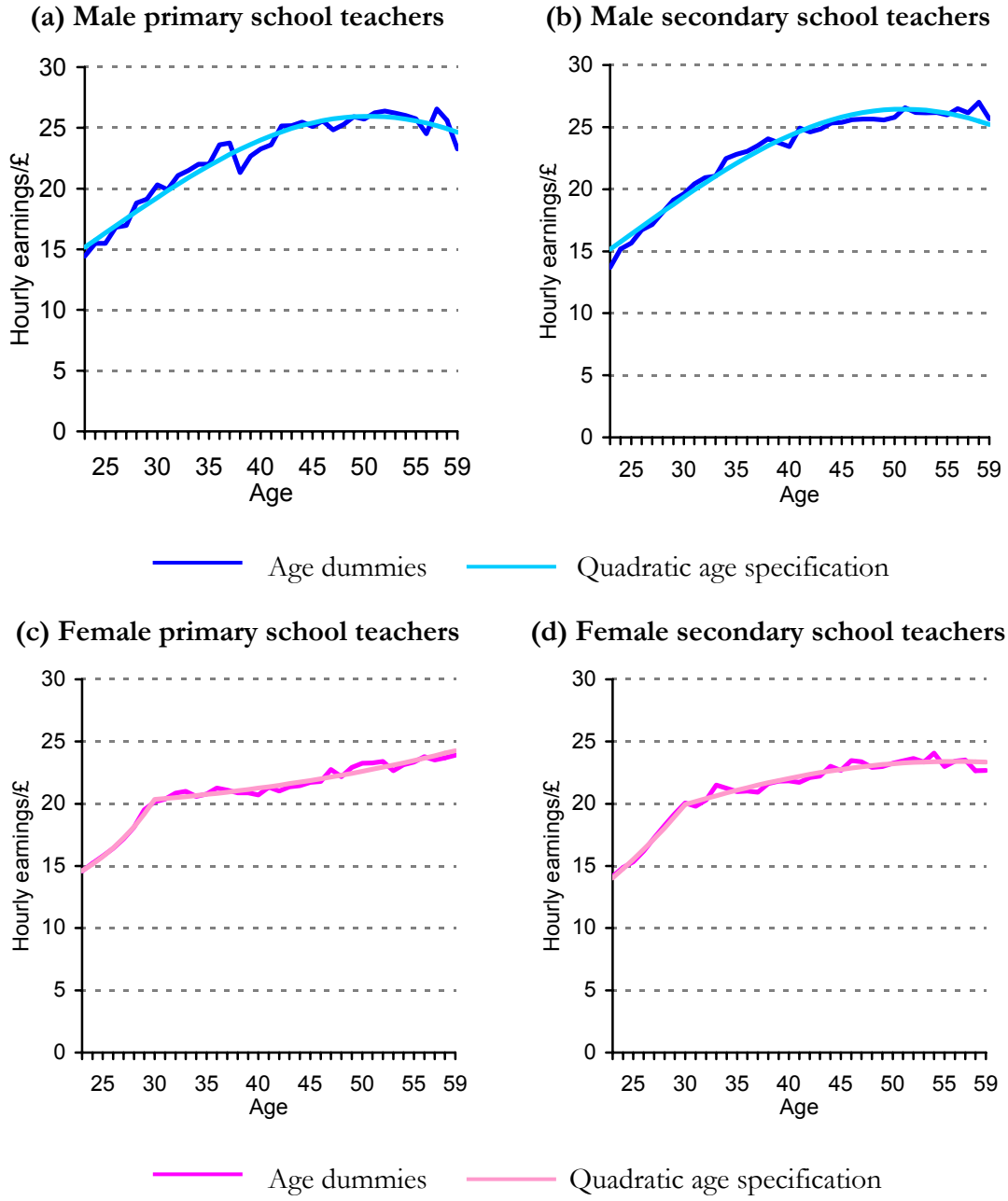
[19] Full results from the regression with complete age dummies are available from the authors on request.

Table 4.1. Results from log earnings regressions (1996 to 2006, inclusive).

	Men		Women	
	Primary	Secondary	Primary	Secondary
Age	0.0292***	0.0299***		
	(0.0021)	(0.0014)		
Age ^ 2	–0.0007***	–0.0007***		
	(0.0001)	(0.0001)		
Age (≤30)			0.0609***	0.0493***
			(0.0070)	(0.0078)
Age (≤30) ^ 2			0.0019***	–0.0001***
			(0.0010)	(0.0011)
Age (>30)			0.0035***	0.0125***
			(0.0018)	(0.0021)
Age (>30) ^ 2			0.0001***	–0.0002***
			(0.0001)	(0.0001)
Year 1996	2.8426***	2.8329***	2.8687***	2.8555***
	(0.0152)	(0.0104)	(0.0145)	(0.0152)
Year 1997	2.8140***	2.8243***	2.8834***	2.8602***
	(0.0151)	(0.0106)	(0.0132)	(0.0143)
Year 1998	2.8108***	2.8178***	2.8724***	2.8537***
	(0.0145)	(0.0109)	(0.0128)	(0.0146)
Year 1999	2.8445***	2.8521***	2.9088***	2.8854***
	(0.0147)	(0.0100)	(0.0126)	(0.0143)
Year 2000	2.8498***	2.8515***	2.9178***	2.9020***
	(0.0165)	(0.0116)	(0.0126)	(0.0139)
Year 2001	2.8925***	2.9039***	2.9496***	2.9408***
	(0.0173)	(0.0107)	(0.0130)	(0.0144)
Year 2002	2.9382***	2.9197***	2.9750***	2.9506***
	(0.0188)	(0.0113)	(0.0127)	(0.0144)
Year 2003	2.9322***	2.9521***	2.9912***	2.9761***
	(0.0214)	(0.0123)	(0.0127)	(0.0149)
Year 2004	2.9079***	2.9478***	2.9828***	2.9524***
	(0.0220)	(0.0132)	(0.0128)	(0.0158)
Year 2005	2.9590***	2.9534***	3.0099***	2.9853***
	(0.0203)	(0.0130)	(0.0130)	(0.0142)
Year 2006	2.9201***	2.9266***	2.9705***	2.9516***
	(0.0203)	(0.0124)	(0.0126)	(0.0137)
Sample size	*3,230*	*7,571*	*15,705*	*10,906*

Note: Age refers to age less 30. ^ 2 is the square of the individual's age. Standard errors, clustered at the individual level, shown in parenthesis. Statistical significance at the 10 per cent, 5 per cent, and 1 per cent level denoted by *, ** and *** respectively.

Figure 4.1. Estimated hourly earnings profiles.



Note: Estimated using hourly earnings data from ASHE/NES, 1996–2006. This is done using the regression co-efficients from log-earnings equations (reported in Table 4.1), with an adjustment following equation 6.40 of Wooldridge (2002), to allow for the change of focus from log earnings to earnings. Sample sizes are 3,230 male primary school teachers, 7,571 male secondary school teachers, 15,705 female primary school teachers, and 10,906 female secondary school teachers.

As described in Section 2 the ASHE/NES data contains years from 1975 onwards. Therefore, it is possible to estimate the log hourly earnings profiles over a longer period, with the larger sample size potentially improving further the precision of the estimates. A possible concern with using data over a longer time span is that the relationship of hourly wages by age might have changed over time, and therefore using these observations might provide a worse indication of how teachers' pay will evolve with age in the future. Previous analysis of the profile of teachers' earnings by age for each fifth

year from 1975 to 2000 (see Chart 4 and Chart 5 of Dolton and Chung (2004)) suggests that the shape of teachers age-earnings profiles has indeed changed over time.

Another concern with using ASHE/NES data prior to 1996 is that the variable in the data that is used to identify whether or not an individual is employed in the public sector changes in 1996.[20] This is associated with a dramatic change in the percentage of teachers who are flagged as working in the public sector. Specifically prior to 1996 fewer than 1 per cent of individuals in England and Wales employed as primary or secondary school teachers are identified as working outside the public sector whereas from 1996 onwards this jumps to around 14 per cent (further details see Figure A.1). The latter figure seems more likely to be correct given that 7 per cent of pupils in the UK are educated in the independent sector.[21] It should be noted, however, that the erroneous inclusion of teachers from outside the public sector would only bias the analysis to the extent that the age-earnings profiles of teachers outside the public sector differed from those in the public sector.

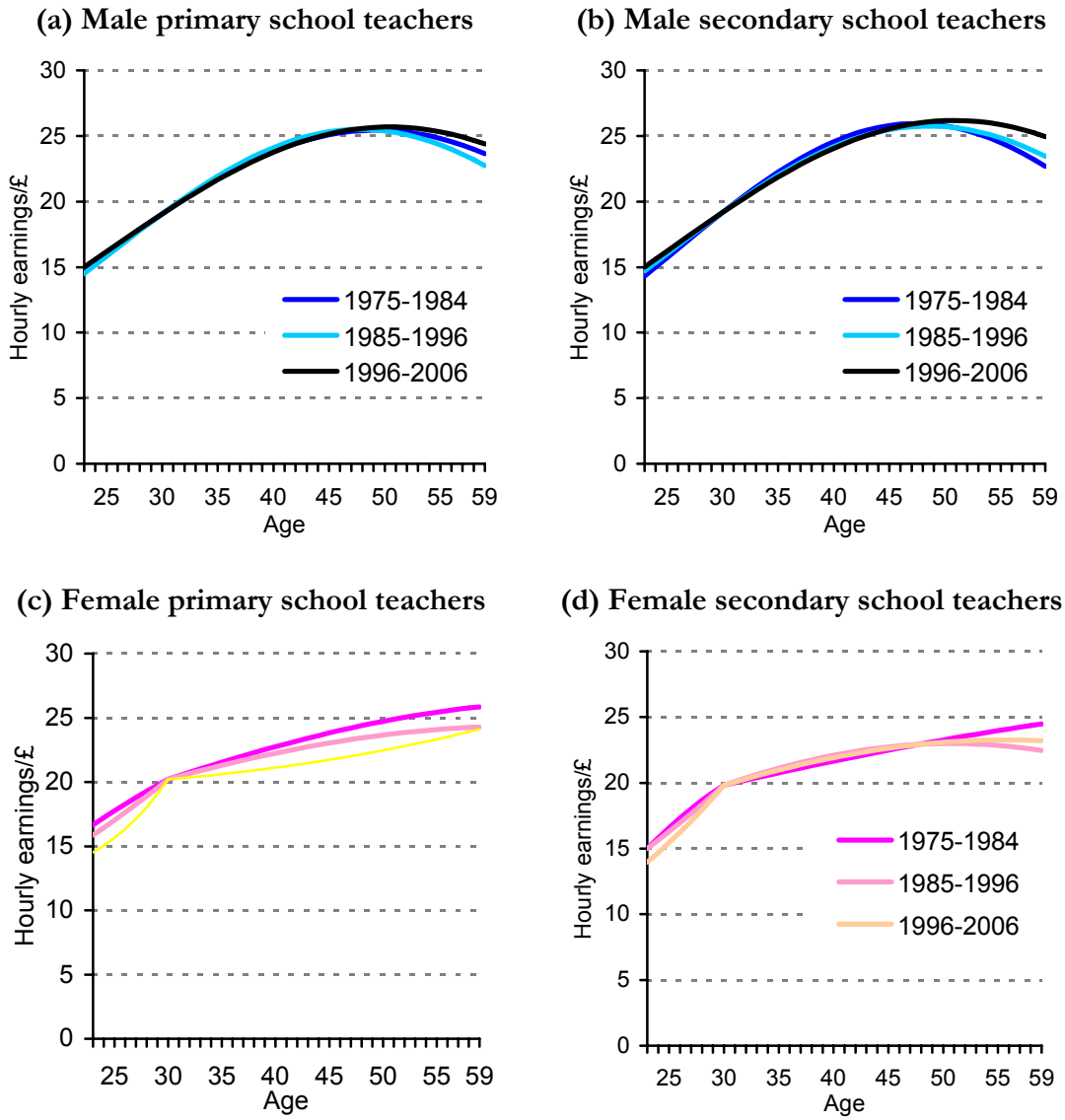
To investigate these issues, estimates of the evolution of log hourly earnings by age were calculated using the full range of data from 1975 to 2006 and allowing for different age coefficients in three periods (1975–1984, 1985–1995 and 1996–2006) as well as a full set of year dummies. The results suggest that the estimated age-earnings profiles have changed slightly over this period, with likelihood ratio tests revealing that the differences are statistically significant. The three alternative profiles are shown (for each of the four groups) in panels a-d of Figure 4.2 (full results are in Appendix Table B.4), with the mean earnings of thirty year-olds in each period normalised to that of thirty year-olds in 2006. For men (both primary and secondary teachers), the age-earnings profile is flatter in recent years than it was previously. For women, the comparison is slightly different – earnings growth is faster for women in their twenties but (for primary school teachers at least) somewhat slower from thirty onwards in the latest period.

