Pension wealth in the British Household Panel Survey

User Guide

The dataset "pensionwealth_1991-2001_v2" available from the Data Archive for the BHPS contains estimates of respondents' pension wealth in each year from 1991 to 2001, which were derived by making use of the additional questions about private pensions which were included in wave 11. As a result these measures of pension wealth are only available for individuals who responded to wave 11 of the BHPS. Full details of the derivation of these pension wealth estimates can be found in the accompanying document, *Accrued and Prospective Pension Rights in Britain* and the associated extensive appendices, and data users are advised to consult this document before making use of these variables. This user guide provides a brief description of each of the variables contained in the "pensionwealth_1991-2001_v2" dataset.

Note on revisions made in version 2

Version 1 of the pension wealth derived variables dataset contained an error in pension wealth measures for 2000. No other years' data was affected. This error has been corrected in version 2. Any analysis conducted using version 1 of the data should be recomputed using version 2.

Accrued pension wealth

For each year (1991 to 2001) private pension wealth and state pension wealth have been separately derived. The dataset contains a separate estimate of state pension wealth and private wealth for each year from 1991 to 2001. There is also a variable for total pension wealth which is simply the sum of private and state pension wealth. The variable naming conventions used for accrued pension wealth measures are outlined in table 1.

Projected future pension wealth

In addition to the measures of accrued pension wealth for the years 1991 to 2001, the dataset also contains estimates of the pension wealth that an individual will accrue by the time he or she reaches the state pension age if he or she continues in their current employment status[1] between 2001 and reaching the state pension age. Estimates of pension wealth at state pension age are provided on three different bases which differ in the way future earnings are assumed to evolve.

The first method for simulating future earnings simply assumes that all individuals experience 2% real earnings growth each year. The second method assumes that each individual receives 2% real earnings growth plus a (positive or negative) component of earnings growth which

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[1] For those who were not in paid employment in 2001, the estimated future pension wealth assumes they continue to be out of work in future years.

depends on their age, sex and education level. The third method assumes that each individual receives 2% real earnings growth plus a component of earnings growth which just depends on their age and education level. For a more complete description of the last two methods see Appendix B of the accompanying document (*Accrued and Prospective Pension Rights in Britain*).

The variable naming conventions used for future pension wealth measures are outlined in table 2.

Table 1. Accrued pension wealth naming conventions

Variable name stem	Variable name suffix	Complete variable name	Type of pension wealth to which variable refers
sta	1991	sta1991	State pension wealth accrued up to relevant year
	1992	sta1992	
	1993	sta1993	
	1994	sta1994	
	1995	sta1995	
	1996	sta1996	
	1997	sta1997	
	1998	sta1998	
	1999	sta1999	
	2000	sta2000	
	2001	sta2001	
pri	1991	pri1991	Private pension wealth accrued up to relevant year
	1992	pri1992	
	1993	pri1993	
	1994	pri1994	
	1995	pri1995	
	1996	pri1996	
	1997	pri1997	
	1998	pri1998	
	1999	pri1999	
	2000	pri2000	
	2001	pri2001	
tot	1991	tot1991	Total pension wealth (state+private) accrued up to relevant year
	1992	tot1992	
	1993	tot1993	
	1994	tot1994	
	1995	tot1995	
	1996	tot1996	
	1997	tot1997	
	1998	tot1998	
	1999	tot1999	
	2000	tot2000	
	2001	tot2001	

Table 2. Pension wealth at state pension age naming conventions

Variable name stem	Variable name suffix	Complete variable name	Type of pension wealth to which variable refers
sta_spa	1 2 3	sta_spa1 sta_spa2 sta_spa3	State pension wealth at state pension age using method 1, 2 or 3 to simulate future earnings
pri_spa	1 2 3	pri_spa1 pri_spa2 pri_spa3	Private pension wealth at state pension age using method 1, 2 or 3 to simulate future earnings
tot_spa	1 2 3	tot_spa1 tot_spa2 tot_spa3	Total (state+private) pension wealth at state pension age using method 1, 2 or 3 to simulate future earnings

RESEARCH REPORT

Background

A key policy issue is the extent to which individuals' retirement saving decisions reflect the incentives that they face. This is of particular importance in the UK given that life expectancies are expected to continue rising and that – at least for those on average or higher earnings – the generosity of state pensions relative to average earnings is likely to have peaked around the beginning of this century. In the context of this background it is perhaps not surprising that barely a day goes by without a media story concerning the adequacy (or otherwise) of the incomes of current pensioners and of the prospective pensions of working age individuals. Questions are raised as to how changes in the pension regime and external circumstances will affect retirement behaviour and the living standards of current and future retirees.

Much of this analysis is, however, hindered by a lack of individual level data containing information on accumulated pension entitlements and other covariates of interest. The two exceptions to this in the UK are information in the British Retirement Survey (BRS) and the English Longitudinal Study of Ageing (ELSA). However both are only representative of older individuals (55 to 69 in the BRS and 50 and over in ELSA) and therefore are not informative on the circumstances, and individual responses to those circumstances, of the majority of working age individuals.

Objectives

The first objective stated in the research proposal was "to construct current and prospective measures of individual-specific pension wealth (deriving from both the public programme and from private schemes) using the BHPS by exploiting the additional questions in Wave 11 (2001) concerning pension scheme tenures and other related data".

We have computed state pension wealth from both the Basic State Pension and from the State Earnings-Related Pension Scheme, and private pension wealth from individual personal (or stakeholder) pensions, current employer defined benefit pensions, current employer defined contribution pensions and from past pensions which are not yet in payment. This has been done for each of the first eleven waves of data of the BHPS (from 1991 to 2001) for all respondents to the wave 11 survey. In addition we have computed prospective pension rights for each year going forwards under three different scenarios for the evolutions of individuals' wages. A paper (attached) has been written describing how the calculations were made and presenting statistics relating to the distribution of accrued and prospective pension wealth and its correlation with other characteristics of interest. In particular we have examined the generosity of public sector defined benefit pensions compared to private sector defined benefit pensions.

The data relating to state and private pension wealth for waves 1 to 11 of the BHPS, and prospective state and private pension wealth at the State Pension Age under three different scenarios for future earnings growth, are to be made publicly available through the ESRC data archive.

The second objective stated in the research proposal was "to utilise these household-specific pension wealth measures to develop two ongoing areas of applied research: the relationship between retirement and pension wealth, and the impact of accrued pension wealth on job mobility".

We have used the pension wealth calculations to estimate how pension rights would evolve were an individual to remain in their current pension scheme or if they were to move to a new employer and join (or not join) a new scheme. These estimates have been used to model how prospective pension rights affect job mobility rates. We have also used the information in the BHPS to exploit a feature of the UK's pension programme whereby we can differentiate between the pension arrangement chosen by the individual and what pension arrangements were offered to that individual. Overall the results provide strong evidence for an 'incentive' story for lower job mobility rates among pension plan-covered workers, since the differences found are significant across workers within pension plans and are not simply identified off differences in job mobility rates between covered and uncovered workers. We also show that there is indeed selection in how pension plans match employees and employers, but that the selection process does not affect the magnitude of the incentive effect of prospective pension plan losses for job tenure among plan participants.

To date less progress has been made on incorporating the pension wealth, and pension accrual, estimates into a model of early retirement. The initial findings, presented in the last section of this report, examine movements out of the labour market between wave 11 (2001) and wave 12 (2002) of the BHPS and therefore are based on a relatively small sample size and a 1 year horizon. These findings suggest that the importance of health shocks on labour market activity is not diminished once financial incentives are taken into account (the lack of financial incentives being taken into account being a critique of our previous work in this area). However while we find that those with higher earnings are more likely to remain in the labour market, no statistically significant role of pension incentives is found. Since this might be due to the relatively small sample sizes, and the one year time horizon, we are planning further work to incorporate subsequent, and potentially also earlier, labour market transitions observed in the other waves of the BHPS.

Methods

We computed the value of accrued rights in both state and private pensions in 2001 using information on those people who responded to wave 11 of the BHPS. Underlying the calculation of wealth from both state and private pensions are assumptions about each individual's employment and earnings, both in the past (for pension rights already accumulated) and into the future (for prospective pension rights). Therefore, we begin first by describing how retrospective employment and earnings were calculated and what assumptions underpin the three different scenarios for future earnings growth.

Employment and earnings

Each year the BHPS asks respondents about their current employment status and, if the respondent has started a job within the last year, what he or she was doing before starting this job. Therefore, a complete record of employment is available for all years between 1991 and 2001 in which the individual responded to the BHPS. Individuals who are not

in work are asked if they have ever done any paid work, which if they say "no" gives us important information about their entire working age life up to that point. Information on employment up to 1990 is used from the series of retrospective questions included in the 1993 BHPS survey (wave 3). This provides employment information for the majority of individuals in the wave 11 survey. During years when, even after considering all the BHPS employment information, we cannot be sure whether an individual was in work or not, we assume that he or she was in paid work unless the year in question is prior to him or her leaving full-time education or after he or she reaches the State Pension Age (SPA).

Similarly BHPS respondents are asked each year about their earnings. This provides more potential information than either the BRS, or from the first two waves of data from ELSA since neither contained retrospective questions on respondents earnings. For years in which individuals who were in wave 11 of the BHPS did not respond to the survey we extrapolate earnings smoothly in real terms between the previously observed earnings and the next observed earnings for that individual. This provides information on earnings from 1991 to 2001 for each employment spell.

For years between 1978 and 1990, earnings profiles are simulated by matching BHPS respondents to earnings profiles from repeat cross-section data, employing a method previously used in the literature. Individuals in the BHPS are assumed to have received wage growth implied by a quantile regression on log earnings for those from a similar group defined in terms of their year of birth, sex and education level observed in successive waves of the Family Expenditure Survey from 1978 to 2004–05. This assumption allows us to extrapolate back from the first observed earnings in the BHPS to 1978 (which is as far back as required for computing entitlement to the State Earnings-Related Pension Scheme). The underlying assumption here is that any shocks to earnings affect all individuals within the same group in the same way and so the ordering of individuals in each group does not change over time. For earnings prior to 1978 (which will only be needed for past spells in private pensions which ended prior to 1978) we assume that individuals earnings all grew by the economy-wide average.

Future accrual of rights to the State Second Pension, and to defined benefit pension schemes, will depend directly on future earnings. Moreover since we assume that contributions to defined contribution pensions (both to individually arranged personal and stakeholder pensions and employer provided defined contribution pensions) remain constant as a share of earnings fund accumulated in these pensions will also depend on the assumed path for earnings.

We estimate future accumulation of pension wealth under three different scenarios. The first is that all individuals see earnings growth of 2% per year (referred to later as scenario A). The second is that there is economy-wide earnings growth of 2% per year and that individuals receive this plus a component (which could be positive or negative) that depends on their sex, age and education (referred to later as scenario B). This component is estimated by running a quantile (median) regression of the logarithm of earnings on a quadratic in age using the post-1978 Family Expenditure Surveys on groups differentiated by sex and education. As shown in Figure 1 the quadratic in age seems to fit the data for men very well. However for women, as shown in Figure 2, it appears to work less well for women. Therefore the third scenario for future earnings growth is one where there is economy-wide earnings growth of 2% per year and individuals receive this plus a component that depends on their age and education, with this component being estimated from data on just men (referred to later as scenario C). For some women this

might be a more realistic scenario for their future wage growth – for example those women who have chosen to join an occupational pension might expect earnings growth similar to the wage growth which has previously been received by the 'median earning male (of their age and education level)' rather than that which has, in the past, been received by the 'median female (of their age and education level)'.