These differences could reflect a genuine change in the age-earnings profiles of teachers in the public sector over time. Alternatively, they could reflect a difference in the age-earnings profiles of teachers in the public sector compared to those employed outside the public sector with the latter being incorrectly included prior to 1996 but correctly excluded from 1996 onwards. Under either scenario, the data from 1996 to 2006 are likely to be a better guide to the evolution of teachers' pay with age in the future and therefore the analysis of pension rights presented in the next section uses earnings profiles estimated on the post 1996 period only.

[20] It is "tpub4" prior to 1996 and "idbrsta" from 1996 onwards.

[21] Source: Independent Schools Council (ISC) website (http://www.isc.co.uk/FactsFigures_PupilNumbers.htm).

Figure 4.2. Estimated hourly earnings profiles.



Note: Estimated using hourly earnings data from ASHE/NES, 1975–2006. This is done using the regression co-efficients from log-earnings equations (reported in Table B.4), with an adjustment following equation 6.40 of Wooldridge (2002), to allow for the change of focus from log earnings to earnings. Sample sizes are 8,810 male primary school teachers, 24,934 male secondary school teachers, 40,059 female primary school teachers and 28,468 female secondary school teachers.

5. The value of pension wealth and accrual

This section presents the results. Section 5.1 focuses on the accumulated pension rights of TPS members and provides a comparison to what the accumulated rights would have been had the reformed system been implemented before all current members joined the plan.[22] Sensitivity analysis of these figures to the assumed discount rate is also presented.

Section 5.2 turns to the main focus of this paper, namely *future* expected pension accrual. In particular, how much is one year's additional accrual of pension rights worth compared to one year's extra pay? This is calculated first under the old TPS rules and second assuming the new rules had been fully implemented for all current members. Sensitivity analysis of these figures to the assumed discount rate is also presented.

Section 5.3 examines how one period pension accrual is affected by the overall size of the teachers' pay award. Section 5.4 describes the sensitivity of one-period pension accrual within the TPS to different earnings profiles. Finally, Section 5.5 compares TPS accrual with that of a stylised DC pension arrangement.

5.1. Accumulated pension wealth

The majority of current teachers have a significant amount of wealth accumulated in the form of pension promises from the TPS. As Table 5.1 shows, in 2007, median accumulated pension rights in the TPS were 2.12 times a teacher's current salary. In other words, if the teacher who had the median level of accrued rights earned £30,000 per year, this figure – 2.12 times current salary – implies that his accumulated pension rights are worth £63,600. If instead these pension rights had been accumulated under the TPS rules for new entrants, this figure would have been reduced to 1.82 times current salary – in other words, a reduction in wealth equal to 30 per cent of current salary, or about one-seventh (14.2 per cent) of the level of total pension wealth under the old scheme rules.

As was discussed in section 4.1.1, the value of accumulated rights relative to current salary is highest for those with longer pension tenure, longer life expectancy and those whose partners are expected to outlive them by the greatest margin. It is not surprising, therefore, that Table 5.1 shows that older teachers have on average higher accrued pension entitlements, as they will have typically been members of the scheme for a greater number of years. Teachers aged forty and over have median accrued pension rights worth 4.86 times their current salary, whereas those aged under forty have accrued rights in the pension scheme worth, on average, only 0.95 times their salary.

Though female teachers have longer life expectancies on average than male teachers, which should boost the value of their pension rights, Table 5.1 shows that this effect is offset by two other factors. First, female teachers have, on average, shorter tenures in the scheme than male teachers do and, second, male teachers are more likely to have

[22] It is also assumed that nothing else, including both teachers' pay awards and recruitment and retention outcomes, changed.

partners who will outlive them and thus receive survivors' benefits. Therefore, overall female teachers have median accrued rights worth 2.12 times current salary, while male teachers have rights worth on average 2.22 times current salary.

The estimated reduction as a result of the change in scheme rules (both in terms of current earnings and as a share of total accumulated rights) is found to vary very little by either sex or sector. The estimated reduction in pension rights is, however, slightly lower for those aged under forty than for those aged forty and over.

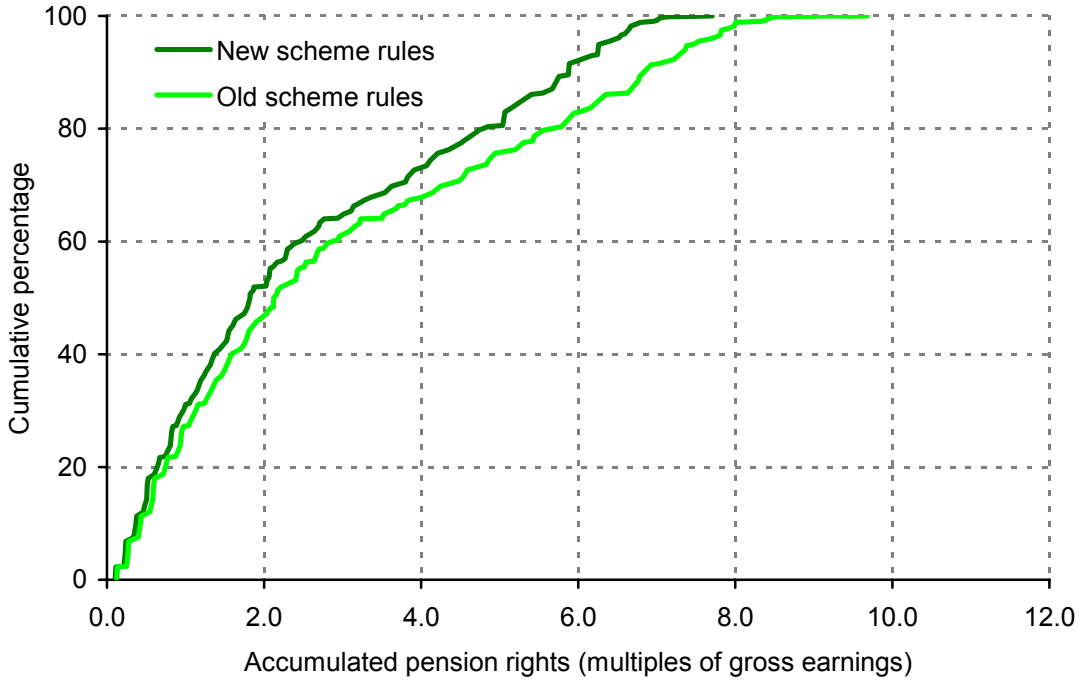
Table 5.1. Median estimated accumulated gross pension rights as a multiple of current earnings under pre and post January 1st 2007 TPS, by sex, sector and age group.

	Old	New	Difference (%)
All			
All	2.12	1.82	–14.2
Primary school	2.12	1.82	–14.2
Secondary school	2.16	1.82	–15.8
Aged under 40	0.95	0.82	–13.6
Aged 40 and over	4.86	4.12	–15.2
Men			
All	2.22	1.87	–15.8
Primary school	2.16	1.82	–15.8
Secondary school	2.45	2.06	–15.9
Aged under 40	1.04	0.88	–15.1
Aged 40 and over	5.20	4.35	–16.3
Women			
All	2.12	1.82	–14.2
Primary school	2.12	1.82	–14.2
Secondary school	2.12	1.82	–14.2
Aged under 40	0.95	0.82	–13.6
Aged 40 and over	4.83	4.12	–14.7

Note: Figures use an annual discount rate of 2½ per cent. See Table 5.2 for sensitivity analysis.

The complete distribution of estimated accrued TPS rights, under both the previous and the new TPS rules, is shown in Figure 5.1. This highlights the fact that some individuals have accumulated substantial pension wealth as a share of their current earnings. This is not surprising insofar as, if an individual makes 30 years of contributions to a 1/60th final salary pension and receives the pension income for 20 years, then (ignoring discounting) the accumulated pension would be worth around 20 × 30 / 60ths of final salary – i.e. about 10 times final salary. What is also clear from Figure 5.1 is that, had the new TPS rules been fully applied to retrospective rights, the accumulated rights would have been reduced by about one-seventh right across the distribution.

Figure 5.1. Distribution of accumulated gross pension rights under pre and post January 1st 2007 TPS.



Note: Figures use an annual discount rate of 2½ per cent, see Table 5.2 for sensitivity analysis.

5.1.1. Sensitivity to choice of discount rate

As pension wealth is expressed as the discounted present value of future pension income (as discussed in section 4.1.1), the estimated value of accumulated pension rights is highly sensitive to the choice of discount rate. This is true not only of the pension wealth estimates presented here but also of, for example, the Government Actuary's Department official estimates of the total TPS liabilities. Recent years have seen a large increase in successive Government Actuary's Department estimates of the unfunded liabilities of public sector pension plans, at least in part because the discount rate used in calculating liabilities has been declining (see, for example, Figure 8.9 of Bozio and Johnson (2008)). The figures presented in Table 5.1 and Figure 5.1 are based on a 'central' assumption of an annual real discount rate of 2½ per cent, which is the same as the rate that will be used for official estimates of the unfunded liabilities of public sector schemes as at 31st March 2008.[23] To illustrate the sensitivity of these estimates to alternative discount rate assumptions, Table 5.2 presents estimates of accumulated pension wealth based on alternative higher (3½ per cent[24]) and lower (1 per cent) real discount rates.

[23] The official estimates use the AA corporate bond rate which for 31st March 2008 was 2½ per cent. Source: HM Treasury (2008b).

[24] 3½ per cent is the rate recommended by the Treasury for discounting the future costs and benefits of potential public sector projects (see Annex 6 of HM Treasury (2006)), and up to 2005 was also the rate that was used by the Government Actuary's department to assess unfunded public sector pension liabilities.

Table 5.2. Sensitivity of estimates of median accumulated gross pension wealth as a multiple of current earnings to choice of discount rate, by pre and post January 1st 2007 TPS and sex.