Figure 1. Simulated median log male earnings, by education, under two different specifications for age.
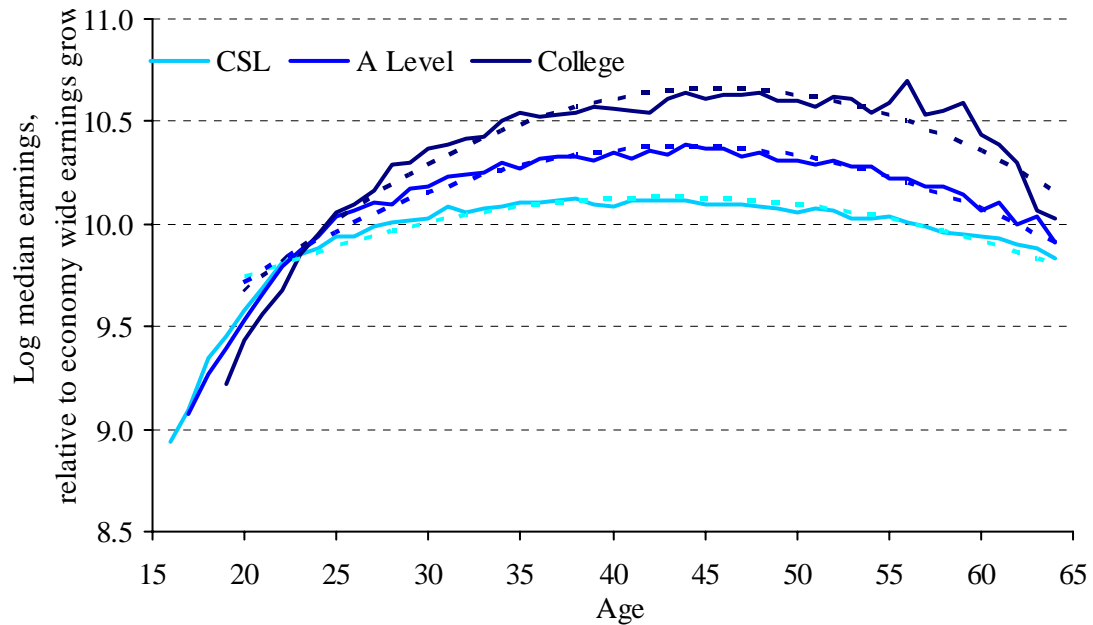
Figure 2. Simulated median log female earnings, by education, under two different specifications for age.
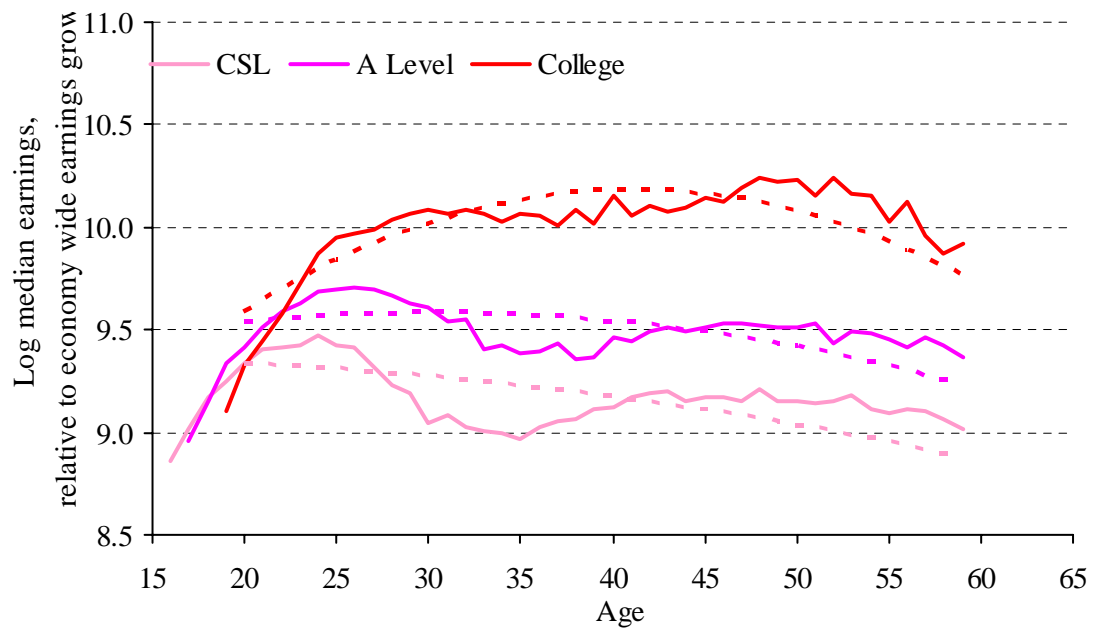
Source: Family Expenditure Survey, 1978 to 2004–05.

State and private pension wealth calculations

Accumulated rights to both state and private pensions are then calculated using the relevant rules in those schemes and the employment and earnings trajectories both derived from the BHPS data itself and those estimated going back to 1978 and forwards until the youngest sample members reach the state pension age. In all cases accrued pension wealth is calculated as the present discounted value (using an assumed discount rate of 2% per year) of the flow of pension income until death that the individual would be expected to receive were they to leave the labour market in the current year. (All individuals are assumed to live until their age and sex specific life expectancy). Predicted pension income from the Basic State Pension, the State Earnings-Related Pension Scheme and the State Second Pension are calculated straightforwardly from applying the rules that applied as of 2001 (when the wave 11 survey was conducted).

For current defined contribution pension schemes we use information in the BHPS on the amount individuals report that they contributed to the scheme. For employer provided defined contribution schemes the BHPS survey did not ask how much the individual's employer contributed to the scheme. Based on figures relating to average employer and member contributions from, we assume that the individual's employer makes a core contribution of 4.6% of salary and in addition matches 1:1 any member contributions above 2% of salary. We assume that the underlying fund increases in value by 2½% per year in real terms. At retirement the accumulated fund is assumed to be annuitised and pension wealth is then calculated as the presented discounted value of that stream of income. This is preferable to simply taking the accumulated pension fund as a measure of pension wealth since it ensures a fairer comparison with defined benefit pension arrangements, particularly if annuity rates are relatively low due to, for example, adverse selection.

For current defined benefit pension schemes the BHPS contains information on how long the individual has been a member of that scheme. In addition to earnings, accumulated pension rights in these schemes will also depend on the accrual fraction in the scheme, the normal pension age and whether there is a lump sum payment on retirement. For public sector workers we assume an accrual rate of $1/80^{th}$ and a normal pension age of 60, while for private sector workers we assume that these are $1/60^{th}$ and 65, respectively. Public sector workers are also assumed to receive a lump sum worth $3/80^{ths}$ of their final salary on retirement. These are the most prevalent scheme rules in each of these sectors.

Results

Distribution of accrued and prospective pension rights

Descriptive statistics from the estimated distribution of total (state and private) pension wealth are presented in Figure 3 which shows the mean level of state and private pension wealth in each quintile of the total pension wealth distribution. Unsurprisingly on average those aged under 40 have significantly less accrued pension wealth than those aged between 40 and the State Pension Age, in the cases of both state pension wealth and private pension wealth. Among those aged 40 and over the distribution of accrued private pension wealth is far more unevenly distributed than state pension wealth, with the richest twenty percent (in terms of their pension wealth) of those aged 40 or over having accumulated 3.7 times the average private pension wealth but only 1.4 times the average state pension wealth accumulated across all those 40 or over.

Figure 3. Distribution and composition of accumulated pension wealth, by age group, those aged between 16 and the State Pension Age in 2001.
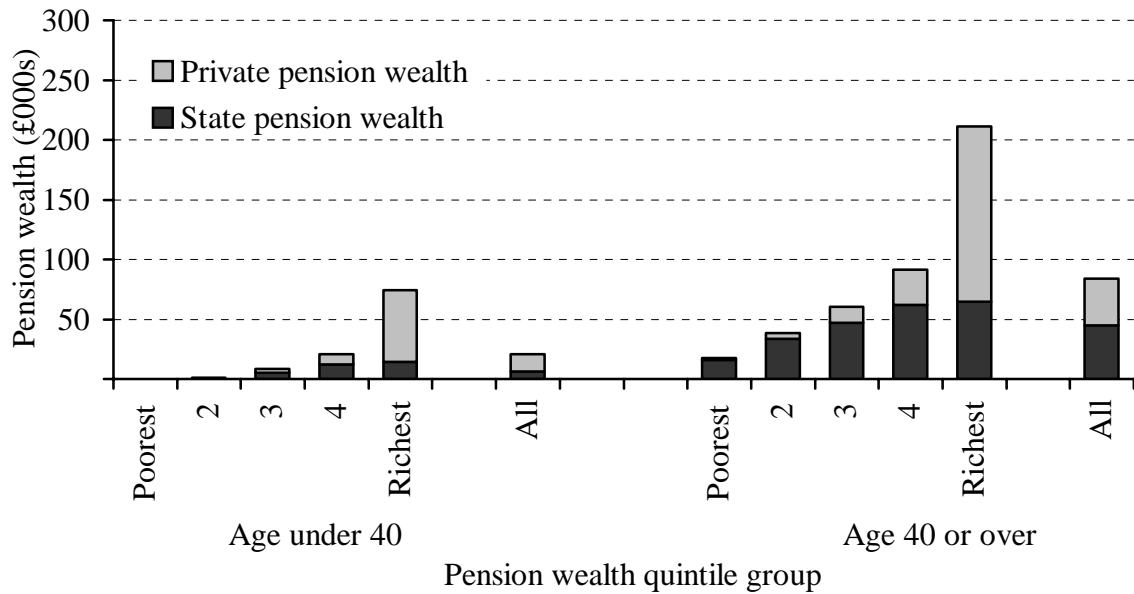
Note: Sample size = 3,692 individuals aged under 40 and 4,521 individuals aged between 40 and the state pension age. Figures in 2001 prices.

Table 1 presents a multivariate analysis of how average (median) accrued (2001) pension wealth, state, private and total, varies with different observed characteristics of interest. In addition to accumulated pension wealth varying with age (being higher for those closer to the state pension age) we find that while there is no statistically significant difference in the pension wealth of single men compared to single women (and the co-efficients suggesting that, if anything, single men had accumulated *lower* levels of pension wealth). However men in couples were found to have more pension wealth than women in couples, with this difference statistically different from zero at conventional levels. Those with higher education, and those with higher levels of current pay were also found, on average, to have accumulated higher pension wealth. All these correlations were found for both state and private pension wealth, although not expectedly (given the relatively flat rate nature of large parts of the state pension system for many individuals) the estimated co-efficients typically imply a stronger correlation with private pension wealth than with state pension wealth.

Table 1. Multivariate analysis of accrued (2001) pension wealth (quantile (median) regression).

	State pension wealth		Private pension wealth		Total pension wealth	
	Co-efficient	Standard error	Co-efficient	Standard error	Co-efficient	Standard error
Age	–2,609***	(82)	–1,174***	(49)	–4,900***	(151)
Age squared	69***	(2)	35***	(1)	135***	(4)
Age cubed	0***	(0)	0***	(0)	–1***	(0)
Male	–193	(124)	–29	(75)	–453**	(227)
Couple	–182	(111)	229***	(67)	328	(205)
Male * couple	1,922***	(151)	–138	(92)	1,346***	(278)
A level	668***	(107)	663***	(65)	1,977***	(198)
Degree	300***	(82)	992***	(50)	2,499***	(151)
Zero earner	–304***	(117)	–100	(71)	0	(215)
Pay quintile 2	781***	(138)	828***	(84)	2,251***	(255)
Pay quintile 3	1,361***	(142)	6,983***	(86)	9,519***	(262)
Pay quintile 4	2,777***	(147)	15,876***	(89)	19,204***	(270)
Highest pay quintile	8,997***	(154)	47,182***	(93)	56,335***	(283)
Constant	25,569***	(932)	11,102***	(554)	47,945***	(1,700)

Note: Sample size = 8,213. Omitted group: single female with low education in paid work in the lowest pay quintile. Statistical significant denoted by *** for the 1% level, ** for the 5% level and * for the 10% level.

We also examine differences in the amounts accumulated and the future accrual of, pension wealth held in current defined benefit pension arrangements by whether the individual was employed in the private or in the public sector. We find that on average members of public sector defined benefit arrangements had currently accumulated greater levels of pension rights in their current scheme than those in a private sector defined benefit pension. However in cash terms the distribution of simulated accrual of pension wealth over the next twelve months was very similar for those in public sector defined benefit arrangements to those in private sector defined benefit arrangements. As a result the higher accumulation to date arises from higher average pension tenures in public sector defined benefit schemes which, at least in part, might be due to the fact that these arrangements are more portable between different jobs. For example teachers and nurses will be able to move between different employing schools and hospitals without having to break their pension tenure unlike the typical private sector job changer.

Typical scheme rules in the public sector are more generous than those in the private sector, so the similar levels of accrual in cash terms are explained by the higher average wages received by members of private sector defined benefit schemes compared to those in public sector defined benefit schemes. As a share of current wages, almost half of those in private sector schemes see their pension wealth accrue by more than 20% of their current salary compared to 82% of those in public sector schemes. Figure 4 below shows the cumulative distribution of simulated pension wealth accrual in defined benefit schemes split by private and public sector, with the accrual measured as a share of current earnings. At the mean the simulated pension accrual is 19.2% of current salary in private sector defined benefit schemes compared to 22.4% in public sector defined benefit schemes, with this 3.2 percentage point difference statistically different from zero. Therefore the finding that pension accrual in cash terms is similar in private sector defined benefit schemes to public sector defined benefit schemes is due to the higher average wages paid to members of defined benefit schemes being offset by the more generous scheme rules typically observed in public sector arrangements.

Figure 4. Cumulative distribution of simulated one-period defined benefit pension accumulation as a percentage of current pay, by sector, those aged between 16 and the State Pension Age in 2001.
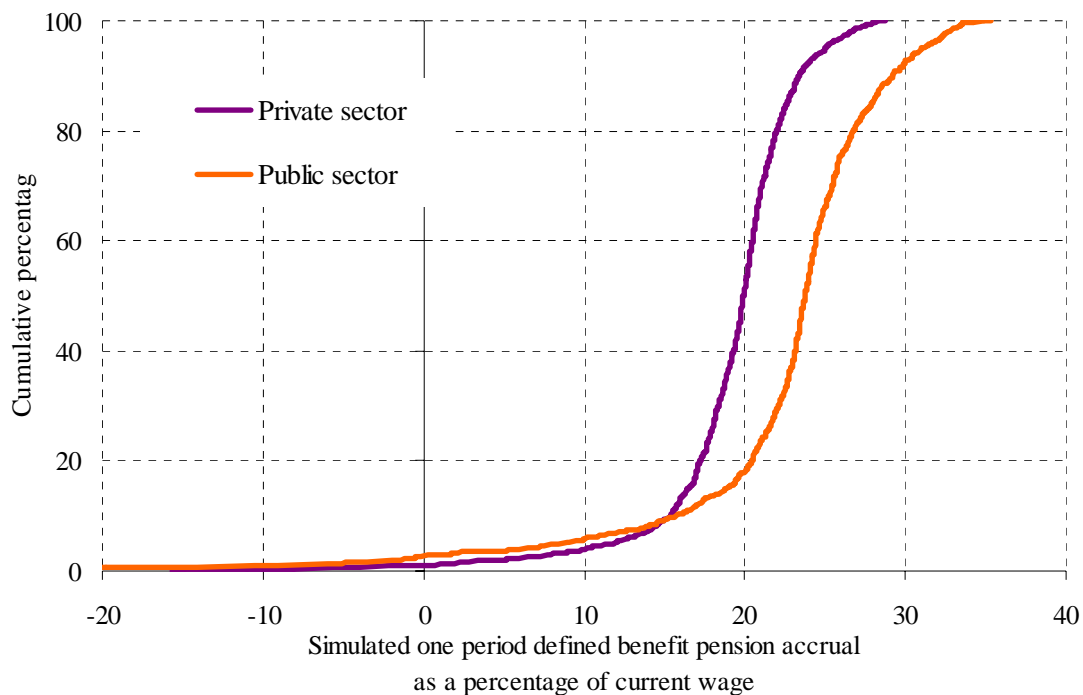
Note: Sample size 2,134 comprising 1,060 members of private sector schemes and 1,074 members of public sector schemes.

Pension rights, choice of pension plan, and job mobility

Our application of the constructed pension data has also focussed on the relation between workers' prospective pension rights and job mobility. This utilises the estimates of pension wealth, and their potential evolution, described above and also a unique facet of the United Kingdom's (UK) social security programme which allows workers the choice as to whether or not to join an employer-offered pension plan in order to shed new light on competing explanations within the academic literature as to why employer-provided pension plans are associated with longer employee job tenures (lower rates of job mobility).

We have examined measures of prospective pension loss arising from job mobility among members of employer-provided pension plans under several assumptions concerning the duration of the period for which the loss is measured and as to whether or not the employee obtains coverage in the new job, and the trajectory of prospective earnings. In most of these estimated models, there is a significant negative association between job mobility and the magnitude of prospective individual pension losses differentiated among plan members. The models work less well where workers are assumed to value these lost rights through to retirement or to maximum values later in life; under some modelled trajectories of earnings, moreover, workers would be best served by quitting now and having rights assessed on their current wage and tenure, so long as they could join a new plan in their next employment. Nevertheless, overall the results provide strong evidence for an 'incentive' story for lower job mobility rates among pension plan-covered workers, since these differences are significant across

workers within pension plans and are not simply identified off differences in job mobility rates between covered and uncovered workers.

Table 2 depicts the mean pension losses for those who actually move in the next 12 months, compared to the calculated losses for those who do not move. The calculations are done both for the whole sample (which will include many zero losses since only those in defined benefit schemes can experience a pension loss, or indeed in some circumstances a pension gain) and, perhaps more pertinently, just for those who belong to a defined benefit pension plan and for whom there is likely to be a change in pension rights. These calculations assume that DB plan members move to another, covered, job. Column A contains the estimates based on the assumption that all employees expect to receive earnings growth of 2% per year (scenario A set out above). Column B contains the estimates based on the assumption that all employees expect to receive earnings growth of 2% per year plus a component that depends on their sex, age and education (scenario B set out above and shown in Figure 1 and Figure 2). Column C contains the estimates based on the assumption that all employees expect to receive earnings growth of 2% per year plus a component that depends on their age and education which is estimated on data from men (scenario C set out above and as shown in Figure 1).

The results confirm that for the whole sample, the average pension loss from moving is rather small, since many people do not belong to DB plans. For the sample of DB members, the average pension loss would be just over £1,100; however the loss among those plan members who actually move is only just over £500 – less than half that amount.

Table 2. Mean defined benefit pension loss by whether or not change jobs

	Estimated wage growth		
	A (base, 2% real)	B (2% real + gender, age & education component)	C (2% real + age & educ. component estimated over men)
All individuals			
Mean expected one period loss with new pension plan			
Stayers	584	418	540
	(21)	*(22)*	*(23)*
Movers	141	153	200
	(22)	*(25)*	*(27)*
All	528	384	497
	(19)	*(20)*	*(20)*
DB plan members only			
Mean expected one period loss with new pension plan			
Stayers	1,203	861	1,113
	(38)	*(42)*	*(43)*
Movers	511	557	725
	(70)	*(81)*	*(82)*
All	1,150	838	1,083
	(36)	*(40)*	*(40)*

Note: Unweighted. Sample size, all in paid work = 3,556 (comprising 3,102 stayers and 454 movers), those in defined benefit schemes only = 1,631 (comprising 1,506 stayers and 125 movers). Standard deviation in parenthesis.

Multivariate estimates of the impact of pension losses on labour market mobility are presented in Table 3. These control for individual characteristics such as age, sex, education and family status and job characteristics such as pay, industry and firm size. Importantly we also control for pension tenure, the offer of an occupational pension and whether an individual is a member of a private pension (either an occupational pension or a personal pension). It is still the case that we find that individuals with greater estimated pension losses from changing employer are found to be less likely to subsequently change employer.

The first specification in column (1) of Table 3 focuses on the role of indicator variables of pension status and omits the measure of pension loss. Of the control variables, the only marginal effects to exhibit individual significance are the cubic in pension plan tenure (the marginal effects of which are jointly significant as confirmed by the χ^2 test as the foot of the table) and the wage, which has the expected negative sign given the other control variables. Other than the pension variables, no other sets of dummy variables (e.g. region, education) are jointly significant. In contrast, the three indicator variables on pension status are jointly significant at the 1% level (as again illustrated by the joint χ^2 test). Being offered a pension is weakly associated with a lower probability of job mobility, accepting the offer (whether of the DB or DC type) is significantly associated with lower job mobility and having a personal pension (whether offered a pension by the employer or not) has a small and insignificant negative effect.

Table 3

Impact of prospective pension losses on job mobility: Alternative specifications of wage growth

	(1) Pension coverage type only		(2) A:1 year pension loss, 2% $\hat{g}$		(3) B: 1 year pension loss, 2% $\hat{g}$ + age, age², education		(4) C: 1 year pension loss, 2% male $\hat{g}$ + age, etc.	
	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Full-time	0.026	0.016	0.022	0.016	0.022	0.016	0.023	0.016
Male	−0.012	0.138	−0.021	0.134	−0.056	0.139	−0.045	0.138
Age	0.386	0.606	0.350	0.588	0.521	0.602	0.564	0.602
Age²	−0.575	0.778	−0.472	0.757	−0.773	0.774	−0.819	0.773
Pension tenure	−0.031***	0.006	−0.032**	0.006	−0.031**	0.006	−0.032**	0.006
Pension tenure²	0.002**	0.001	0.002**	0.001	0.002**	0.001	0.002**	0.001
Pension tenure³	−0.00005*	0.00002	−0.00005*	0.0002	−0.00005*	0.0002	−0.00005*	0.0002
Current wage	−0.027*	0.012	−0.017	0.012	−0.023*	0.012	−0.021	0.012
Public sector (Y/N)	−0.031	0.018	−0.026	0.017	−0.029	0.017	−0.028	0.017
Offered pension (Y/N)	−0.026	0.016	−0.027	0.016	−0.028	0.016	−0.028	0.016
Accepted pension offer (Y/N)	−0.031*	0.014	−0.020	0.014	−0.023	0.014	−0.021	0.014
Has personal pension (Y/N)	−0.001	0.013	−0.007	0.013	−0.004	0.013	−0.005	0.013
Pension loss (£000)	Not included	Not included	−0.032**	0.009	−0.021**	0.006	−0.022**	0.006
No of obs	3565		3549		3549		3549	
χˣ(3) for Pen offer, Accepted pen offer, has Personal P.	14.74	p-value 0.002	10.01	p-value 0.019	11.16	p-value 0.011	10.36	p-value 0.016
χˣ(3) for Pension tenure	73.00	0.000						

Source: calculated from BHPS.

 Notes: Estimation method: probit; marginal effects are cited. LHS variable: Probability of moving job between waves 11 and 12 of BHPS (2001/2002). **=1%, *=5% significance. Additional controls: quadratic in time to travel to work, age-gender interactions, working status of partner, ethnicity, full sets of dummies for education, industry, firm size and region. Construction of earnings growth and pension loss variables as explained in test: this specification, one year loss if individual moves from one pension-covered job to another.

In Column 2, we augment the specification with the measure of one period pension loss under the assumption that all individual expect earnings growth of 2%. The coefficient on prospective pension loss is negative and significant as expected; it implies that a £1,000 pension loss is associated with a reduction in the job moving probability of about 3 percentage points. To put this in context, the overall moving probability among the sample between waves 11 and 12 is just under 12 percent. Roughly 60% of the sample could expect a pension loss of less than £1,000 year-on-year and 40% of more than that amount. For those in the tail of large pension losses, therefore, the impact on the moving probability is therefore large in absolute terms. Columns 3 and 4 repeat the exercise in Column 2 using Methods B and C respectively for calculating pension losses. These methods allow for the possibility of falling wages and therefore pension gains from moving employer. Coefficients on other variables are barely affected but the marginal effects on the pension losses are somewhat smaller – they are however most precisely estimated under Method C. Note that the three indicator variables on pension status remain jointly – although not individually – significant, and that the current wage level is no longer a significant determinant of mobility once the pension losses are incorporated.

Activities

Both papers (see below) will be circulated to the IFS retirement savings consortium (which comprises HM Treasury, the Department for Work and Pensions, HM Revenue and Customs, the Bank of England, the Investment Management Association, the Association of British Insurers and the Institute of Actuaries) for both comments and to ensure a wide dissemination.

We will also submit the paper "Pension rights, choice of pension plan and job mobility of Britain" to the Department for Work and Pensions Work and Pensions Economics Group conference.

Outputs

"Accrued and Prospective Pension Rights in Britain" by Richard Disney, Carl Emmerson, Gemma Tetlow and Matthew Wakefield will be published as an IFS working paper. After a final revision in the light of comments received it will be submitted to the journal *Fiscal Studies*.

The data produced by this study will be submitted to the ESRC data archive. The appendices to the working paper detailed above will be available for users of the data to understand how the pension wealth calculations were done.

"Pension rights, choice of pension plan and job mobility of Britain" by Richard Disney, Carl Emmerson and Gemma Tetlow will also be published as an IFS Working Paper. After a final revision in the light of comments received it will be submitted to a such as the *Journal of Human Resources*.

Impacts

No instances of the research being used or applied outsider of the project as yet, but we are hopeful that the data being deposited with the archive will prove to be a useful future research tool.

Future Research Priorities

Pension rights and retirement

To date less progress has been made on incorporating the pension wealth, and pension accrual, estimates into a model of early retirement. Previous research (Disney, Emmerson and Wakefield, *Journal of Health Economics,* vol 25, June 2006) looked at the role of ill-health in retirement decisions in Britain, using the first eight waves of the British Household Panel Survey (1991-98). This tackled the problem that self-reported health status is likely to be endogenous to the retirement decision by using a two-stage method. The first stage constructed a 'health stock' measure cleansed of the effects of reporting behaviour reflecting labour market participation. This measure was then introduced into a reduced form model of labour market (in)activity. Deterioration in an individual's health was found to be strongly positively associated with movement out of work.

A critique of this research was that the reduced form retirement model did not take into account the financial incentives facing individuals. To date we have only incorporated the pension incentives constructed from the BHPS data into a model of retention in paid work among those aged between 50 and the state pension age between wave 11 and wave 12 of the BHPS, which is a relatively small sample size and only a 1 year time horizon. The results are presented in Table 4. Column 1 (Model 1) excludes financial incentive variables. This shows that men and those who own their homes outright are statistically more likely to remain in the labour market. Those estimated to have a larger health stock (i.e. those in better health) are also found to be more likely to remain in paid work with this co-efficient statistically significant at the 10% level. Those whose health, relative to the rest of the sample, improves are also found to be more likely to remain in paid work, although this co-efficient is not statistically significantly different from zero.

The estimates once earnings, pension wealth and one-period pension accrual are included in the model are presented in column 2. As might be expected higher earners are found to be more likely to remain in paid work while those with greater pension wealth are found to be more likely to leave the labour market, although the latter co-efficient is not statistically significantly different from zero. The co-efficient on pension accrual has the 'wrong' sign in that it is those individuals with greater pension accrual who are found to be less likely to remain in paid work, although again the co-efficient is not statistically significantly different from zero. Neither the co-efficient on health stock, or the co-efficient on the change in health stock (or the precision with which they are estimated) is affected by the inclusion of the financial characteristics. These findings suggest that the importance of health shocks on labour market activity is not diminished once financial incentives are taken into account. Future work will incorporate subsequent, and potentially also earlier, labour market transitions observed in the other waves of the BHPS in order this important issue to be investigated fully and examine the way in which we incorporate our measures of pension wealth into the retirement model.

Table 4. Movements out of paid work between 2001 and 2002, those aged between 50 and the State Pension Age and in paid work in 2001 only

	Model 1		Model 2	
Male	+0.034*	(0.019)	+0.026	(0.019)
Couple	–0.029	(0.020)	–0.028	(0.020)
Age/10	+16.926	(14.312)	+18.452	(14.025)
Age/10 squared	–2.830	(2.536)	–3.102	(2.485)
Age/10 cubed	+0.156	(0.149)	+0.172	(0.146)
Owner occupier – outright	+0.057*	(0.036)	+0.054*	(0.036)
Owner occupier – mortgage	–0.026	(0.021)	–0.025	(0.021)
No. children at home	+0.010	(0.026)	+0.011	(0.025)
Health stock	+0.024*	(0.013)	+0.023*	(0.013)
Change in health stock (2001 to 2002)	+0.018	(0.014)	+0.018	(0.013)
Earnings (£'000)			+0.002**	(0.001)
Pension wealth in 2001 (£00,000)			–0.014	(0.012)
Pension accrual to 2002 (£00,000)			–0.050	(0.034)
Joint F-test on health stock and change in health stock	4.26	p-value = 11.9%	4.13	p-value = 12.7%

Note: Characteristics all relate to 2001 unless otherwise stated. Number of observations = 945 of which 862 remain in paid work while 83 move out of paid work. Statistical significance denoted by ** for 5% level and * for 10% level. Controls for region also included.