	Old	New	Difference (%)
2½% discount rate			
All	2.12	1.82	–14.2
Men	2.22	1.87	–15.8
Women	2.12	1.82	–14.2
3½% discount rate			
All	1.56	1.29	–17.0
Men	1.66	1.36	–18.5
Women	1.56	1.29	–17.0
1% discount rate			
All	3.45	3.10	–10.2
Men	3.48	3.07	–11.9
Women	3.45	3.10	–10.2

Under the higher discount rate, the estimated value of accumulated rights is much smaller. In addition, the higher assumed discount rate also leads to a larger – at least in percentage terms – estimate of the reduction in accumulated rights that would occur had the new TPS rules been applied to existing rights (note, however, that the reduction as a share of earnings is lower). This is due to the fact that the higher NPA delivers savings that are relatively up-front (in that they are realised between the ages of 60 and 65) whereas the enhanced accrual rate increases costs that are relatively back-loaded (in that it increases annual pension payments from age 65 onwards). A higher discount rate will reduce the cost of the latter relative to the savings from the former. Similarly, a lower assumed discount rate is found to increase the estimated value of accumulated rights, and to reduce the percentage reduction that would be brought about by fully applying the new TPS rules retrospectively (but, also similarly, leads to a larger percentage point reduction in accumulated pension rights as a share of current earnings).

5.2. Future pension accrual

Accumulated rights are clearly very valuable to TPS members. However, when considering the value to a teacher of working an additional year, it is most useful to think about how the value of an *additional* year's worth of pension rights compares to the current pay received over the same period. In other words, one would like to know the value of the marginal pension accrual rather than the value of the stock of accrued rights. This section, therefore, presents estimates of the expected value of pension accrual over the next year, measured as a share of current earnings. In particular, the focus is on the extent to which expected pension accrual under the new TPS rules differs from that implied by the TPS rules prior to 1st January 2007.

This section presents baseline estimates of the value of pension accruals using the earnings growth implied by the estimated age co-efficients presented in Table 4.1.

Sensitivity analysis of these figures to the assumed discount rate is presented in Appendix A.

The value of annual pension accruals depends on the length of post-NPA life expectancy. This has increased significantly over recent decades. Therefore, an interesting counterfactual is how much lower the value of pension accrual would be if current TPS members had the life expectancy of people of the same age in earlier years. To look at this, section 5.2.2 presents estimates of the value of pension accrual based on 1981 life expectancies.

5.2.1. The value of future pension accrual under the old and new TPS rules

This section presents estimates of the value to scheme members of an additional year's pension accrual, assuming that earnings growth is as implied by the estimated age co-efficients presented in Table 4.1. In other words, the earnings profiles shown in Figure 4.1 are used. This scenario is equivalent to assuming that future teachers' pay awards are equal to inflation (as measured by the RPI). Real changes in overall teachers' pay in the sample will then only arise due to changes in the age composition of teachers, in other words they will reflect 'incremental drift' in pay. On average (i.e. the mean) in each year of the data, this incremental pay drift leads to teachers experiencing an increase in annual pay of 1.6 per cent in real terms.

Estimates of the average (median) value of expected one-period pension accrual are provided in Table 5.3. Overall, under the TPS rules applying to those who joined before 1st January 2007, pension accrual is estimated to be worth an average of 14.7 per cent of earnings. Applying instead the TPS rules for new members – in particular the higher (i.e. less generous) NPA and the higher (i.e. more generous) accrual rate – leads to an overall reduction in the size of pension accrual relative to current pay. Average accrual is reduced by 3.5 percentage points of earnings.

Both under the old TPS rules but also under the new rules, it is clear from Table 5.3 that annual pension accrual is a large component of total annual remuneration. Under the old scheme rules, accrual of pension rights was worth about one-seventh of current salary. In other words, on average teachers receive one-eighth of their total annual remuneration (i.e. pay plus pension accrual) in the form of deferred pay. Under the new scheme rules, this falls to about one-tenth of total remuneration being received in the form of deferred pay.

Under both the old and the new TPS rules, annual accrual of pension entitlement is worth more to women than to men, on average. This fact is the result of a number of different factors boosting the pension rights of men compared to women and vice versa. Men have shorter life expectancies (and therefore a shorter average length of time from the NPA to death) than women, which boosts the accrual of pension rights amongst women compared to otherwise identical men. However, two factors partially offset this. First, men have, on average, longer tenures in the scheme than women have. Second, the partners of men have, on average, longer life expectancies than the partners of women (since the partners of men are more likely to be female and, as shown in Figure 3.2, are also more likely to be younger).

Under both the old and the new scheme rules, accrual of pension rights is highest for those aged forty and over. This is because, though younger individuals have higher earnings growth each year (see Figure 4.1), older teachers have much longer pension plan tenure, which boosts the value of staying in the scheme for an extra year (as discussed in section 4.1.1). Table 5.3 shows that there is relatively little difference in average expected one-period pension accrual by sector. This is true regardless of whether one-period pension accrual is estimated under the old or the new TPS rules.

Table 5.3. Median estimated one-period pension accrual (net of employee contribution) under pre and post January 1st 2007 TPS, by sex, age group and sector, per cent of earnings.

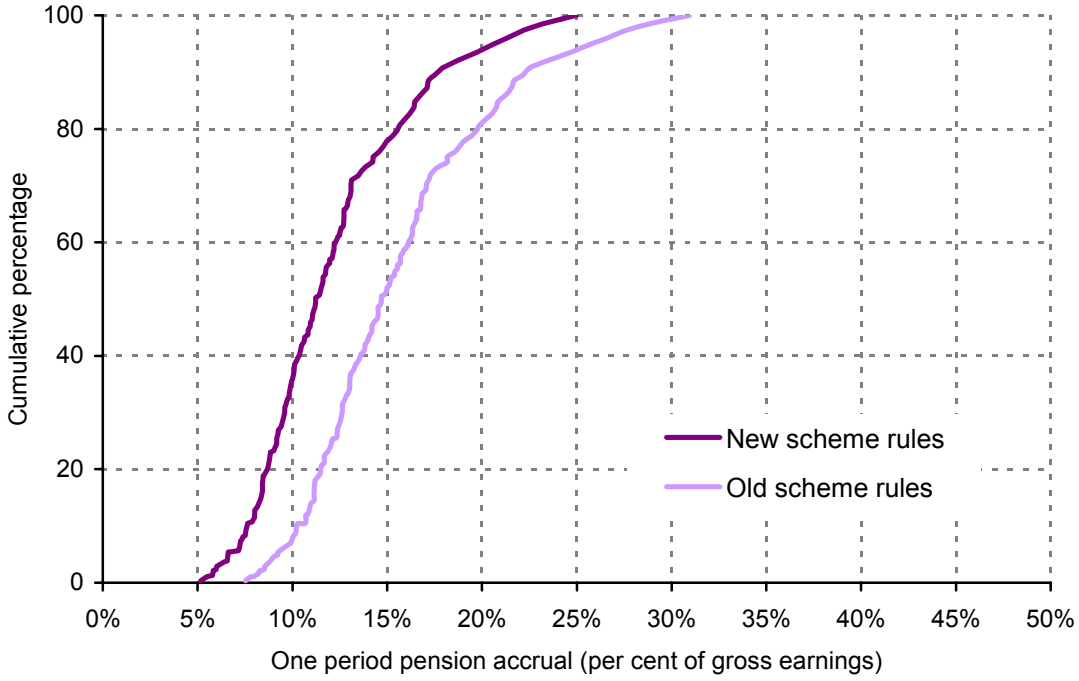
	Headline pay award equal to RPI; resulting average real pay increase in sample = 1.6%		
	Old (% salary)	New (% salary)	Diff (%)
All			
All	14.7	11.2	–23.7
Primary school	15.1	11.5	–23.6
Secondary school	14.5	11.1	–23.8
Aged under 40	12.1	9.2	–24.0
Aged 40 and over	18.2	14.3	–21.5
Men			
All	14.3	10.6	–26.1
Primary school	13.9	10.4	–25.1
Secondary school	14.5	10.9	–24.7
Aged under 40	12.1	9.0	–25.8
Aged 40 and over	16.0	12.1	–24.4
Women			
All	15.2	11.8	–22.5
Primary school	15.2	11.8	–22.5
Secondary school	15.0	11.6	–22.6
Aged under 40	12.1	9.2	–24.0
Aged 40 and over	20.2	15.9	–21.2

Note: Figures use an annual discount rate of 2½ per cent. See Table 5.4 for sensitivity analysis.

The complete distribution of estimated one-period pension accrual, under both the old and the new TPS rules, is shown in Figure 5.2. This shows that there is a relatively wide dispersion in estimated one-period pension accrual. The vertical axis shows the percentage of teachers whose one-period pension accrual is less than any given percentage of their current pay (as shown on the horizontal axis). For example, around 20 per cent of TPS members covered by the pre-reform pension plan rules are estimated to accrue additional pension rights worth at least 20 per cent of their earnings. In contrast, under the new TPS rules this falls to around 6 per cent of teachers accruing

additional pension rights worth at least 20 per cent of earnings, with nearly 40 per cent of teachers accruing rights worth less than 10 per cent of their earnings.

Figure 5.2. Distribution of estimated one-period pension accrual (net of employee contribution) under pre and post January 1st 2007 TPS.



Note: Figures use an annual discount rate of 2½ per cent. See Table 5.4 for sensitivity analysis.

5.2.2 The value of pension accrual to an earlier cohort of TPS members

While life expectancies have increased steadily over recent decades, the rules of the Teachers' Pension Scheme have not reflected this change – at least until the reforms enacted in 2007. The cost of making pension payments for longer as a result of increased longevity has, therefore, fallen entirely on public sector employers (and thus ultimately on the taxpayer). One possible reason for reforming the TPS rules has been that the level of benefits implied by the TPS rules has increased in a way that perhaps was not originally anticipated. This section examines how the current value of annual pension accrual under the old TPS rules changes (from those shown in the previous subsection) if instead teachers are assumed to have the same life expectancy as individuals of the same age in 1981 would have expected. Average female teachers' life expectancy is thereby reduced by 3.5 years and that of male teachers by 4.2 years when 1981 cohort life expectancies are used instead of 2006 cohort life expectancies.

Table 5.4 shows that, because of lower average life expectancies in 1981, the median value of pension accrual would have been 1 percentage point of salary lower if TPS members had the life expectancy of 1981 scheme members rather than current life expectancy. In other words, the level of benefits offered by the scheme has increased significantly because of improved life expectancy. However, the increase in benefits over this 25-year period is not as large as the cut in benefits that will result from moving to the new TPS rules. As shown in Table 5.4, the median reduction in benefits from this change is 3.5 percentage points of salary – in other words, more than three times as large

as the increase in benefits that has resulted simply from increases in average life expectancy over the last 25 years.

Table 5.4. Median estimated one-period pension accrual (net of employee contribution) under pre January 1st 2007 TPS, assuming 1981 and 2006 cohort life expectancies, by sex, age group and sector, per cent of earnings.

	Headline pay award equal to RPI; resulting average real pay increase in sample = 1.6%		
	1981 life expectancy Old rules	2006 life expectancy Old rules	2006 life expectancy New rules
All			
All	13.7	14.7	11.2
Primary school	13.8	15.1	11.5
Secondary school	13.4	14.5	11.1
Aged under 40	11.2	12.1	9.2
Aged 40 and over	16.2	18.2	14.3
Men			
All	13.3	14.3	10.6
Primary school	13.2	13.9	10.4
Secondary school	13.3	14.5	10.9
Aged under 40	11.6	12.1	9.0
Aged 40 and over	14.8	16.0	12.1
Women			
All	13.8	15.2	11.8
Primary school	13.8	15.2	11.8
Secondary school	13.7	15.0	11.6
Aged under 40	11.0	12.1	9.2
Aged 40 and over	17.4	20.2	15.9

Note: Figures use an annual discount rate of 2½ per cent. See Table A.1 for sensitivity analysis.

5.3. The effect of a headline real pay increase on the value of pension accruals

The value of annual pension accruals is directly affected by changes in current pay (as shown in section 4.1.1). Our baseline estimates of the value of a year's pension accrual relative to current salary (presented in section 5.2), assume that pay awards reflect increases in inflation (at 2%) and that pay increases over and above come about from individuals getting older and moving along the age-earnings profile shown in Figure 4.1. Any deviation of pay growth from this baseline would lead individuals to experience faster (or slower) pay growth than our baseline assumes, and the value of annual pension accrual would also be higher (or lower). However, because of the way final salary DB pensions are structured, the effect of faster/slower current pay growth is amplified in its

effect on the value of annual pension accrual. This section examines this point in more detail.

Equation 7 below reproduces equation 3, from section 4.1.1, under the assumption that there is no real increase in current pay (i.e. y_{t+1} is equal to y_t, where both are expressed in real terms). Equation 7, therefore, shows the value of an additional year's pension accrual if earnings remain constant in real terms over the next year.

$$\begin{aligned} w_{t+1} - w_t = {} & \delta^r \left(\frac{3}{80} y_t \right) \\ & + \sum_{s=r}^{T} \delta^s (\alpha y_t) \\ & + \sum_{q=T+1}^{T_p} \frac{1}{2} \delta^q (\alpha y_t) \\ & - \delta c y_t \end{aligned} \qquad [7]$$

If instead earnings were to grow by g per cent in real terms, the value of current pay next year would be equal to $(1+g)$ times the value of current pay this year. However, the effect on the value of annual pension accrual is larger. This is shown in equation 8, which is derived by substituting $y_{t+1}=(1+g)y_t$ into equation 3. The expression in equation 8 is equal to more than $(1+g)$ times the expression in equation 7.

$$\begin{aligned} w_{t+1} - w_t = {} & \delta^r \frac{3}{80} \left(ngy_t + (1+g) y_t \right) \\ & + \sum_{s=r}^{T} \delta^s \left(\alpha ngy_t + \alpha (1+g) y_t \right) \\ & + \sum_{q=T+1}^{T_p} \frac{1}{2} \delta^q \left(\alpha ngy_t + \alpha (1+g) y_t \right) \\ & - \delta c (1+g) y_t \end{aligned} \qquad [8]$$

Consequently, when pay increases by g per cent, the value of remuneration in the form of pensions increases by more than g per cent. If the pay growth is lower than inflation (i.e. g is less than zero), this obviously means that the decline in pension accrual value, relative to the baseline of no real pay growth, is also more than g per cent. As pensions form a significant proportion of total remuneration (see subsection 5.2.1), the impact of this latter effect on the growth in total remuneration is non-negligible and thus total remuneration grows by more than g per cent. This is an important point for those who set public sector pay awards – and more generally for those setting pay awards for employees who are members of a final salary pension scheme – to bear in mind: under such systems, a headline pay rise of g per cent does not imply that total remuneration will also increase by g per cent.

This impact on total remuneration may not matter for individuals at an early stage of their career. It is in the nature of pay settlements over time that higher headline pay growth in one year may be offset by lower growth in another year, meaning that over time the level current pay (and hence pension value) converges back to a long-run trend

level. However, for individuals close to leaving the scheme, a higher pay settlement in their last year of membership can lead to a larger increase in pension rights because the value of the pension depends heavily on the level of final pensionable pay. Similarly, of course, a lower pay award in that year can reduce the value of accrued pension rights (subject to the rules of the scheme allowing for a definition of 'final salary' that is not strictly equal to actual final year's pensionable pay[25]).

The amount by which growth in deferred remuneration exceeds *g* per cent depends on a number of individual characteristics, such as tenure in the pension scheme and number of years to NPA. To investigate this, section 5.3.1 looks at how median pension accrual changes between a lower and higher pay growth scenario for various different groups. These figures give a picture of how the importance of this phenomenon varies across individual teachers. To aid the extrapolation of the results from section 5.3.1 to other changes in pay growth, section 5.3.2 presents summary figures for the growth in total remuneration (current pay plus pensions) that would result from a range of alternative headline increases in current pay.

5.3.1. Teachers' pension accrual under a higher or lower pay growth scenario

To quantify the phenomenon described above for various different types of current members of the TPS, this subsection compares the figures for the value of annual pension accrual from Section 5.2 (which assumed no headline real pay increase and will hereafter be referred to as the 'lower pay award' scenario) with alternative estimates under a higher pay award assumption. These figures, by definition, look at the change in pension value over the next year taking into account above-/below-inflation current pay growth. This will be the extent to which the member's pension rights are revalued because of remaining in the scheme for another year if the member then leaves the scheme after that year. Taking a longer-term perspective, members who do not leave the scheme in the near future may well experience offsetting lower/higher pay growth in some future year(s). However, for any members who are close to leaving the scheme (for example due to being close to retirement), this increase in pension valuation may be highly pertinent as it will determine their final pensionable salary.

The assumed higher pay award presented in Table 5.5 is that teachers receive a headline pay award of 2.0 per cent a year in real terms on top of inflation as measured by the RPI.[26] Over the longer-term, productivity growth in the private sector has grown by about 2 per cent a year. To the extent that this is reflected in the pay of jobs that teachers might alternatively undertake, the pay of teachers might need to grow by this amount in order for public sector schools to continue to attract and retain staff of a similar quality.

Table 5.5 shows that, under the new TPS rules, if there is a headline award of 0 per cent – the lower pay award scenario – the median value of remuneration in the form of pension accrual over the next year is worth 11.2 per cent of current salary to TPS

[25] See Table 2.1 for the definition of 'final salary' used under the old and new scheme rules.

[26] Once 'incremental drift' within the sample (of 1.6 per cent per year on average, as discussed in section 5.2.1) is taken into account, the headline pay rise of 2 per cent above inflation results in average pay in the sample increasing by 3.6 per cent above inflation.

members. If instead there were a headline award of a real 2 per cent increase (the higher pay award scenario), the median value of remuneration in the form of pension accrual would be worth 15.6 per cent of salary. In other words, even though current pay would increase by 2 per cent, the median value of pension accrual increases by 38.9 per cent, relative to the baseline of no change in real pay. Of course, the reverse is also true – if headline pay were to be less than the trend increase in line with inflation, the value of pension accrual would be eroded even more (relative to the baseline of constant real pay). This comes about because the annual pay award changes the measure of 'final' earnings used to calculate pension benefits and so not only the current year's pension rights but also all existing accrued rights are revalued to the new earnings level, as shown in equation 8 above.

Table 5.5. Median estimated one-period pension accrual (net of employee contribution) under pre and post January 1st 2007 TPS, by future pay awards, sex and sector, per cent of earnings.

	Old TPS rules			New TPS rules		
	Less generous pay award	More generous pay award	Diff (%)	Less generous pay award	More generous pay award	Diff (%)
All						
All	14.7	19.9	35.0	11.2	15.6	38.9
Primary school	15.1	19.2	27.1	11.5	15.2	31.8
Secondary school	14.5	20.2	38.8	11.1	15.7	41.7
Aged under 40	12.1	14.6	20.3	9.2	11.3	23.0
Aged 40 and over	18.2	29.1	60.1	14.3	23.0	61.4
Men						
All	14.3	20.5	43.1	10.6	15.9	50.3
Primary school	13.9	20.1	44.8	10.4	15.6	49.8
Secondary school	14.5	21.3	46.9	10.9	16.6	51.8
Aged under 40	12.1	14.5	19.6	9.0	11.0	22.5
Aged 40 and over	16.0	27.7	72.6	12.1	21.8	79.7
Women						
All	15.2	19.2	26.1	11.8	15.2	28.8
Primary school	15.2	19.2	26.1	11.8	15.2	28.8
Secondary school	15.0	19.6	30.9	11.6	15.6	34.2
Aged under 40	12.1	14.6	20.3	9.2	11.4	23.9
Aged 40 and over	20.2	31.2	54.8	15.9	25.3	59.3

Note: Figures use an annual discount rate of 2½ per cent. See Table 5.4 for sensitivity analysis.

Since the importance of this phenomenon is greatest for those with the longest existing tenure in the scheme, the growth in pension accrual for this growth in current pay is

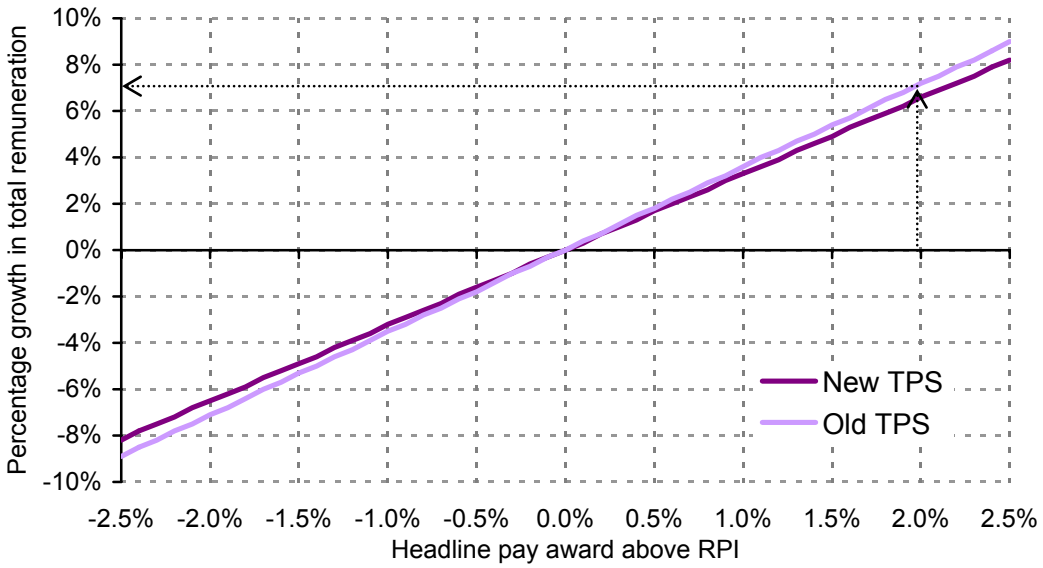
largest for those with the highest average length of pension tenure. As an example, a 55 year-old single woman working in a secondary school and with average tenure in the pension scheme (25 years) would accrue 61.3 per cent more pension over a year under the higher pay award scenario than under the lower pay award scenario. In contrast, a 25 year-old single female secondary school teacher with average tenure in the scheme (2 years) would accrue just an additional 9.8 per cent more pension under the higher pay award scenario.

5.3.2. How does the increase in total remuneration vary with the headline pay award?

There is obviously considerable variation amongst individuals in how a headline pay award translates into additional pension accrual over the next year. When pay increases, all existing tenure in the pension scheme is also revalued to the new earnings level. Therefore, those with longer tenure in the pension scheme (typically those who are closest to retirement) find that their pension accrual increases faster for each additional percentage point added to the headline pay award than those with shorter tenure in the scheme. Similarly, each percentage point fall in the headline pay award below the RPI hits the pension accrual of those with the longest tenure most heavily (in proportional terms). It might, therefore, be of interest to know how such headline pay awards translate into average changes in total remuneration (i.e. current pay plus pension accrual) once the effect of the pay award on pension accrual is taken into account.