Word count (excluding Tables 1 to 4) = 4,700 words

Accrued and Prospective Pension Rights in Britain[1]

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July 2007

Abstract

This paper explains the methodology used for calculating pension wealth for individuals in the British Household Panel Survey, making use of a special module of questions included in the 2001 survey. In addition to estimating state and private pension wealth at the time of the 2001 survey – and its level in past waves – we also estimate how it would accrue in the future under three different scenarios for the evolution of earnings. While older individuals had, unsurprisingly, accumulated greater pension wealth than younger individuals there was relatively little difference in simulated total pension wealth at the state pension age. Higher pension wealth is found to have been accumulated by men in couples compared to their partners, and by those with higher levels of education and higher levels of current pay. On average members of public sector defined benefit arrangements had accumulated greater levels of pension in their current scheme than those in a private sector defined benefit pension. This is found to be due to both more generous scheme rules, and also the higher typical pension tenures in public sector arrangements. Moreover it is despite the fact that, on average, those in private sector defined benefit arrangements have higher earnings than those in public sector defined benefit arrangements.

1. Introduction

A key policy issue is the extent to which individuals' retirement saving decisions reflect the incentives that they face. This is of particular importance in the UK given that life expectancies are expected to continue rising and that – at least for those on average or higher earnings – the generosity of state pensions relative to average earnings is likely to have peaked around the beginning of this century (Disney and Emmerson, 2005). In the context of this background it is perhaps not surprising that barely a day goes by without a media story concerning the adequacy of the incomes of current pensioners and of the prospective pensions of working age individuals. Questions are raised as to how changes in the pension regime and external circumstances will affect retirement behaviour and the living standards of current and future retirees. Recently these have included debate around the impact on individuals of means-tested components of state support for pensioners, declining coverage of defined benefit occupational pension schemes within the private sector, lower expected investment returns, and larger than expected increases in life expectancies.

What is perhaps surprising is that analysis seeking to address these issues typically focuses on either illustrations derived from stylised individual work histories and profiles of accrued pension rights, grossed up to obtain an aggregate estimate (as in for example Pension Policy Institute, 2003 and Disney and Emmerson, 2005), or alternatively information on mean saving rates which are potentially very sensitive to the behaviour of relatively few individuals with very high income (Oliver Wyman and Company, 2001, and much of the analysis in Pensions Commission, 2004 and 2005). An alternative is to look at the incomes of current pensioners, but this could be a bad guide to the future as the environment in which current retirees made their retirement saving decisions is likely to be very different in many dimensions to that experienced by future generations. An exception to this in the UK is the construction of pension wealth estimates using the comprehensive information available from the English Longitudinal Study of Ageing (Banks, *et al*, 2005). However this survey is only representative of individuals aged 50 and over in households in England.

This paper describes the calculation of individual pension wealth using panel data from a representative sample of British households. The basic dataset used is the British Household Panel Survey (BHPS), and in particular we exploit the additional questions in Wave 11 (2001)[2] concerning pension scheme tenures and other related data in order to augment the panel data on personal characteristics including earnings and job tenures of respondents. We compute state pension wealth from both the Basic State Pension and from the State Earnings-

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[2] The questions relating to private pensions included in wave 11 of the BHPS are detailed in Appendix A.

Related Pension Scheme, as well as private pension wealth from individual personal (or stakeholder) pensions, current employer defined benefit pensions, current employer defined contribution pensions and from past pensions which are not yet in payment. This is done for each of the first eleven waves of data of the BHPS (from 1991 to 2001) for all respondents to the wave 11 survey. In addition we compute prospective pension rights for each year going forwards under three different scenarios for the evolution of individuals' wages.[3]

In Section 2 of the paper we provide details of the calculations to obtain these results. Section 2.1 describes the assumptions underpinning the employment and earnings histories, which are important for the computation of both current state and current private pension wealth, and the assumptions over future wage growth which affect both state and private pension accrual. Section 2.2 describes how, using these estimated profiles of employment and earnings, both private and state pension rights are calculated. More details on both the computation of employment and earnings and also how these are translated into pension rights can be found in the appendices (B to E). Section 3 provides some descriptives of the resulting data. In particular in Section 3.1 we describe how pension wealth (both state and private) varies by individual characteristics such as age, sex and education. Finally in section 3.2 we examine the relative importance of pension accrual in defined benefit arrangements as part of the remuneration package of members of public sector pension schemes compared to members of private sector pension schemes. Section 4 concludes.

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[3] The data relating to state and private pension wealth for waves 1 to 11 of the BHPS, and prospective state and private pension wealth at the State Pension Age under three different scenarios for future earnings growth, are to be made publicly available through the ESRC data archive.

2. Calculation of state and private pension wealth

This section describes how the value of accrued rights in both state and private pensions in 2001 was calculated for those people who responded in wave 11 of the BHPS. Underlying the calculation of wealth from both state and private pensions are assumptions about each individual's employment and earnings, both in the past (for pension rights already accumulated) and into the future (for prospective pension rights). Therefore, section 2.1 begins by describing how retrospective employment and earnings were calculated and what assumptions underpin the three different scenarios for future earnings growth.

2.1   Employment and earnings

2.1.1 Retrospective employment and earnings

Each year the BHPS asks respondents about their current employment status and, if the respondent has started a job within the last year, what he or she was doing before starting this job. Therefore, a complete record of employment is available for all years between 1991 and 2001 in which the individual responded to the BHPS. Individuals who are not in work are asked if they have ever done any paid work, which if they say "no" gives us important information about their entire working age life up to that point. Information on employment up to 1990 is used from retrospective questions included in the 1993 BHPS survey (wave 3). This provides employment information for the majority of individuals in the wave 11 survey. During years when, even after considering all the employment information available from all the waves of the BHPS we cannot be sure whether an individual was in work or not, we assume that he or she was in paid work unless the year in question is prior to him or her leaving full-time education or after he or she reaches the State Pension Age (SPA).

Similarly BHPS respondents are asked each year about their earnings. For the years in which individuals responded to this survey this is more information than is available in either the British Retirement Survey or from the first two waves of data from the English Longitudinal Study of Ageing, since neither contained retrospective questions on respondents' earnings. For years in which individuals who were in wave 11 of the BHPS did not respond to the survey we extrapolate earnings smoothly in real terms between the previously observed earnings and the next observed earnings for that individual. This provides information on earnings from 1991 to 2001 for each employment spell.

For years between 1978 and 1990, earnings profiles are simulated by matching BHPS respondents to earnings profiles from repeat cross-section data, employing a method similar to that used by Blundell, Meghir and Smith (2002). Individuals in the BHPS are assumed to have received the same wage growth as implied by a quantile regression on log earnings for

those from a similar group defined in terms of their year of birth, sex and education level observed in successive waves of the Family Expenditure Survey from 1978 to 2004–05. This assumption allows us to extrapolate back from the first observed earnings in the BHPS to 1978 (which is as far back as required for computing entitlement to the State Earnings-Related Pension Scheme). The underlying assumption here is that any shocks to earnings affect all individuals within the same group in the same way and so the ordering of individuals in each group does not change over time. For earnings prior to 1978 (which will only be needed for past spells in private pensions which ended prior to 1978) we assume that individuals' earnings all grew by the economy-wide average. Further details on the assumptions underpinning both the employment and the earnings histories are provided in Appendix B.

2.1.2 Prospective earnings

Future accrual of rights to the State Second Pension, and to defined benefit pension schemes, will depend directly on future earnings. Moreover since we assume that contributions to defined contribution pensions (both to individually arranged personal and stakeholder pensions and employer provided defined contribution pensions) remain constant as a share of earnings, the funds accumulated in these pensions will also depend on the assumed path for earnings.

We estimate future accumulation of pension wealth under three different scenarios. The first is that all individuals see earnings growth of 2% per year. The second is that there is economy-wide earnings growth of 2% per year and that individuals receive this plus a component (which could be positive or negative) that depends on their sex, age and education. This component is estimated by running a quantile (median) regression of the logarithm of earnings on a quadratic in age using the post-1978 pseudo-panel of Family Expenditure Surveys on groups differentiated by sex and education. While the quadratic in age seems to fit the data for men very well, it appears to work less well for women (see Appendix E and, in particular, figures E.1 and E.2 for more details). Therefore the third scenario for future earnings growth that we use is one where there is economy-wide earnings growth of 2% per year and that individuals receive this plus a component that depends on their age and education, with this component being estimated from data on just men. For some women this might be a more realistic scenario for their future wage growth – for example those women who have chosen to join an occupational pension might expect earnings growth that is more similar to the wage growth which had previously been received by the 'median earning male (of their age and education level)' rather than which had, in the past, been received by the 'median earning female (of their age and education level)'. Under all of these scenarios those in paid work remain in paid work and those not in paid work remain not in paid work.

2.2　State and private pension wealth calculations

Accumulated rights to both state and private pensions are calculated using the relevant rules in the schemes and the employment and earnings trajectories described in section 2.1. Detailed information on the rules used for determining the accrual of state and private pension rights in each year can be found in Appendix C and Appendix D respectively. However in all cases accrued pension wealth is calculated as the present discounted value (using an assumed discount rate of 2% per year) of the flow of pension income until death that the individual would be expected to receive were they to leave the labour market in the current year. All individuals are then assumed to live until their age and sex specific life expectancy.

Predicted pension income from the Basic State Pension, the State Earnings-Related Pension Scheme and the State Second Pension are calculated simply by applying the rules as set out in legislation at 2001[4] (when the wave 11 survey was conducted) to the estimated employment and earnings paths. The rules of these schemes are described in Appendix C.

For current defined contribution pension schemes we use information in the BHPS on the reported amounts that individuals contributed to their schemes. However, for employer-provided defined contribution schemes the BHPS survey did not ask how much the individual's employer contributed to the scheme. Based on figures relating to average employer and member contributions from Watson Wyatt (2005), we assume that the individual's employer makes a core contribution of 4.6% of salary and in addition matches 1:1 any member contributions above 2% of salary. We assume that the underlying fund increases in value by 2½% per year in real terms. At retirement the accumulated fund is assumed to be annuitised and pension wealth is then calculated as the present discounted value of that stream of income. This is preferable to simply taking the accumulated pension fund as a measure of pension wealth since it ensures a fairer comparison with defined benefit pension arrangements, particularly if annuity rates are relatively low due to, for example, adverse selection (Finkelstein and Poterba, 2002)

For current defined benefit pension schemes the BHPS contains information on how long the individual has been a member of that scheme. In addition to earnings, accumulated pension rights in these schemes will also depend on the accrual fraction in the scheme, the normal pension age and whether there is a lump sum payment on retirement. For public sector workers we assume an accrual rate of 1/80th and a normal pension age of 60, while for private sector workers we assume that these are 1/60th and 65, respectively. Public sector workers are

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[4] The relevant SERPS rules were applied to earning from 1978–79 to 2001–02, while the S2P rules that were in place in 2001 were applied to earnings from 2002–03 onwards. Therefore revisions to the S2P rules set out in the 2007 Pensions Act are not taken into account.

also assumed to receive a lump sum worth $3/80^{ths}$ of their final salary on retirement. These are the most prevalent scheme rules in each of these sectors. Section 3.2 provides evidence on the relative generosity of these two schemes taking into account differences in the observed pension tenures in public and private sector schemes, both in absolute terms and as a share of gross wages.

# 3. Distribution of accrued and prospective pension rights

This section presents descriptive evidence on the correlation between the estimates of accrued state and private pension rights among sample members of the BHPS and other observed characteristics of interest. In section 3.1 we focus on the correlation between pension wealth (both that accumulated to date and prospective pension wealth) and individual characteristics such as age, sex and education. In section 3.2 we turn to examine the issue of how accumulated pension rights, and the accrual of pension rights, differs in relative generosity between those in public sector employment compared to those in private sector employment.

3.1 Pension wealth by individual characteristics

Descriptive statistics from the estimated distribution of total (state and private) pension wealth are shown in Figure 3.1. This figure shows (separately for those aged under 40 and those 40 and over) the mean level of state and private pension wealth in each quintile of the total pension wealth distribution. Unsurprisingly those aged under 40 have, on average, significantly less accrued pension wealth than those aged between 40 and the State Pension Age. This is the case for both state pension wealth and private pension wealth. The figure also shows that among those aged 40 and over the distribution of accrued private pension wealth is far more unevenly distributed than state pension wealth, with the richest twenty percent (in terms of their pension wealth) of those aged 40 or over having accumulated 3.7 times the average private pension wealth but only 1.4 times the average state pension wealth accumulated across all those 40 or over.

On average, currently accrued pension rights will be small relative to pension rights at retirement for younger individuals. Figure 3.2 shows statistics on the simulated distribution of pension rights at the state pension age. This assumes that individuals remain in their current employment and pension status, and that their earnings evolve under the third scenario set out in section 2.1 (and in Appendix E). Under this scenario there is surprisingly little difference between the average pension wealth of those aged under 40 compared to those aged over 40. This is true for both state and private pension wealth, and is also true on average in each quintile of the pension wealth distribution. It is important to note, however, that for younger individuals the estimates of pension wealth at state pension age are likely to be less accurate than the estimates for those who are closer to retirement. For example younger individuals in the under 40 category might not have started saving in a pension yet, but will do so in the future. Moreover, if anything, the estimates for those aged under 40 are at the mean, in real terms, slightly lower than those for individuals aged 40 and over whereas we might have expected them to be higher as a result of the younger group having higher lifetime earnings.

Figure 3.1. Distribution and composition of accumulated pension wealth, by age group, those aged between 16 and the State Pension Age in 2001.
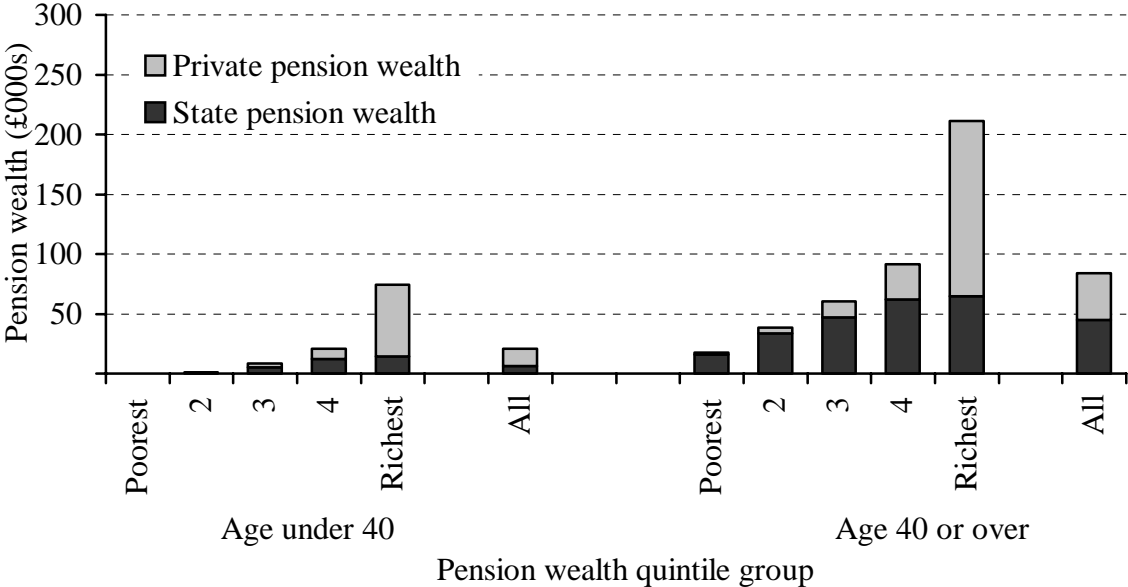
Note: Sample size = 3,692 individuals aged under 40 and 4,521 individuals aged between 40 and the state pension age. Figures in 2001 prices.

Figure 3.2. Distribution and composition of simulated pension wealth at state pension age, by age group, those aged between 16 and the State Pension Age in 2001.
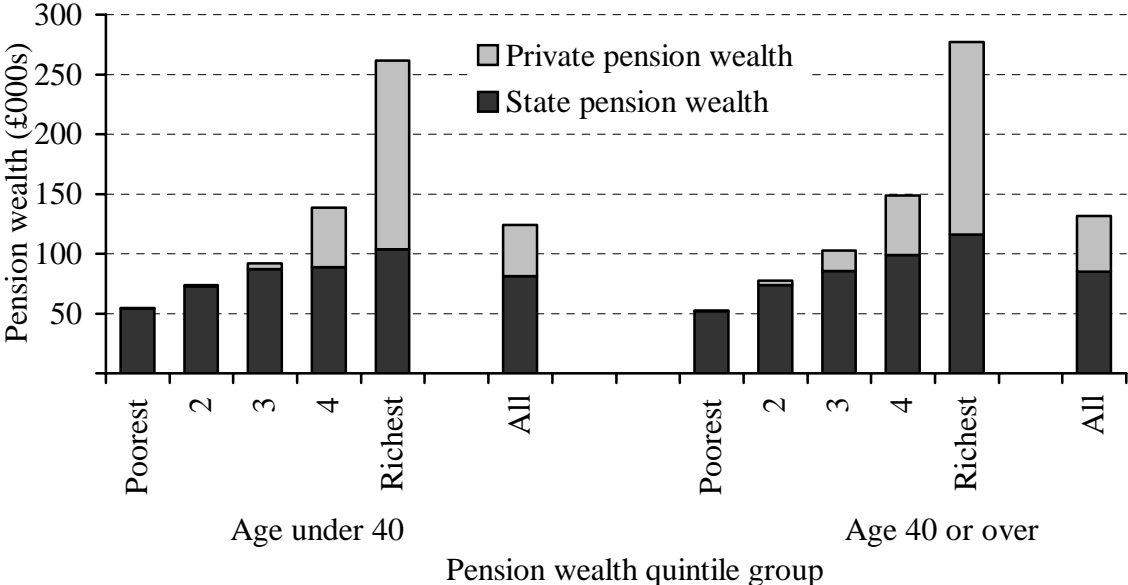

Note: Sample size = 3,692 individuals aged under 40 and 4,521 individuals aged between 40 and the state pension age. Figures in 2001 prices.

The data also reveal large differences in pension wealth by sex: pension wealth is, on average, higher among men than among women. This is despite the fact that those women aged over 46 in 2001 will be able to receive their state pension from an earlier age than men of the same age and that all women, due to their longer life expectancy, will on average expect to receive any state or private pension income to an older age than men of the same age. For savings held in defined contribution pensions this should be completely offset by a relatively lower annuity rate but this will not be the case for state pensions or wealth accumulated in defined benefit pension schemes. Figure 3.3 shows the cumulative distribution of accrued pension wealth in 2001 split by sex. 73% of women are estimated to have accrued total pension wealth of less than £50,000 but this was true for only around 60% of men. Reading the graph the other way shows that, for example, while half of women are estimated to have accumulated pension wealth of more than £21,500 half of men are estimated to have accumulated more than £34,200.

A similar finding emerges for simulated pension wealth at the state pension age. The cumulative distribution of simulated pension wealth at the state pension age, again split by sex, is shown in Figure 3.4. Very few individuals (although a higher proportion of women than men) are found to have total pension wealth below £50,000, which will largely be due to estimated entitlement to the (flat rate) Basic State Pension (the value of a full Basic State Pension discounted to different ages is shown in Figures C.1 and C.2). While it is estimated that half of women will have accumulated more than £85,500, it is estimated that half of men will have accumulated more than £110,000.

Table 3.1 presents the findings of a multivariate analysis of how average (median) accrued (2001) pension wealth, state, private and total, varies with different observed characteristics of interest. In addition to accumulated pension wealth varying with age (i.e. being higher for those closer to the state pension age) we find that there is no evidence that single men have, on average, greater pension wealth than single women (and the co-efficients suggest that, if anything, single men had accumulated *lower* levels of pension wealth). However men in couples are found to have more pension wealth than women in couples, with this difference statistically different from zero at conventional levels. Those with higher education and those with higher levels of current pay were also found, on average, to have accumulated higher levels of pension wealth. All these correlations were found to be true of both state and private pension wealth, although as one might expect (given the relatively flat rate nature of large parts of the state pension system for many individuals) the estimated co-efficients typically imply a stronger correlation with private pension wealth than with state pension wealth.

Figure 3.3. Cumulative distribution of accumulated pension wealth, by sex, those aged between 16 and the State Pension Age in 2001.
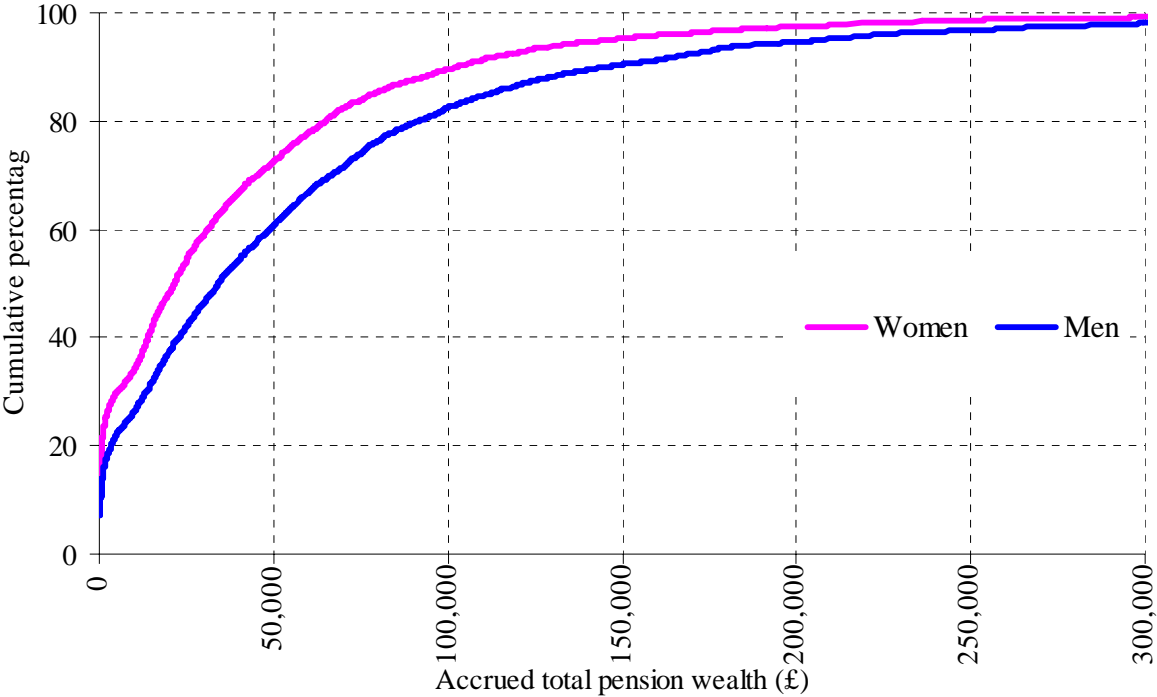
Figure 3.4. Cumulative distribution of simulated pension wealth at state pension age, by sex, those aged between 16 and the State Pension Age in 2001.
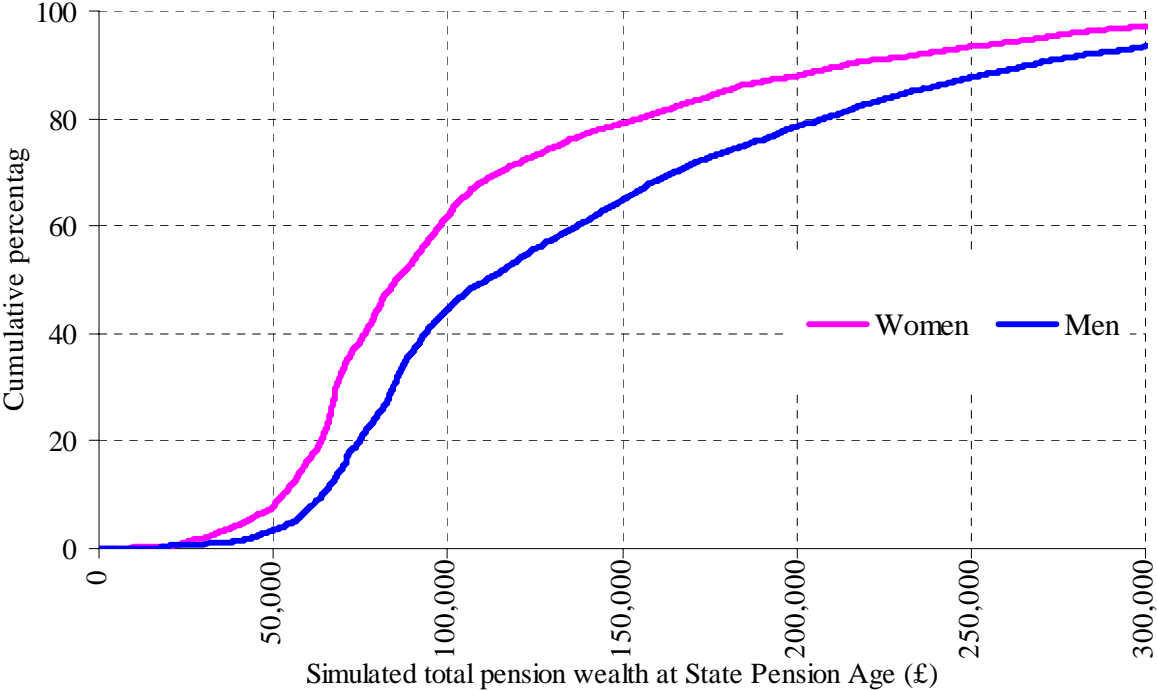
Table 3.1. Multivariate analysis of accrued (2001) pension wealth (quantile (median) regression).

|	State pension wealth		Private pension wealth		Total pension wealth	
	Co-efficient	Standard error	Co-efficient	Standard error	Co-efficient	Standard error
Age	–2,609***	(82)	–1,174***	(49)	–4,900***	(151)
Age squared	69***	(2)	35***	(1)	135***	(4)
Age cubed	0***	(0)	0***	(0)	–1***	(0)
Male	–193	(124)	–29	(75)	–453**	(227)
Couple	–182	(111)	229***	(67)	328	(205)
Male * couple	1,922***	(151)	–138	(92)	1,346***	(278)
A level	668***	(107)	663***	(65)	1,977***	(198)
Degree	300***	(82)	992***	(50)	2,499***	(151)
Zero earner	–304***	(117)	–100	(71)	0	(215)
Pay quintile 2	781***	(138)	828***	(84)	2,251***	(255)
Pay quintile 3	1,361***	(142)	6,983***	(86)	9,519***	(262)
Pay quintile 4	2,777***	(147)	15,876***	(89)	19,204***	(270)
Highest pay quintile	8,997***	(154)	47,182***	(93)	56,335***	(283)
Constant	25,569***	(932)	11,102***	(554)	47,945***	(1,700)

Note: Sample size = 8,213. Omitted group: single female with low education in paid work in the lowest pay quintile. Statistical significant denoted by *** for the 1% level, ** for the 5% level and * for the 10% level.

3.2 Pension wealth by sector of employment

We now turn to examine the issue of how accumulated pension wealth and the accrual of pension wealth differ in relative generosity between those who are members of defined benefit pension arrangements in the public sector and those who are members of defined benefit pension arrangements in private sector employment. Here we consider only the pension wealth in the current defined benefit arrangement, ignoring any pension wealth held in state pensions or past private pension arrangements.