Figure 5.3 shows the average (mean) growth in total remuneration amongst the sample of teachers for any given headline pay award, relative to the baseline of a 0 per cent real pay award that was discussed in section 5.2. The arrows in Figure 5.3 indicate that the scenario of a 2 percentage point above RPI headline pay award, which was considered in section 5.3.1, results in an average increase in total remuneration of 6.6 per cent under the new TPS rules, relative to the baseline of no real pay increase. Figure 5.3 shows, however, that the converse is also true – if the headline pay award falls below inflation, the real fall in total remuneration will be even larger. For example, if the headline pay award were to be 1 percentage point below inflation, total remuneration would be 3.2 per cent lower than if a headline award equal to RPI were given. As shown in Figure 3.2, four of the fifteen years between 1992 and 2006 did see headline pay awards below inflation, as measured by the RPI, and the most recent pay award (in September 2008) was just 2.45 per cent while inflation (as measured by the RPI) was running at 5.0 per cent. This 2.55 per cent fall in real pay is found to lead to an average drop in remuneration, relative to a benchmark of an RPI increase in pay, of just over 8 per cent for those covered by the new TPS rules and just over 9 per cent for those covered by the old TPS rules.

Figure 5.3. Growth in total remuneration relative to the benchmark of growth in total remuneration resulting from a 0% headline pay award.



Note: Figures use an annual discount rate of 2½ per cent.

5.4. Future pension accrual under alternative earnings profiles

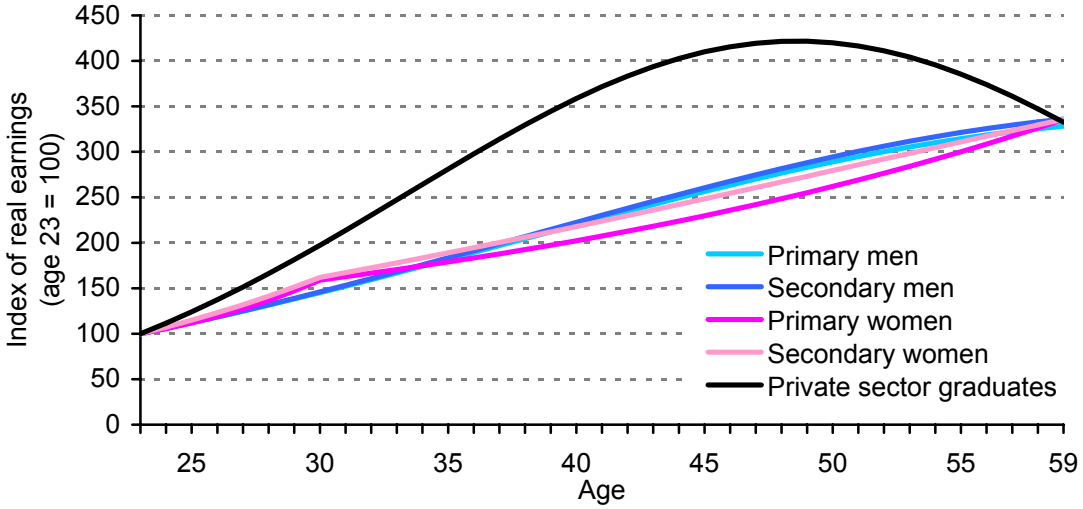
Sections 5.2 and 5.3 presented estimates of one-period pension accrual within the TPS under both the pre and post 1st January 2007 pension plan rules, and showed how these vary by sex, sector and age group, and also how they are affected by both the assumed discount rate and size of the headline pay award. This section examines the extent to which the results presented above are driven by the shape of the age-earnings profile by comparing them with values for annual pension accrual under a very different age-earnings profile.

This is done by taking an alternative profile for earnings growth estimated from male graduates working within the private sector (taken from Disney, Emmerson and Tetlow (2007)) using data from the Labour Force Survey from 1994 to 2006 (inclusive).

This pay profile estimated from the LFS data is then adjusted to include 2 per cent per year headline pay growth. The resulting profile is then compared in Figure 5.4 to the profiles for teachers (with the teachers' profiles also assuming headline pay growth of 2.0 per cent – i.e. the higher pay award scenario that was presented in Section 5.3). Figure 5.4 shows the level of real earnings for each group relative to their real earnings at age 23. For example, a value of "200" on the vertical axis implies that real earnings at a particular age are twice as high as that received by a 23 year-old. It is clear that, among private sector graduates, earnings growth is much higher at younger ages but then declines with age and becomes negative from age 49 onwards. (Note that a cost neutral shift to the private sector profile would involve lower salaries for teachers at the start and end of their careers and commensurately higher salaries for teachers in the middle of their careers). An alternative methodology employed by Dolton and Chung (2004) estimated the earnings profiles of those with teaching qualifications who were not

currently working as a teacher, with these profiles also found to exhibit much greater curvature than those estimated for teachers.

Figure 5.4. Alternative earnings profile.



Source: "Private sector graduates" profile adapted from Disney, Emmerson and Tetlow (2007). Underlying data is the Labour Force Survey from 1994 to 2006. Profile is estimated using a median quantile regression (i.e. not ordinary least squares) with log annual earnings as the dependent variable (i.e. not log hourly wages) with a full set of year dummies, age and age squared.

Of course, the differential earnings profiles in the public and private sectors may be a direct result of the different pension scheme arrangements in these sectors. Employees in the private sector are much more likely to be members of DC pensions than are employees in the public sector. Given the way in which pension entitlements accrue in DC schemes, members of such schemes are better off if their earnings peak earlier in their careers. Table 5.6 provides an interesting illustration of the effect of a different profile of earnings growth on annual pension accruals but it should be borne in mind that the curvature of the age-earnings profiles estimated from the data may be directly related to the pension scheme arrangements to which these workers belong.

Under the alternative earnings profile in Figure 5.4, one-period pension accrual would be increased for younger individuals (as their pay growth is now higher) and reduced for older individuals (as their pay growth is now lower). In theory, those with low or even negative pay growth could exhibit negative pension accrual, if the value of one additional year of membership of the pension scheme is sufficiently mitigated by the fact that tenure already accrued will be revalued at the lower level of salary. However, the final salary used to calculate pension benefits from the TPS is either the pensionable pay in the last year of employment or the average of the best three consecutive years' pay in the last ten years (see Table 2.1). This latter provision means that, even if teachers experience declines in real pay towards the end of their career (as they do under the private pay profile shown in figure 5.4), the impact of this on final pensionable salary will be ameliorated. Table 5.6 confirms that this is the case.

If, however, private sector pay profiles are applied to the TPS, the median value of pension accrual under the new TPS rules, which was estimated to be 15.6 per cent under

the teachers' pay profile, would be 14.8 per cent under the profile estimated from graduates employed in the private sector. Among those aged under 40 the shift to the private sector pay profile boosts pension accrual: for example, average pension accrual would increase from 11.3 per cent to 14.7 per cent. In contrast, among older individuals there would be a fall in pension accrual: on average, this would decline from 23.0 per cent to 15.1 per cent. The effect of the private sector earnings profile, therefore, is to smooth out the accrual of pension rights over the individual's working life. Whereas under the teachers' pay profile accrual of rights is heavily weighted towards the end of the working life, with the private sector earnings profile the value of each year's accrual of pension rights as a share of current earnings is roughly the same for all age groups.

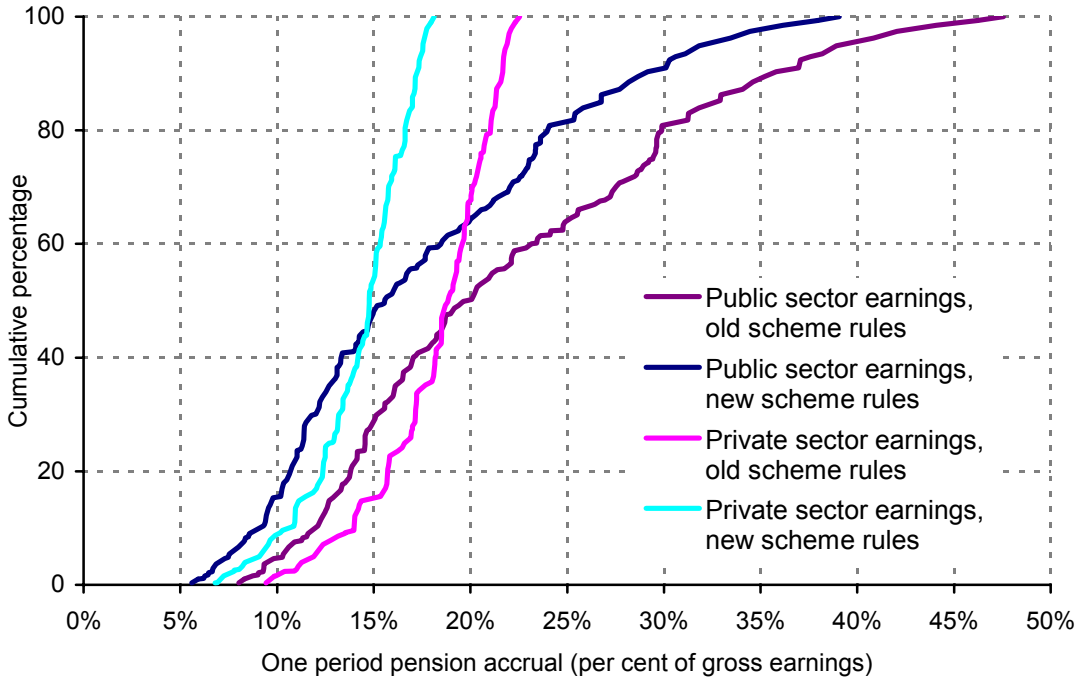
Table 5.6. Median estimated one-period pension accrual (net of employee contribution) under different earnings profiles, by both pre and post January 1st 2007 TPS, sex and sector, per cent of earnings.

	Old TPS rules, headline real pay award equal to 2%			New TPS rules, headline real pay award equal to 2%		
	Teachers' pay profile	Private graduate pay profile	Diff (%)	Teachers' pay profile	Private graduate pay profile	Diff (%)
All						
All	19.9	18.9	–5.0	15.6	14.8	–5.3
Aged under 40	14.6	18.5	27.1	11.3	14.7	30.4
Aged 40 and over	29.1	19.3	–33.7	23.0	15.1	–34.4
Men						
All	20.5	18.1	–11.8	15.9	13.9	–12.8
Aged under 40	14.5	18.0	24.1	11.0	14.0	26.6
Aged 40 and over	27.7	18.2	–34.2	21.8	13.8	–36.5
Women						
All	19.2	19.3	0.6	15.2	15.1	–0.3
Aged under 40	14.6	18.5	27.1	11.4	14.8	29.7
Aged 40 and over	31.2	19.7	–37.0	25.3	15.6	–38.6

Note: Figures use an annual discount rate of 2½ per cent. Both pay scenarios have an average increase in pay of 2.0 per cent per year. See Figure 5.5 for more details of the profiles.

This point is evident in Figure 5.5, which provides a comparison of the whole distribution of one-period pension accrual under both pay profiles and both the old and the new TPS rules. The distribution of the value of one-period pension accrual is much more condensed under the private sector pay profile than under the teachers' pay profile. Furthermore, the relatively small differences in average (median) one-period pension accrual under the different pay profiles in Table 5.6 disguise much larger differences in pension accrual at the higher percentiles of the distribution.

Figure 5.5. Distribution of estimated one-period pension accrual (net of employee contribution) under different estimated earnings profiles and both pre and post January 1st 2007 TPS.



Note: Figures use an annual discount rate of 2½ per cent. Both pay scenarios have an average increase in pay of 2.0 per cent per year. See Figure 5.5 for more details of the profiles.