The cumulative distribution of accumulated pension rights in current defined benefit pension arrangements, split by sector, is shown in Figure 3.5. Those currently not a member of a defined benefit arrangement are excluded from this analysis. This shows that, at all points in the distribution of accumulated rights, public sector defined benefit schemes are worth more than private sector defined benefit schemes. For example one-third of those in public sector schemes had accumulated a pension estimated to be worth more than £60,000 where this was true of only one-quarter of those in private sector arrangements. Median accumulated pension rights were £35,700 in public sector schemes compared to £24,500 in private sector arrangements. Mean accumulated pension rights were £18,050 higher in public sector schemes than in private sector schemes (£66,830 compared to £48,780) with this difference being statistically different from zero (standard error of £3,220 and a t-stat of 5.6).

Figure 3.5. Cumulative distribution of estimated accumulated defined benefit pension wealth, by sector, those aged between 16 and the State Pension Age in 2001.
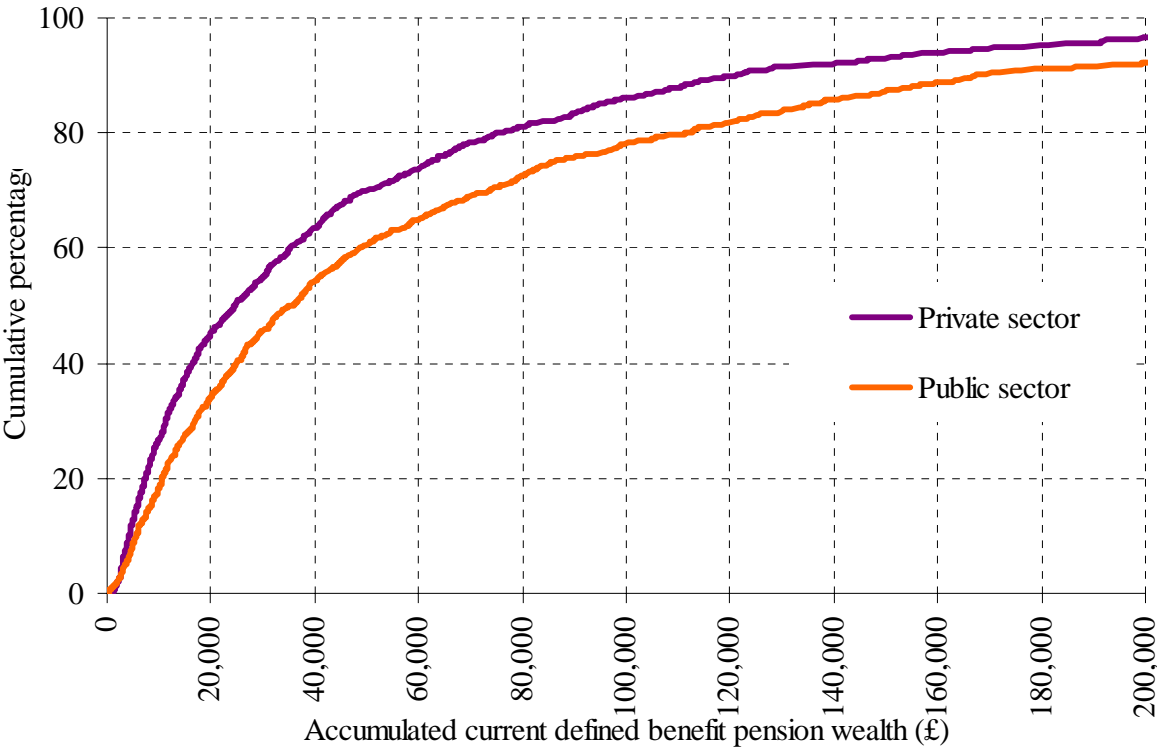
Note: Sample size 2,134 comprising 1,060 members of private sector schemes and 1,074 members of public sector schemes.

Despite this higher level of accumulated rights we find that, on average, those in public and private sector schemes can expect the value of their pension rights to increase by a similar amount in the next twelve months. Under the assumption that wages grew in real terms by 2% a year plus a component dependent on an individuals age and education (with that component estimated from data on men, described as the third scenario in section 2.1 and Appendix E) we calculate the increase in pension fund value between 2001 and 2002 assuming that all individuals remained in their existing schemes. The cumulative distribution of the increase in pension fund value is shown in Figure 3.6, again split by sector. This shows very little difference in the distribution of the expected cash increase in the value of the fund. The mean increase in simulated current defined benefit pension wealth is £4,345 across private sector arrangements compared to £4,338 in public sector arrangements (with the £7 difference, with a standard error of £129, not statistically significantly different from zero).
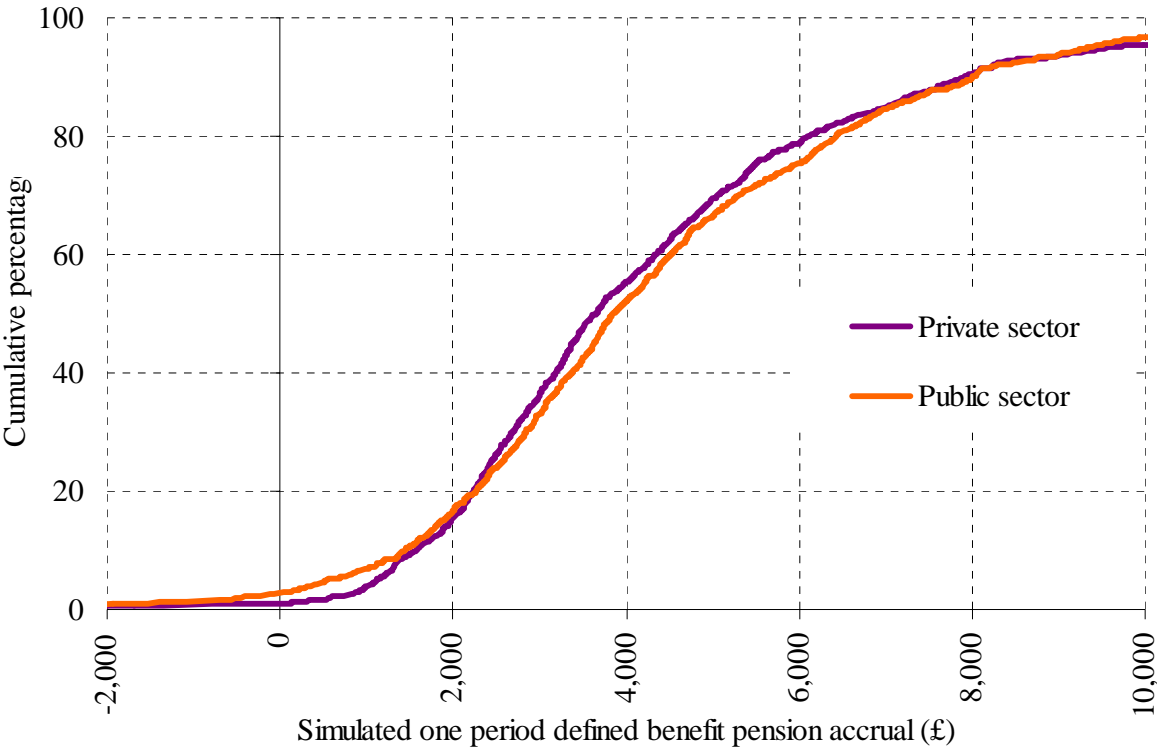
Figure 3.6. Cumulative distribution of simulated one-period defined benefit pension accumulation, by sector, those aged between 16 and the State Pension Age in 2001.

Note: Sample size 2,134 comprising 1,060 members of private sector schemes and 1,074 members of public sector schemes.

The fact that future pension accrual is similar across the two types of schemes, but that those in public sector arrangements have accumulated, on average, significantly greater levels of pension wealth implies that, unless our assumption over earnings growth is particularly wrong for one of these two sectors, the driver of higher pension entitlements in public sector schemes is longer average pension tenures in public sector schemes. Indeed we do find that observed pension tenures in public sector schemes are longer than those in private sector schemes: in 2001 median reported pension tenures in public sector defined benefit schemes was 10.5 years compared to 6.5 years among those in private sector defined benefit schemes. Mean pension tenures were 12.2 and 9.5 years respectively, with this 2.7 year difference being statistically significantly different from zero (standard error = 0.4, t-value = 7.4).[5]

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[5] Another reason for higher pension wealth among those in defined benefit public sector arrangements is that on average they are slightly older (i.e. closer to retirement) than those in private sector arrangements which means that their pension income is less heavily discounted. However conditional on age members of defined benefit public sector pension arrangements are still found to have, on average, longer pension tenures than those in defined benefit private sector arrangements.

The fact that accumulated pension wealth in public sector defined benefit schemes is generally higher than in private sector defined benefit schemes because of greater pension tenures, rather than higher annual accrual, should not be interpreted as meaning that the typical scheme rules in a public sector defined benefit pension are not more generous than those in a private sector scheme. This is demonstrated in Figure 3.7 below which again looks at the cumulative distribution of simulated pension wealth accrual in defined benefit schemes split by private and public sector, but this time with the accrual measured as a share of current earnings. We find that while we estimate that 50% of those in private sector defined benefit arrangements will see their accumulated pension rights increase by more than 20% of their current salary if they remain in the scheme for the next twelve months, this is true of 82% of those in public sector defined benefit arrangements. At the mean the simulated pension accrual is 19.2% of current salary in private sector defined benefit schemes compared to 22.4% in public sector defined benefit schemes, with this 3.2 percentage point difference being statistically different from zero (standard error = 0.3 percentage points, t-value = 11.2). Therefore the finding that pension accrual in cash terms is similar in private sector defined benefit schemes and public sector defined benefit schemes (shown in Figure 3.6) is due to the higher average wages paid to members of defined benefit schemes, which offset the more generous scheme rules typically observed in public sector arrangements.

Figure 3.7. Cumulative distribution of simulated one-period defined benefit pension accumulation as a percentage of current pay, by sector, those aged between 16 and the State Pension Age in 2001.
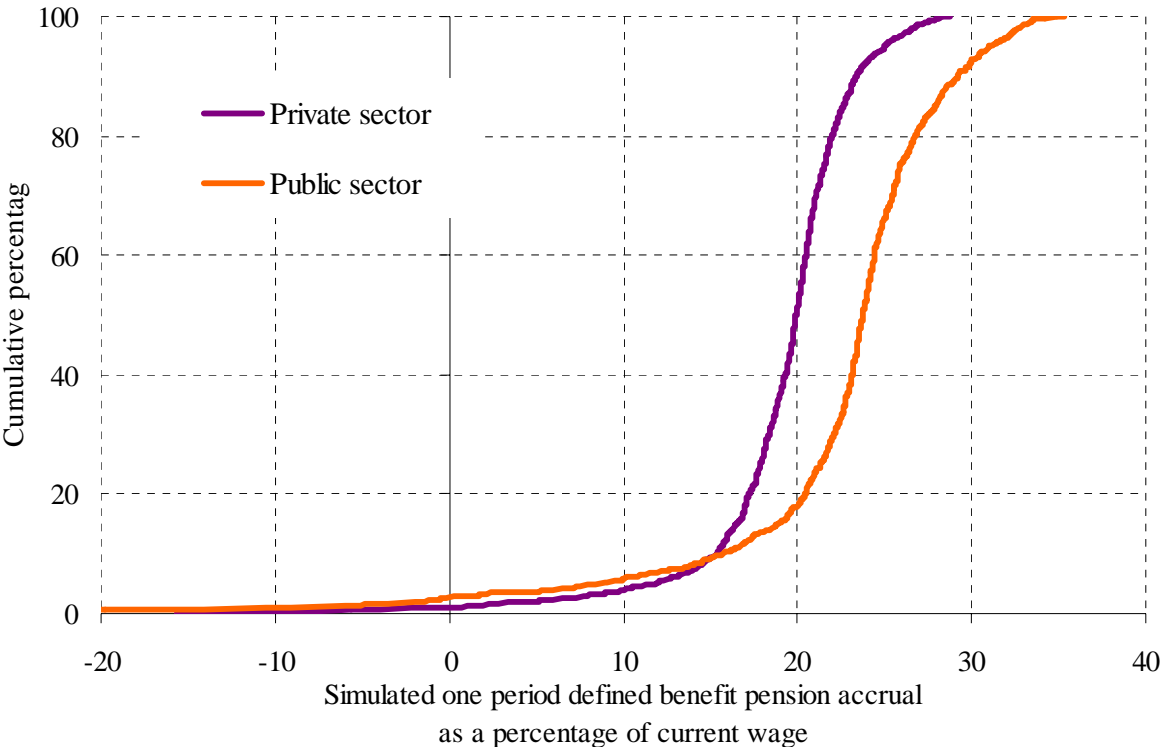
Note: Sample size 2,134 comprising 1,060 members of private sector schemes and 1,074 members of public sector schemes.

4. Conclusions

This paper has explained how pension wealth was calculated for each individual in wave 11 (2001) of the British Household Panel Study. We have calculated both the amount of state and private pension wealth accumulated to date (and for each wave of the BHPS from 1991 to 2001), and also simulated state and private pension wealth under the assumption that the individual remains in their current pension until the state pension age. In addition to a simple scenario of uniform earnings growth we also compute the future accrual of pension rights under scenarios which allow for earnings growth to vary by age, sex and education and where earnings growth depends on just age and education.

While older individuals had, unsurprisingly, accumulated greater pension wealth than younger individuals, there was relatively little difference in simulated total pension wealth at the state pension age. There was no evidence that single men had, on average, accumulated more pension wealth than single women, but we did find that higher pension wealth on average to have been accumulated by men in couples compared to their partners. We also find that those with higher levels of education and those with higher levels of current pay had accumulated higher pension wealth.

The last part of the paper focuses on differences in the amounts of pension wealth accumulated, and differences in the future accrual of pension wealth, in current defined benefit pension arrangements for individuals employed in the private sector and the public sector. We find that on average members of public sector defined benefit arrangements had accumulated greater levels of pension in their current scheme than those in a private sector defined benefit pension. However in cash terms the distribution of simulated accrual of pension wealth over the next twelve months was very similar for both groups.

The higher accumulation to date in public sector schemes arises from higher average pension tenures in public sector defined benefit schemes which, at least in part, might be due to the fact that these arrangements are more portable between different jobs. For example teachers and nurses will be able to move between different employing schools and hospitals without having to break their pension tenure whereas this would typically not be the case for job changes in the private sector.

The similar levels of accrual in cash terms are explained by the higher average wages received by members of private sector defined benefit schemes compared to those in public sector schemes, which offset the more generous rules which generally apply to public sector schemes compared to private sector schemes. As a share of current wages only just under half of those in private sector schemes are estimated to see their pension wealth accrue by more than 20% of their current salary compared to 82% of those in public sector schemes.

References

Banks, J., Emmerson, C. and Oldfield, Z. (2005), *Preparing for retirement: The pension arrangements and retirement expectations of older workers in England*, IFS Working Paper no. 05/13 (http://www.ifs.org.uk/publications.php?publication_id=3396).

Banks, J., Emmerson, C. and Tetlow, G. (2005), *Estimating pension wealth of ELSA respondents*, IFS Working Paper no. 05/09 (http://www.ifs.org.uk/publications.php?publication_id=3369).

Banks, J., Emmerson, C., Oldfield, Z. and Tetlow, G. (2005), *Prepared for retirement? The adequacy and distribution of retirement resources in England*, London: Institute for Fiscal Studies (http://www.ifs.org.uk/publications.php?publication_id=3443).

Blundell, Meghir and Smith (2002), 'Pension incentives and the pattern of early retirement', in Gruber and Wise, (eds), *Social Security Programs and Retirement around the World: Micro-Estimation*, The University of Chicago Press.

Disney, R. and Emmerson, C. (2005), 'Public pension reform in the United Kingdom: what effect on the financial well-being of current and future pensioners?' *Fiscal Studies*, Vol. 26, No. 1, pp. 55-81.

Finkelstein, A. and Poterba, J. M. (2002), "Selection Effects in the Market for Individual Annuities: New Evidence from the United Kingdom," *The Economic Journal*, 112(476): 28-50.

Oliver, Wyman & Company (2001), *The Future Regulation of UK Savings and Investment*, London. Executive summary is available at http://www.abi.org.uk/oliverwymanreport.pdf.

Pensions Commission (2004), *Pensions: Challenges and Choices. The First Report of the Pensions Commission*, London: The Stationery Office (http://www.pensionscommission.org.uk/publications/2004/annrep/index.asp).

Pensions Commission (2005), *A New Pension Settlement for the Twenty-First Century: The Second Report of the Pensions Commission*, London: The Stationery Office (http://www.pensionscommission.org.uk/publications/2005/annrep/annrep-index.asp).

Pension Policy Institute (2003), *The Under-Pensioned: Technical Paper,* London: PPI. (http://www.pensionspolicyinstitute.org.uk/news.asp?p=52&s=2&a=0).

Appendix A: Wave 11 Pension Questions

This appendix sets out the questions from the BHPS wave 11 questionnaire that were used to calculate pension rights.

ASK ALL

F14.   I'd like to ask you now about private personal pensions, that is a pension that you yourself have taken out on your own behalf.

In the past year, that is since September 1st 2000 have you paid any contributions or premiums for a private personal pension, or had such contributions paid on your behalf by the Department of Social Security?

KPPPEN

Yes 1   **ASK F15**
No 2   **GO TO F37** (page 126)

F15.   Was your policy taken out <u>before</u> July 1st 1988 or since then?
THIS IS THE DATE `RETIREMENT ANNUITY PENSIONS' WERE REPLACED WITH `PERSONAL PENSIONS'

KPENB4

<u>Before</u> July 1st 1988 1   **ASK F16**
July 1st 1988 or since 2   **GO TO F19**
Both 3

PENSIONS BEFORE JULY 1st 1988

F16.   What year did you first take out a policy?

Year

WRITE IN:

KPENB4Y4

Don't know 8
Refused 9

F17.   How much was your last contribution or premium?
IF `DON'T KNOW/CAN'T REMEMBER' PROBE: `Can you give me an approximate amount?'

£   **ASK F18**

KPENB4V

Don't know 8   **GO TO**
Refused 9   **F37**

F18.   How long did this cover?

KPENB4W

A week 1
A month 2
A quarter 3   **GO TO**
Six months 4   **F37**
A year 5
A once off payment 6
Other **(SPECIFY)** 7

19

PENSIONS SINCE JULY 1st 1988

F19.   In what year since July 1st 1988 did you first take out a policy?

Year

WRITE IN: ☐ ☐ ☐
KPENYR4

Don't know 8
Refused 9

F20.   Since September 1st 2000, over and above those contributions paid on your behalf by the Department of Social Security, have you yourself made any <u>extra</u> contributions towards your personal pension?

KPENADD
Yes 1   **ASK F21**
No 2   **GO TO F37**

F21.   How much was your last contribution?
IF `DON'T KNOW/CAN'T REMEMBER' PROBE: `Can you give me an approximate amount?'

£ ☐ ☐ ☐ ☐   **ASK F22**
KPENADV

Don't know 8   **GO TO**
Refused 9   **F37**

F22.   How long did this cover?

KPENADW
A week 1
A month 2
A quarter 3
Six months 4
A year 5
A once off payment 6
Other (SPECIFY)

_____ 7

20

LIS/LIW/NIHPS RESPONDENTS GO TO F37
ASK F23 BHPS/ECHP RESPONDENTS

F23.   **IF CURRENTLY RETIRED (D17 or D34 = 4) OR MALE**
65+/FEMALE 60+ GO TO F36
IF E50 eq 1 ASK F23
ELSE GO TO F29 CHECK
You told me earlier that you are a member of your employers
occupational pension scheme. When did you first join this scheme?

WRITE IN YEAR: ☐☐☐☐
KPENMJN

Don't know 8

F24.   **SHOWCARD F5**
Which of the statements on this card best describes the
contributions made by you to this employers scheme?
CODE ONE ONLY

KPENMCN

Contributions are deducted from my pay
each week/month. The scheme is contributory 1
The scheme is called noncontributory but I
do pay something to make additional provisions
for myself or my dependents 2   **ASK F25**
No contributions are deducted from my pay
each week/month. The scheme is noncontributory. 3   **GO TO F26**
Don't know 8

IF F24 EQ 1 or 2 ASK F25
ELSE GO TO F26

F25.   What percentage of your pay or salary do you contribute to this
scheme?

ENTER PERCENT TO ONE DECIMAL PLACE: ☐☐ . ☐
KPENMPY

Don't know 8

F26.   **SHOWCARD F6**
There are two main ways in which your pension entitlement can be
worked out in an employers pension scheme. Which of the
statements on this card best describes how your pension will be
calculated?
CODE ONE ONLY

KPENMTP

My pension will be related to my salary in my final year
(or years) and the number of years I have been in the scheme 1
My pension will be depend(ent) on the value of contributions paid
to the scheme and the rate of return achieved on their investment. . 2
Combination of the two statements/other 3
Don't know 8

F27. **INTERVIEWER CHECK:**
      Is respondent living with spouse/partner?

                                                        KSPINHH
                              Yes .... *1*   **ASK F28**
                              No................................ *2*   **GO TO F30 CHECK**

F28. Can I check, will your husband/wife/partner receive benefits under
      this occupational pension scheme if they outlive you?

                                                        KPENMSP
                              Yes .... 1 ⌉
                              No................................ 2 │ **GO TO F30 CHECK**
                              Don't know................ 8 ⌋

**IF HAS NO CURRENT OCCUPATIONAL PENSION (E50 = 1) ASK F29
ELSE GO TO F30 CHECK**

F29. Do you currently expect to receive any income or benefit from an
      employers occupational pension scheme when you retire?

                                                        KPENMEX
                              Yes 1
                              No................................ 2
                              Don't know................ 8

**IF HAS NO CURRENT PRIVATE PENSION (F14 = 2) ASK F30
ELSE GO TO F31**

F30. Do you currently expect to receive any income or benefit from a
      private pension scheme when you retire?

                                                        KPPPEX
                              Yes 1
                              No................................ 2
                              Don't know................ 8

F31. (Apart from the pensions already mentioned) Do you currently
      expect to receive any income or benefit from (other) savings and
      investments when you retire?

                                                        KPPPEXM
                              Yes 1
                              No................................ 2
                              Don't know................ 8

F32. In the last year Stakeholder Pensions have been introduced. Do you
      currently belong to a Stakeholder Pension scheme?

                                                        KSTAKEH
                              Yes 1
                              No................................ 2
                              Don't know................ 8

F33.   *INTERVIEWER CHECK:*
       Is respondent living with spouse/partner?

                                                  KSPINHH
                                    Yes..............................1   ASK F34
                                    No...............................2   GO TO F35a Check

F34.   Does your husband/wife/partner belong to any pension scheme,
       either an occupational or private scheme under which <u>you</u> would
       receive benefits if you outlive them?

                                                  KSPPEN
                                    Yes 1
                                    No............................... 2
                                    Don't know................ 8

IF AGED 40+ ASK F35a
ELSE GO TO F36

F35a   Do you expect your income in the year after you retire to be more
       than your preretirement income, less than your preretirement
       income, or about the same?

                                                  KRETEXP
                          More than..1   **GO TO F36**
                          Less than..2   **ASK F35b**
                          About the same...3   **GO TO F36**
                          Don't know/have not thought about it...........8

F35b   **SHOWCARD F7**
       Can you tell me from this card what you expect your income to be
       compared with your preretirement income?

                                                  KRETAMT
                          Less than a quarter 1
                          About a quarter 2
                          About a third...................................... 3
                          About a half 4
                          About two thirds................................ 5
                          About three quarters 6
                          Other **(SPECIFY)**
                          _____ 7
                          DK/has not thought about it.............. 8

F36.   Looking to the future, do you expect your income during (the rest of
) your retirement to be ...
       READ OUT EACH AND CODE ONE ONLY
                                                  KRETSUF
                   a)   More than enough to meet your needs 1
                   b)   Just about enough to meet your needs 2
                   c)   Less than enough to meet your needs 3
                          Don't know 8

Appendix B. Employment and earnings histories

B.1 Employment history

Various data sources were used to construct an employment history for each individual who responded to the BHPS in 2001. The principal source of information for employment prior to the start of BHPS data collection is the set of questions included in the 1993 BHPS survey (wave 3) about individuals' employment histories prior to 1991. Therefore, for those individuals who were interviewed at wave 3 (63% of those who were interviewed in wave 11), a complete employment history up to 1990 is available.

Each year the BHPS asks respondents about their current employment status and, if the respondent has started a job within the last year, what he was doing before starting this job. A complete record of employment is available for all years between 1991 and 2001 in which the individual responded to the BHPS. Individuals who are not in work are asked if they have ever done any paid work, which (if they say "no") gives us important information about their entire working age life up to that point. Whilst many individuals do respond in all waves of the BHPS, some have years during which they did not participate. Therefore, for a few people, there are periods between 1991 and 2001 when we cannot be certain of their employment status. Table B.1 shows how many of those who responded in wave 11 responded in each previous wave.

For the purposes of the employment history on which the pension wealth calculations are based, an individual is treated as being in work in any year during which he or she is observed to have worked at all. During those years when (even after considering all the employment information available from all the waves of the BHPS) we cannot be sure whether an individual was in work or not, we assume that he or she was in work unless the year in question is prior to him of her leaving full-time education or after he or she reaches the State Pension Age (SPA).

Table B.1. Number and percentage of those individuals interviewed in 2001 who also responded in previous years to the British Household Panel Survey

| Wave | Year | Of those interviewed in 2001 | |
		Number who responded in this year	% who responded in this year
1	1991	6,228	59.6
2	1992	6,342	60.6
3	1993	6,564	62.8
4	1994	6,777	64.8
5	1995	6,982	66.8
6	1996	7,327	70.1
7	1997	8,829	84.4
8	1998	9,063	86.7
9	1999	9,334	89.2
10	2000	9,722	93.0
11	2001	10,459	100.0

B.2 Earnings history

Various elements of current state and private pension wealth (described in detail in Appendix C and D respectively) rely on knowledge of an individual's earnings in each year of his working life. In particular, entitlement to the state second tier pension (SERPS and S2P) is accrued in proportion to an individual's earnings in each year since 1978. Therefore, we need to estimate earnings for each year in which we think the individual was in paid work (see section B.1) but in which we do not observe his earnings (either because it was prior to the start of BHPS data collection or because he did not respond to one wave of the survey).

In the case of years during the BHPS survey period (i.e. between 1991 and 2001) in which an individual did not respond to the survey and therefore in which we do not observe his or her earnings, we assume that earnings grew smoothly in real terms between the last previously observed earnings and the next observed earnings for that individual. For example, if someone was observed earning £10,000 in real terms in 1992 and £11,000 in real terms in 1997 but he did not respond to the survey in 1993, we assume that he was earning £10,200 in 1993.[6]

For years between 1978 and 1990, the earnings profiles are simulated by matching BHPS respondents to earnings profiles from cross-section data, employing a method similar to that used by Blundell, Meghir and Smith (2002). The earnings profile is based on data from consecutive waves of cross-sections from the Family Expenditure Survey (FES) from 1978 to 2002. A quantile regression on log earnings is performed to find median gross earnings for a

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[6] (£11,000-£10,000)*(1993-1992)/(1997-1992)=£10,200

specific group (based on year of birth, sex and education level) in all years between 1978 and 2001. The year of birth is grouped into three-year cohorts and three education groups are used (those who left full-time education at or before the compulsory school leaving age (CSL), those who left full-time education between the CSL and 18 and those who continued in full-time education past 18 years old). Interactions are allowed between education and sex and between education and cohort. However, interaction terms between sex and cohort and between all three variables together are not included.