5.5. Future pension accrual compared to a typical DC plan

We now contrast pension accruals of teachers under the rules of the TPS with the value to members of annual contributions to two example DC pension plans. The first is a stylised scheme that is broadly representative of average DC pensions on offer in the private sector that provide some employer matching of contributions. The second example simulates the pension rights that would accrue to teachers if they were members of the new Civil Service Partnership scheme (or, more generally, a scheme with equivalent rules), which is one of the few DC employer-provided pensions on offer in the public sector.

The first example scheme assumes that the employer contributes 10 per cent of gross salary, while the employee contributes 6.5 per cent of gross salary to the scheme each year. This is in line with the findings of Watson Wyatt (2008b) for employer-provided DC pensions offering some employer matching of contributions.[27]

The second example scheme assumes that employer and employee contribute according to the rules of the Civil Service Partnership pension accounts. Under this scheme, the employer contributes an amount that increases the older the member is, plus a matching contribution of up to 3 per cent of salary if the employee makes a contribution of their

[27] See Figure 2.

own.[28] We therefore assume that the employee contributes 3 per cent to this scheme, in order to attract the full employer match. The value of annual pension accrual for both these example schemes is expressed as a percentage of current salary, net of the employee contribution.

The calculated value of pension accruals in DC schemes depends on the investment return earned on the pension fund. Therefore, the assumed investment return is crucial to the result. The majority of individuals with DC pension funds invest them in products that reduce their exposure to more risky, volatile investments as the individual ages. In particular, these pension funds increasingly shift more towards safer, lower expected return investments once the individual reaches age 50. This is known as "lifestyling". We, therefore, value annual accrual in DC pensions by assuming that each individual invests their annual contribution in a "lifestyling" pension fund. This fund is assumed to earn a 3½ per cent real return each year (net of charges) when the individual is aged under 50. From age 50 to age 60, the net real return is assumed to fall by 0.2 percentage points per year and from age 60 onwards the entire fund is assumed to be invested in safe assets earning a 1.5 per cent net real return each year.

Table 5.7 shows how the value of annual pension accrual (net of the employee contribution) varies for different groups of teachers, and also compares these figures for each of the example DC schemes to those for the TPS scheme rules that apply to both existing and new members.

Under the assumption of a 10 per cent employer contribution and a 6.5 per cent employee contribution, the median value of annual pension accrual (net of the employee contribution) is 7.1 per cent of salary.[29] This is about a third lower than the median value of pension accrual in the TPS. This finding is, of course, highly sensitive to the choice of employer contribution rate. The variation in accrual value by age is though very different in this scheme to the TPS, however. Since the employer contribution is constant by age and older individuals (by assumption) earn a lower investment return on their fund, the DC pension accrual is worth more to younger members than older members – median value of accrual for those under 40 is 8.5 per cent of salary, compared to 6.0 per cent for those over 40. This is in stark contrast to the TPS where average accrual was found to be greater for older individuals rather than younger individuals.

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[28] Precise details of the core employer contribution for members of different ages in the Civil Service Partnership pension accounts are provided in Table B.6 of Annex B.

[29] This is not the same as the amount the employer put in (i.e. 10 per cent) for a number of reasons. First, adverse selection in the annuities market, which means that those who purchase annuities have on average longer life expectancies than other members of their cohort. Therefore, using average life expectancies as we do may understate the value of pension accrual if TPS members also have similarly higher than average life expectancies (though the same would also be true of our valuation of the accrual within a final salary DB scheme such as the TPS). Two, even if the gross investment return was the same as the discount rate the value of pension accrual would still be lower than the employer contribution due to administrative costs, and profits, of those providing the pension. Third, we have assumed a certain date of death. In reality members of DC pensions are likely to be uncertain about their true life expectancy and, if they are risk averse, they may value the insurance against living a long time which is provided by annuity income and therefore still prefer to receive a pension accrual worth 7.2 per cent than a larger immediate increase in salary. So, again, our valuation may understate the true extent to which members of DC pensions value the employer contribution. However, again this would also apply to our valuation of the employer contribution to DB schemes.

Table 5.7. Value of annual pension accrual in a stylised DC pension plan (net of employee contribution), by age, sex and sector (% of salary)

	Headline pay award equal to RPI		Defined Contribution pensions	
	Old TPS rules	New TPS rules	10% employer + 6.5% employee	Civil Service Partnership rules
All				
All	14.7	11.2	7.1	10.6
Primary school	15.1	11.5	7.1	10.6
Secondary school	14.5	11.1	7.1	10.6
Aged under 40	12.1	9.2	8.5	9.1
Aged 40 and over	18.2	14.3	6.0	10.8
Men				
All	14.3	10.6	7.2	10.8
Primary school	13.9	10.4	7.4	10.8
Secondary school	14.5	10.9	7.1	10.8
Aged under 40	12.1	9.0	8.6	9.3
Aged 40 and over	16.0	12.1	6.1	11.0
Women				
All	15.2	11.8	7.1	10.6
Primary school	15.2	11.8	7.1	10.6
Secondary school	15.0	11.6	7.1	10.6
Aged under 40	12.1	9.2	8.3	9.1
Aged 40 and over	20.2	15.9	5.8	10.7

Note: Figures use an annual discount rate of 2½ per cent. See Table 5.4 for sensitivity analysis.

A slightly different picture emerges if we look at the value of annual pension accruals under the rules of the Civil Service Partnership DC scheme. This scheme has employer contributions that increase with the member's age. This means that the pension accrual is less 'front-loaded' than in the first example – the lower investment return for older members is more than offset by a higher employer contribution. For younger members, the median value of annual pension accrual in the Civil Service Partnership scheme (at 9.1 per cent of current salary) is almost the same as under the TPS rules. However, amongst older members, despite the higher employer contribution as the members gets older in the DC scheme, median annual pension accrual (at 10.8 per cent of salary) is still lower than in the TPS. This finding actually highlights the great extent to which pension accruals are 'back-loaded' in the TPS.

6. Conclusions

This paper has examined in detail the value of pension provision to teachers in the public sector in England and Wales who are members of the TPS. These valuations are based on the distribution of teachers by age, sex and sector in England and Wales in 2007, and incorporate data on both mean teacher tenures by age, sex and sector in the same year, and on the distribution of partner's ages observed among graduates in recent years. Cohort life expectancies from 2006 are used, adjusted to take into account that those in social class II such as teachers have higher average life expectancies. In addition, rich microdata from ASHE/NES over the period from 1996 to 2006 have been used to estimate the shape of hourly earnings profiles by age for teachers in England and Wales, again allowing these to differ by both sex and whether the teacher is employed in a primary school or a secondary school. Among both primary and secondary school men, evidence is found that real hourly earnings increase up to about age 51 and decline thereafter. Among both primary and secondary school women, evidence is found of a relatively linear increase in hourly earnings with respect to age, with both cases showing that wages typically increase less quickly from age 30 onwards.

Analysis of the pension rights that have already been accrued shows that the majority of teachers have a significant amount of wealth accumulated in the form of a pension promise from the TPS. Under the TPS rules in place for existing members, and assuming a 2½ per cent real discount rate, these accumulated rights were worth, on average, 2.12 times a teacher's current salary. Since older teachers typically have had longer periods of TPS membership, on average teachers aged forty and over have accrued pension rights worth 4.86 times their current salary, whereas those aged under forty have accrued rights in the pension scheme worth, on average, 0.95 times their current salary. If instead these pension rights had been accumulated under the TPS rules that are now in place for new entrants, it is estimated that all groups would have had their rights reduced by about one-seventh. For example, overall average accrued pension rights would have been reduced from 2.12 times current salary to 1.82 times current salary, which represents a reduction in wealth equal to 30 per cent of current salary, or about one-seventh of the level of total pension wealth under the old scheme rules. An important caveat to these results is their sensitivity to the choice of discount rate: a lower (higher) discount rate is found to increase (reduce) significantly the value of accrued pension rights, and to reduce (increase) the percentage reduction in accumulated pension rights that would have been implied by a complete shift to the new TPS rules.

Rather than *accrued* pension rights the main focus of this paper is the estimation of *future* expected pension accrual: in particular looking at how one year's additional accrual of pension rights compares to one year's extra salary. The baseline used for this analysis is that headline pay awards are equal to RPI. Under this assumption, and the TPS rules in place for existing members, on average pension accrual is found to be worth 14.7 per cent of current salary. Women are found, on average, to have slightly higher pension accrual than men, but a far more significant difference is that older individuals are typically found to have much higher pension accrual than younger individuals. This is despite their lower earnings growth and arises because within final salary schemes increases in salary increase the value of all previous years of pension membership

therefore benefiting those with higher pension tenure (i.e. typically older individuals) more.

Had instead all teachers been made subject to the new TPS rules, average pension accrual would be 11.2 per cent of current salary, which represents a fall in the level of pension accrual of almost one-quarter brought about by the shift from the TPS rules in place for existing members to those in place for new members. Slightly larger falls in average pension accrual arising from the change in scheme rules are estimated for men than for women. This is due to their lower life expectancy meaning that they benefit less from the enhancing of pension accrual from $1/80^{th}$ to $1/60^{th}$ despite experiencing a similar loss in pension accrual from the increase in NPA from age 60 to 65.

It is clear, therefore, that the new TPS rules typically reduce the level of pension benefits, and therefore lower the cost to the taxpayer, than the ones that they replaced. This is not surprising given that one of the motivations for the reform was to reduce the expected cost to future taxpayers. However, a description of the reforms by the National Union of Teachers (2006) states that "New entrants to teaching from 1 January 2007 will have a normal pension age of 65. Their pension accrual rate, however, is improved to 1/60th with the option to take 25 per cent of their pension fund as a tax-free lump sum. This will offset the effects of the higher normal pension age." This might suggest that new entrants would, on average, be fully compensated for the increase in the NPA through the improved accrual rate. The analysis in this paper has shown that this, evidently, is not the case: the increase in the accrual rate is not sufficient, on average, to offset the reduction in pension benefits brought about the rise in the NPA.

A justification for the need to reduce the cost of the public sector pension schemes, and in particular the increase in normal pension age, is that the level of benefits offered by these schemes, and therefore the cost to the taxpayer, has increased unintentionally due to larger than expected increases in life expectancy. Taking the cohort life expectancies projected in 1981 rather than in 2006, confirm that the TPS rules in place for existing members now provide higher pension benefits than the same rules for TPS members 25 years ago. Specifically pension accrual is found, on average, to have been 13.7 per cent of current salary in 1981 compared to 14.7 per cent now, which is an increase in pension accrual of some 7.3 per cent. This increase is, however, far smaller than the cut in average pension accrual being brought about by the shift in TPS rules from those in place for existing members to those in place for new members. As highlighted above, these are estimated to reduce pension accrual by almost one-quarter from 14.7 per cent of current salary to 11.7 of current salary. Therefore, TPS members covered by the new scheme rules will, on average, have a lower expected pension accrual than individuals twenty-five years ago with the longer life expectancies of the former group being more than offset by the changes to the scheme rules, which have reduced the overall level of pension benefits offered.

This paper has also explored the sensitivity of pension accrual within the TPS to both the overall level of pay award and the shape of the age-earnings profile. With respect to the former, the value of annual pension accrual is found to be extremely sensitive to the overall level of headline pay increase. The figures for pension accrual set out above all assume that the headline pay increase is equal to the RPI. If instead it is assumed that

headline pay is increase by 2 percentage points above the RPI, pension accrual is found to be boosted by far more and, as a result, total remuneration is increased by 6.6 per cent. This phenomenon is not unique to the TPS: it arises in all final salary schemes and is the result of all accumulated pension rights being uprated by future pay increases. The converse is also true. This may be considered more relevant at the moment given that the headline increase in teachers' pay for September 2008 was 2.45 per cent while inflation at the same point in time (as measured by the RPI) was running at 5.0 per cent. This 2.55 per cent fall in real pay is found to lead to an average drop in remuneration, relative to a benchmark of an RPI increase in pay, of just over 8 per cent for those covered by the new TPS rules and just over 9 per cent for those covered by the old TPS rules.

The shape of the age-earnings profile is also an important determinant of the size of the accrual of pension benefits offered by final salary pension arrangements relative to current pay. An alternative age-earnings profile estimated from data on graduates working in the private sector exhibits greater curvature: in other words, pay is relatively lower at younger and older ages, and is relatively higher for individuals in their forties. Under this alternative age-earnings profile, TPS accrual would be increased for younger individuals (arising from pay growth being higher) and reduced for older individuals (arising from pay growth being lower). This would lead to a smoother pattern of pension accrual over an individual's working life. Whereas under the teachers' pay profile accrual of pension rights was found to be heavily weighted towards the end of the working life, with the private sector earnings profile the value of each year's accrual of pension rights as a share of current earnings is roughly the same for all age groups. Of course, the differential earnings profiles in the public and private sectors may be a direct result of the different pension scheme arrangements in these sectors. Specifically given the way in which pension entitlements accrue in DC schemes, which are more common in the private than the public sector, members of such schemes would be better off if their earnings peak earlier in their careers.

Finally, the paper assessed the value to members of annual contributions to two example DC pension plans and compared these to those for the TPS. The first is a stylised scheme into which the employer contributes 10 per cent, and the employee 6.5 per cent, of gross salary. Median pension accrual in this scheme, at 7.1 per cent of current salary, is found to be lower than average pension accrual in the TPS under either the scheme rules applying to existing members or those applying to new members. This finding is, however, highly sensitive to the choice of employer contribution rate. The other key difference is that if younger individuals make riskier investment choices than older individuals and therefore can expect higher returns (for example as would happen under a "lifestyling" approach), then younger members of such a stylised DC scheme have, on average, higher pension accrual than older members. This is in stark contrast to the TPS where average accrual was found to be greater for older individuals rather than younger individuals. The second DC example uses the rules of the Civil Service Partnership Defined Contribution pension, in which the employers contribution increases with age and contribution rates are on average higher than that assumed above. In this case average pension accrual is found to be 10.6 per cent of current salary, which is only slightly below the average accrual under the TPS rules for new members. Moreover the

relative benefit to younger members of receiving a higher average investment return is, on average, more than offset by the lower initial employer contribution.

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Appendix A: Sensitivity of pension accrual estimates to choice of discount rate

This Appendix presents sensitivity analysis of the estimated one-period pension accrual figures (from section 5.2) to alternative discount rate assumptions.

Just as a higher (lower) assumed discount rate led to lower (higher) estimates of accumulated pension wealth (see section 5.1.1), a higher (lower) assumed discount rate is also found to lead to lower (higher) estimates of one-period pension accrual. For example, average estimated one-period pension accrual under old TPS rules is 15.2 per cent with a 2½ per cent discount rate, 9.7 per cent with a higher (3½ per cent) discount rate and 28.8 per cent with a lower (1 per cent) discount rate.

The fall in average one-period pension accrual arising from a complete shift from the old TPS rules to the new TPS rules also varies by the assumed discount rate. A higher (lower) assumed discount rate is found to lead to a larger (smaller) percentage reduction in the one-period accrual rate (but a smaller (larger) reduction in the one-period accrual rate measured as a share of earnings).

Table A.1. Sensitivity of estimates of median one-period pension accrual (net of employee contribution) to choice of discount rate, by pre and post January 1st 2007 TPS and sex.

	Headline pay award equal to RPI; resulting average real pay increase = 1.6%		
	Old (% salary)	New (% salary)	Diff. (%)
2½% discount rate			
All	14.7	11.2	–23.7
Men	14.3	10.6	–26.1
Women	15.2	11.8	–22.5
3½% discount rate			
All	9.5	6.3	–34.0
Men	9.9	6.5	–33.7
Women	9.1	6.1	–32.7
1% discount rate			
All	28.2	24.0	–14.6
Men	26.0	22.0	–15.4
Women	28.9	24.9	–13.8

One point to note from Table A.1 is that the discount rate assumed affects the assessment of whether the accrual of rights in the TPS is worth more to men or women. As discussed in section 5.2.1, under the baseline assumption of a 2½ per cent discount rate, it is concluded that on average women in the TPS have higher annual accrual as a share of earnings than men – on average, a year's pension accrual under the new TPS rules is worth 11.8 per cent of salary to women but 10.6 per cent of salary to men. However, under the assumption of a higher (3½ per cent) discount rate, the conclusion changes – on average, a year's pension accrual under the new TPS rules is worth 6.5 per

cent of salary to men and 6.1 per cent to women. This is because, when using a higher discount rate, the additional pension income received by women in the last years of their lives (when men of the same cohort will, on average, have already died) is discounted more heavily.

Appendix B: Supplementary tables and figures

Table B.1. Distribution of hourly earnings (£ 2006 prices), 1996 to 2006.

Year	Mean	p1	p5	p10	p25	Median	p75	p90	p95	p99	N
Primary school, men											
1996	21.4	10.0	13.5	14.6	18.1	21.2	24.7	28.5	30.2	36.5	333
1997	20.8	9.0	12.8	14.6	17.5	20.7	23.9	27.4	30.2	34.2	318
1998	20.6	9.8	12.3	13.8	17.3	20.3	24.1	27.3	29.3	35.2	338
1999	21.2	9.9	12.1	14.1	17.4	21.5	24.3	28.4	31.1	37.6	363
2000	21.6	10.1	12.1	13.6	17.6	21.5	25.2	29.1	31.6	37.8	370
2001	22.6	9.9	13.3	14.5	17.5	22.8	26.6	31.5	33.8	39.6	350
2002	23.9	9.0	13.7	15.3	19.3	23.3	28.0	32.9	35.9	41.9	333
2003	24.0	6.1	12.3	14.6	19.5	23.7	28.6	33.2	37.7	42.7	338
2004	23.5	7.0	11.5	14.1	18.8	22.7	27.9	33.6	37.8	45.9	301
2005	24.3	8.9	12.3	14.4	18.3	23.6	29.1	34.4	38.9	46.6	315
2006	23.1	8.4	12.0	13.7	17.5	22.5	27.5	33.3	37.8	47.4	302
Primary school, women											
1996	19.0	5.1	11.5	13.5	16.5	19.1	21.8	24.3	26.3	31.4	1,675
1997	19.1	6.0	11.7	13.5	16.5	19.0	21.7	24.6	26.5	33.6	1,558
1998	18.9	5.7	11.1	13.0	16.4	18.6	21.7	24.5	27.0	32.3	1,648
1999	19.5	6.0	11.9	13.4	16.9	19.3	22.4	25.5	28.0	34.5	1,660
2000	19.7	7.0	12.1	13.5	17.0	19.3	22.8	26.1	28.4	34.8	1,670
2001	20.5	7.0	12.0	13.6	17.2	19.9	23.6	27.7	30.7	38.2	1,682
2002	21.0	8.7	12.4	13.7	17.4	20.5	24.1	27.9	30.9	37.7	1,703
2003	21.5	6.8	12.3	14.3	17.9	21.2	24.9	28.5	31.8	40.2	1,749
2004	21.3	6.8	12.1	14.0	17.7	20.9	24.8	28.7	32.1	37.9	1,543
2005	21.9	7.6	12.2	14.2	17.9	21.2	25.1	29.8	33.5	43.7	1,540
2006	21.0	7.3	11.7	13.2	17.2	20.6	24.3	28.4	31.3	39.3	1,544
Secondary, men											
1996	21.7	9.5	13.4	15.4	18.4	21.4	24.9	27.9	30.5	39.5	712
1997	21.5	9.8	13.1	15.1	18.0	21.4	24.1	27.9	31.0	40.2	658
1998	21.2	10.4	12.6	14.5	17.6	20.8	24.1	27.8	30.8	40.2	633
1999	22.1	10.9	12.7	14.8	18.2	21.8	25.0	29.4	33.4	41.6	668
2000	22.2	10.4	12.8	14.4	17.7	21.6	25.1	30.0	35.0	46.5	779
2001	23.3	12.0	13.7	15.1	18.3	22.4	26.6	31.8	37.3	47.9	740
2002	23.5	10.7	13.1	14.7	18.9	23.1	26.7	32.0	37.4	46.2	796
2003	24.6	10.2	13.7	15.9	19.5	24.0	27.9	32.9	36.8	50.3	778
2004	24.5	10.0	13.3	15.2	19.2	23.6	27.9	33.1	38.9	52.3	733
2005	24.5	8.8	12.7	15.2	18.9	23.8	28.6	33.9	40.6	52.0	774
2006	23.7	8.6	12.9	14.9	19.0	22.9	27.1	32.4	37.1	50.3	752
Secondary, women											
1996	19.4	5.9	11.1	12.7	16.5	19.5	22.0	25.3	27.9	35.3	1,088
1997	19.2	7.2	11.7	12.8	16.5	19.3	21.7	25.0	27.3	33.6	1,016
1998	19.1	5.8	11.7	12.9	16.4	19.0	21.8	24.8	26.7	33.4	918
1999	19.8	6.0	11.8	13.5	16.7	19.7	22.8	26.1	28.6	34.3	1,017
2000	20.1	10.2	12.2	13.6	17.1	19.8	22.9	26.5	28.8	34.4	1,139
2001	21.1	9.4	12.6	13.9	17.4	20.5	24.2	28.6	31.5	41.4	1,147
2002	21.2	7.1	12.2	13.5	17.4	21.1	24.6	28.8	30.8	37.2	1,146
2003	22.0	6.7	12.2	14.0	18.0	21.4	25.3	30.2	33.9	45.4	1,161
2004	21.6	6.4	11.6	13.4	16.6	21.0	25.1	29.6	32.8	48.1	1,172
2005	22.0	7.4	12.1	13.9	17.3	21.6	25.4	30.6	33.6	42.9	1,229
2006	21.3	7.4	11.8	13.3	17.1	20.8	24.9	29.1	32.6	43.1	1,255

Notes: Earnings inflated to 2006 prices using the RPI.

Table B.2. Nominal headline teachers' pay awards since the introduction of the School Teachers' Pay Review Body in 1992.

Year	Award
1992	7.5% from 1st April
1993	1.5% from 1st April
1994	2.9% from 1st April
1995	2.7% from 1st April
1996	2.75% from 1st April, 3.75% from 1st December
1997	2.0% from 1st April, 3.3% from 1st December
1998	2.0% from 1st April, 3.8% from 1st December
1999	3.5% from 1st April
2000	3.3% from 1st April
2001	3.7% from 1st April
2002	3.5% from 1st April
2003	2.9% from 1st April
2004	2.5% from 1st April
2005	2.5% from 1st April, 3.25% from 1st September
2006	2.5% from 1st September
2007	2.5% from 1st September
2008	2.45% from 1st September
2009	*2.3% from 1st September*
2010	*2.3% from 1st September*

Note: The 1991 pay award was staged (7.5% from 1st April 1991 and 9.5% from 1st December 1991) thereby affecting the baseline for assessing the generosity of the 1992 award. Future awards in italics correct at the time of writing.

Table B.3. Percentage of graduates living in couples, and average (mean) age difference, those aged 23 to 59 (inclusive) only.

	Per cent living in couples	Mean partners age less own age (those in couples only)	Sample size (all)
Men aged under 40	63.5%	–1.06	3,051
Men aged 40 and over	83.9%	–2.51	3,489
All men	73.0%	–1.84	6,540
Women aged under 40	68.6%	+2.50	3,675
Women aged 40 and over	77.0%	+1.91	2,880
All women	72.0%	+2.24	6,555
All	72.5%	+0.21	13,095

Source: Authors' calculations using data from the Family Resources Survey 2003–04, 2004–05 and 2005–06.

Table B.4. Results from log earnings regressions (1975 to 2006, inclusive).

	Men				Women			
	Primary		Secondary		Primary		Secondary	
Age (1)	0.0300	(0.0016)	0.0348	(0.0008)				
Age (1) ^ 2	-0.0008	(0.0001)	-0.0010	(0.0000)				
Age (2)	0.0327	(0.0018)	0.0319	(0.0011)				
Age (2) ^ 2	-0.0009	(0.0001)	-0.0009	(0.0001)				
Age (3)	0.0292	(0.0021)	0.0299	(0.0014)				
Age (3) ^ 2	-0.0007	(0.0001)	-0.0007	(0.0001)				
Age (≤30) (1)					0.0218	(0.0055)	0.0255	(0.0057)
Age (≤30) (1) ^ 2					-0.0008	(0.0007)	-0.0020	(0.0007)
Age (>30) (1)					0.0136	(0.0018)	0.0097	(0.0023)
Age (>30) (1) ^ 2					-0.0002	(0.0001)	-0.0001	(0.0001)
Age (≤30) (2)					0.0338	(0.0079)	0.0375	(0.0078)
Age (≤30) (2) ^ 2					-0.0001	(0.0011)	-0.0003	(0.0012)
Age (>30) (2)					0.0113	(0.0019)	0.0143	(0.0021)
Age (>30) (2) ^ 2					-0.0002	(0.0001)	-0.0003	(0.0001)
Age (≤30) (3)					0.0609	(0.0070)	0.0493	(0.0078)
Age (≤30) (3) ^ 2					0.0019	(0.0010)	-0.0001	(0.0011)
Age (>30) (3)					0.0035	(0.0018)	0.0125	(0.0021)
Age (>30) (3) ^ 2					0.0001	(0.0001)	-0.0002	(0.0001)
Year 1975	2.6354	(0.0117)	2.6746	(0.0075)	2.4882	(0.0116)	2.6025	(0.0139)
Year 1976	2.6754	(0.0125)	2.7228	(0.0064)	2.5702	(0.0114)	2.6656	(0.0127)
Year 1977	2.5837	(0.0114)	2.6037	(0.0065)	2.4646	(0.0111)	2.5519	(0.0125)
Year 1978	2.5938	(0.0134)	2.6255	(0.0063)	2.4832	(0.0111)	2.5702	(0.0129)
Year 1979	2.4964	(0.0122)	2.5223	(0.0064)	2.3889	(0.0109)	2.4752	(0.0125)
Year 1980	2.4926	(0.0121)	2.5152	(0.0070)	2.3855	(0.0109)	2.4604	(0.0130)
Year 1981	2.6801	(0.0123)	2.7014	(0.0067)	2.5706	(0.0113)	2.6481	(0.0122)
Year 1982	2.5932	(0.0132)	2.6147	(0.0069)	2.4850	(0.0116)	2.5784	(0.0128)
Year 1983	2.6245	(0.0138)	2.6412	(0.0070)	2.5211	(0.0115)	2.6144	(0.0122)
Year 1984	2.6311	(0.0141)	2.6280	(0.0072)	2.5109	(0.0115)	2.5961	(0.0131)
Year 1985	2.6261	(0.0136)	2.6187	(0.0078)	2.5356	(0.0129)	2.5849	(0.0126)
Year 1986	2.6945	(0.0140)	2.6837	(0.0081)	2.6009	(0.0132)	2.6452	(0.0130)
Year 1987	2.7067	(0.0149)	2.6876	(0.0087)	2.6178	(0.0131)	2.6597	(0.0133)
Year 1988	2.7247	(0.0147)	2.7022	(0.0083)	2.6349	(0.0128)	2.6839	(0.0129)
Year 1989	2.7191	(0.0153)	2.7064	(0.0085)	2.6504	(0.0133)	2.6803	(0.0140)
Year 1990	2.7063	(0.0171)	2.7056	(0.0089)	2.6438	(0.0135)	2.6906	(0.0145)
Year 1991	2.7960	(0.0161)	2.7716	(0.0090)	2.7366	(0.0133)	2.7806	(0.0134)
Year 1992	2.8731	(0.0162)	2.8946	(0.0095)	2.8483	(0.0134)	2.8792	(0.0138)
Year 1993	2.8365	(0.0159)	2.8405	(0.0103)	2.8199	(0.0134)	2.8542	(0.0140)
Year 1994	2.8224	(0.0160)	2.8345	(0.0106)	2.8118	(0.0144)	2.8514	(0.0151)
Year 1995	2.8231	(0.0176)	2.8160	(0.0119)	2.8059	(0.0144)	2.8176	(0.0169)
Year 1996	2.8426	(0.0152)	2.8329	(0.0104)	2.8687	(0.0145)	2.8555	(0.0152)
Year 1997	2.8140	(0.0151)	2.8243	(0.0106)	2.8834	(0.0132)	2.8602	(0.0143)
Year 1998	2.8108	(0.0145)	2.8178	(0.0109)	2.8724	(0.0128)	2.8537	(0.0146)
Year 1999	2.8445	(0.0147)	2.8521	(0.0100)	2.9088	(0.0126)	2.8854	(0.0143)
Year 2000	2.8498	(0.0165)	2.8515	(0.0116)	2.9178	(0.0126)	2.9020	(0.0139)
Year 2001	2.8925	(0.0173)	2.9039	(0.0107)	2.9496	(0.0130)	2.9408	(0.0144)
Year 2002	2.9382	(0.0188)	2.9197	(0.0113)	2.9750	(0.0127)	2.9506	(0.0144)
Year 2003	2.9322	(0.0214)	2.9521	(0.0123)	2.9912	(0.0127)	2.9761	(0.0149)
Year 2004	2.9079	(0.0220)	2.9478	(0.0132)	2.9828	(0.0128)	2.9524	(0.0158)
Year 2005	2.9590	(0.0203)	2.9534	(0.0130)	3.0099	(0.0130)	2.9853	(0.0142)
Year 2006	2.9201	(0.0203)	2.9266	(0.0124)	2.9705	(0.0126)	2.9516	(0.0137)
Sample size	*8,810*		*24,934*		*40,059*		*28,468*	

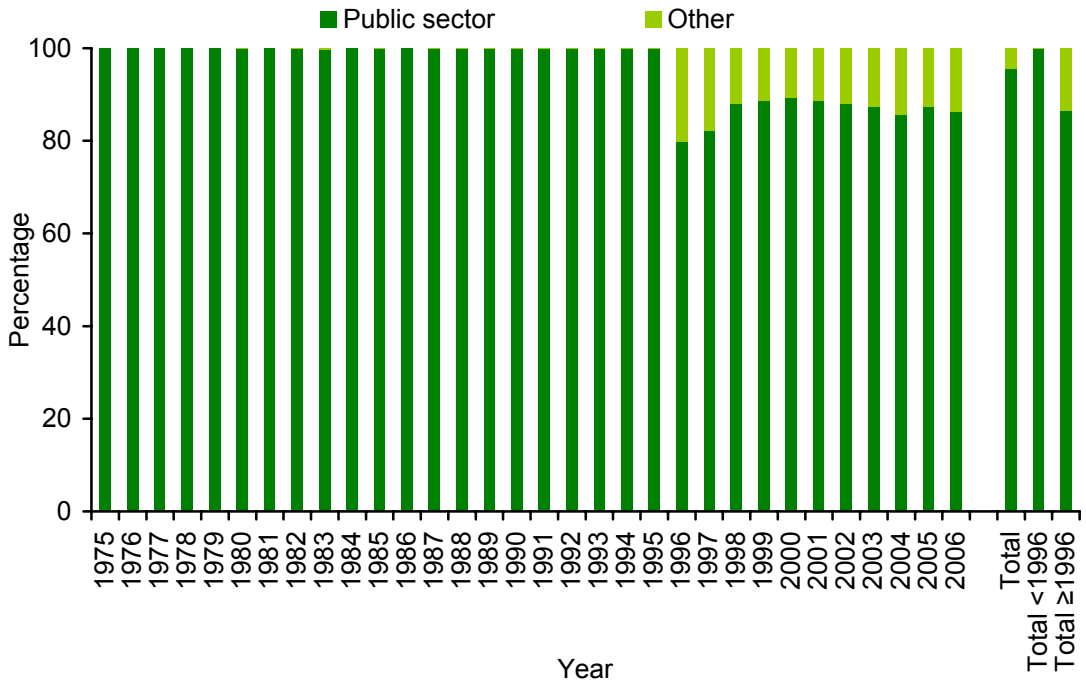
Note: Age refers to age less 30. Standard errors, which are clustered at the individual level, shown in parenthesis. For the co-efficients on the age terms (1) refers to the period from 1975–1985, (2) refers to 1986–1995 and (3) refers to 1996–2006.

Table B.5. Mean estimated one-period pension accrual (net of employee contribution) under pre and post January 1st 2007 TPS, by future pay awards, sex and sector, per cent of earnings.

	Old TPS rules			New TPS rules		
	Less generous pay award	More generous pay award	Diff (ppt)	Less generous pay award	More generous pay award	Diff (ppt)
All						
All	15.8	22.2	40.9	12.2	17.7	44.9
Primary school	16.7	23.0	38.2	13.0	18.4	41.7
Secondary school	15.0	21.5	43.7	11.4	17.0	48.3
Aged under 40	12.0	14.3	19.1	9.1	11.1	21.7
Aged 40 and over	19.3	29.6	53.6	15.1	23.8	58.1
Men						
All	13.8	20.8	50.8	10.3	16.2	57.2
Primary school	13.6	20.5	50.9	10.1	15.9	57.4
Secondary school	13.9	20.9	50.8	10.3	16.3	57.2
Aged under 40	11.8	14.1	19.4	8.7	10.7	22.3
Aged 40 and over	15.5	26.5	71.2	11.6	20.9	79.5
Women						
All	16.5	22.7	37.9	12.9	18.2	41.4
Primary school	17.1	23.4	36.6	13.4	18.8	39.9
Secondary school	15.6	21.8	39.6	12.1	17.4	43.6
Aged under 40	12.1	14.4	19.0	9.2	11.2	21.5
Aged 40 and over	20.7	30.8	48.5	16.4	25.0	52.3

Note: Figures use an annual discount rate of 2½ per cent.

Figure B.1. Percentage of primary and secondary school teachers in England and Wales identified in ASHE/NES as working in the public sector, 1975 to 2006.



Note: Whether the teachers is employed in the public sector identified in the ASHE/NES data using the variable "tpub4" prior to 1996 and "idbrsta" from 1996 onwards.

Table B.6. Core employer contribution to members pension in the Civil Service Partnership pension.

Member's age at last 6th April	Core employer contribution (percentage of pensionable earnings)
Under 21	3.0
21 to 25	4.5
26 to 30	6.5
31 to 35	8.0
36 to 40	10.0
41 to 45	11.5
46 and over	12.5

Source: Civil Service Pensions scheme information (http://www.civilservice-pensions.gov.uk/scheme_information/partnership/how_much_does_it_cost.aspx).