The effect of imposing these limitations on the relationship between earnings, sex, education and cohort is as follows. First, the interaction term between education and sex allows for the effect on earnings of having a higher level of education to be different for men and women who were born in the same year. Second, the interaction term between education and cohort allows for the effect of a higher level of education on earnings to differ for people born in different years. Third, the omission of the interaction term between sex and cohort means that the effect on earnings of being female relative to being male cannot differ for people born in different years but with the same level of education.

Finally, median earnings were calculated across three consecutive years of data. For example, median group earnings for 1980 were found by taking the median earnings for people in that group in 1979, 1980 and 1981 (where the earnings in 1979 and 1981 are inflated and deflated, respectively, using average earnings growth).

One final adjustment is made to the earnings profile. Those who are still in employment after the SPA are unlikely to be representative of the rest of their cohort. Therefore, median earnings for those groups over the SPA in any year are replaced with their real median group earnings in the year before the SPA (assuming 2½% inflation). Figures B.1 and B.2 show examples of two earnings profiles. Figure B.1 is the median earnings profile for a man born in 1947, showing the different profiles for men with different education levels. Figure B.2 shows the equivalent profiles for a woman born in 1947.

To get an historic earnings profile for each BHPS respondent, we use the first earnings information available from the BHPS to calculate the ratio of actual earnings in that year to group median earnings (from the FES) in the same year. We then assume that this individual effect is the same in every year back to 1978. The underlying assumption here is that any shocks affect individuals in the same group in the same way and so the ordering of individuals in each group does not change over time. So, for example, an individual who earns 20% more than their group median in 2002 is assumed to always earn 20% more than their group median. In the case of the small number of individuals for whom we never observe any earnings in the BHPS, we assume that they have always earned at their group median.

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Figure B.1 – Median earnings profiles for men born in 1947, by year and education, 1978-2001
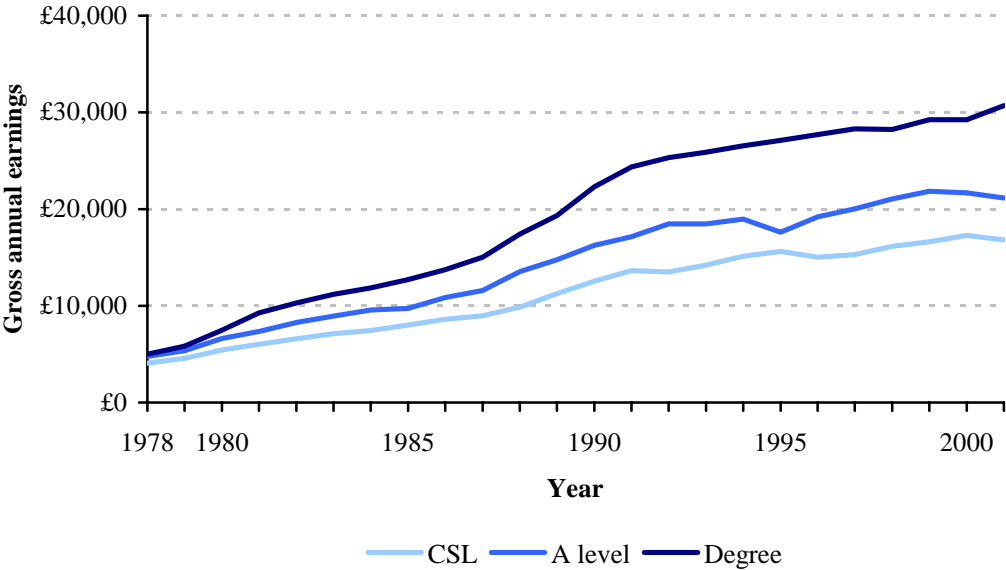
Source: Family Expenditure Survey (various years)

Figure B.2 – Median earnings profiles for women born in 1947, by year and education, 1978-2001
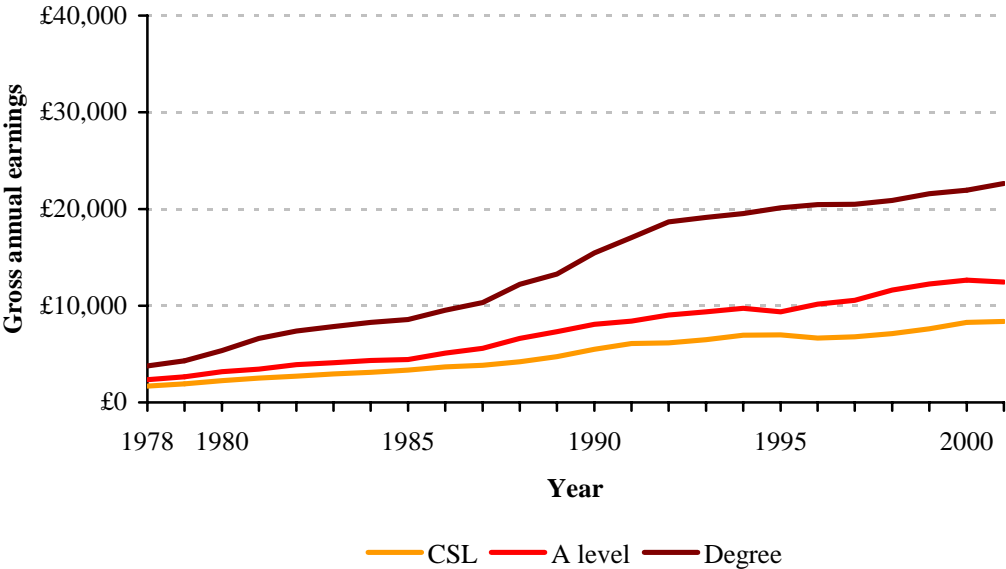
Source: Family Expenditure Survey (various years)

Appendix C. Accrued state pension rights

There are two main types of state pension: the compulsory Basic State Pension and the State Second Pension (previously known as the State Earnings Related Pension Scheme, SERPS). In this appendix we describe the calculation of accrued rights to each pension in turn. All of these calculations were done on the basis of Government legislation that existed, and that had existed, at the time of the 2001 BHPS survey. Therefore no account of subsequent changes – such as those included in the 2007 Pensions Act – is included.

C.1 Basic State Pension

Individuals were (in 2001) entitled to some part of the BSP if they had made National Insurance (NI) contributions for at least 25% of their working lives (i.e. from 16 to the SPA). To calculate entitlement to the Basic State Pension we assume an individual was making National Insurance Contributions in each year in which he or she was in work. See Appendix B for a full description of the assumptions made in estimating employment histories for BHPS respondents.

Prior to 1978, married women could opt to pay reduced rate NI contributions in exchange for not accruing their own entitlement to the BSP. We do not know in the BHPS whether women chose to do this, nor do we know in which years they were married. Therefore, we assume that they did not do this and so accrued entitlement to the BSP in all years in which they were working.

The estimate of the total number of years in employment was then divided by the number of years of working life (i.e. the number of years between age 16 and the State Pension Age, SPA) to give the fraction of the BSP to which an individual is entitled in 2001. This denominator is 49 for men or 44 for women.[7] Since 1978, any individuals who received child benefit for children aged under 16 but who were not paying NI contributions in any year have been eligible for Home Responsibilities Protection (HRP). This essentially reduces the denominator used when calculating the proportion of BSP to which the individual is entitled. However, as an individual's history of caring for children is not known from the BHPS, we assume that no one has benefited from HRP and so all individuals are assumed to have the maximum denominator. This will understate accrued entitlement to the Basic State Pension for some individuals, in particular for women.

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[7] For women born in 1955 or later, the SPA is 65 and therefore these women have a denominator of 49 when calculating BSP entitlement. For women born between 1950 and 1955, the denominator increases gradually from 44 to 49 as the SPA increases.

Men with at least 44 years of contributions and women with at least 39 years are entitled to the full BSP. Anyone with a fraction below 25% is not entitled to any part of the BSP. We also assume that the value of the BSP rises in line with inflation (2½%) in all future years.

Married women are entitled to receive BSP income equal to 60% of their husband's entitlement even if they do not (in their own right) qualify for this level of BSP income (this is known as a Category B pension). Therefore, married women in the sample, who qualify for less than 60% of their husband's BSP entitlement, are given BSP income equal to this level (instead of what they would receive in their own right) for all years when both partners are above the SPA.

This entitlement to a category B pension will be extended to men in the future. To qualify, a man must have a wife who reaches the SPA after 2009 (i.e. born in 1950 or later) and have a personal entitlement to BSP that is less than 60% of his wife's entitlement. However, a man with a wife born before 1950 does not qualify for any BSP income above the level to which he is personally entitled, even if his own entitlement is less than 60% of his wife's entitlement. Finally, when one spouse dies, the surviving spouse inherits the deceased spouse's BSP entitlement (in place of his own) if his spouse's entitlement exceeded his own.

An individual's BSP wealth in 2001 is based on his years of accrued entitlement to date. In other words, it is the value of the BSP to which he is currently entitled if he does not make any further NI contributions. To calculate the net present value (in 2001) of the flow of BSP income between the SPA and life expectancy, nominal BSP income in all future years is discounted back to 2001 (using a 2% real annual discount rate). Throughout all the calculations of pension wealth, we assume that everyone dies at his life expectancy. The life expectancies used are sex and age-specific.[8] As a result of discounting the stream of income from the BSP back to 2001, the present value of the BSP to, say, a 50 year-old man is higher than the value of the same flow of income to a 30 year-old man, since the stream of income for the latter is discounted over twenty more years.

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[8] Government Actuary's Department website, http://www.gad.gov.uk/Life_Tables/Interim_life_tables.htm

Figure C.1 - Discounted present value of BSP wealth for men of different ages in 2001

Source: Authors' calculations.

Figure C.2 - Discounted present value of BSP wealth for women of different ages in 2001

Source: Authors' calculations.
Note: The steep increase in the present value of BSP wealth for women aged 46 to 51 in 2001 is due to the change in the SPA for women from 60 to 65, which is gradually phased in for women born between 1950 and 1955. Younger women, whose SPA is 65, will have peak BSP wealth at age 65, rather than 60.

The total amount of income received between age 65 and his life expectancy for a man with full BSP entitlement is about £72,000 in 2001 prices. The corresponding figure for the income of a woman with full BSP entitlement between age 60 and her life expectancy is about £103,000. However, discounting of this income stream means that the total wealth from receipt of a full BSP is lower than this. Figures C.1 and C.2 show how the discounted present value of wealth from receipt of a full BSP varies by age in 2001 for men and women respectively. The dashed line shows the discounted present value (in 2001) of the stream of BSP between the SPA and his life expectancy for individuals of each age, assuming that they will qualify for a full BSP. The solid line shows the discounted present value (in 2001) of the stream of BSP income from the SPA to life expectancy assuming the individual accrues no further BSP entitlement after 2001.[9] The discounted present value of a full BSP is about £61,000 to a man aged 65 in 2001 and about £79,000 to a woman aged 60 in 2001.[10]

The steep increase in the solid line in figure C.1 at age 28 is due to the fact that if an individual has accrued less than 25% entitlement to the BSP, he receives nothing. The second steep increase in figure C.1 at age 60 occurs because once a man has accumulated about 90%[11] of full BSP entitlement he automatically qualifies for the full BSP. Similar increases occur in figure C.2 at ages 28 and 55. The second of these steep increases is at a younger age in figure C.2 because women of this age in 2001 have a SPA of 60, compared to 65 for men. The third steep increase in the solid line in figure C.2 (between ages 46 and 51) is as a result of the increase in the state pension age for women.

C.2 Second Tier State Pension

The second type of state pension provision is second tier state provision (either the State Earnings Related Pension Scheme, SERPS, or the State Second Pension, S2P). Entitlement to this is based on an individual's earnings and employment history. Prior to the introduction of SERPS there existed the Graduated Retirement Scheme. This was introduced in 1961 and continued until 1975. We do not model wealth from this state pension scheme in our calculations because the income available from this source is small. For example, the average weekly benefit from the Graduated Retirement Scheme amongst recipients for the tax year

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[9] The individuals illustrated here are assumed to have worked in every year from the age of 16 onwards.

[10] These figures assume that the individual lives to his or her life expectancy.

[11] The exact number of years of contributions required to receive a full BSP is 44 out of 49 for a man and 39 out of 44 for a woman.

2003–04 was only £3.55 for men and £1.29 for women.[12] Weekly income is likely to be even lower for future pensioners because they will have accrued less entitlement under the scheme.

An individual's entitlement to the second tier state pension depends on his employment and earnings history. Though the exact calculation of second tier pension entitlement has changed several times, essentially entitlement accrues in proportion to earnings between a lower earnings limit and an upper earnings limit in all years of a person's working life since 1978 (see section C.2.1 to C.2.4 for a detailed description of each system). Therefore, in order to calculate an individual's second tier pension entitlement we need to use the individual earnings profiles described in Appendix B.

Having simulated an earnings history for each individual, it is possible to calculate SERPS and S2P accrual from 1978 to 2002, assuming that an individual was contracted-in in all these years. The rules for SERPS accrual changed twice between its introduction in 1978 and its replacement by S2P in 2002. There are, therefore, four different systems under which individuals accrue state second tier pension entitlement. The one that applies to a particular individual depends on when he reaches state pension age. For a detailed analysis of how these changes will effect state retirement incomes of current and future generations of pensioners see Disney and Emmerson (2005). Under all systems, only earnings below the Upper Earnings Limit (UEL) in that year are eligible to accrue entitlement.

C.2.1 Original SERPS System

Anyone who reached state pension age before 1998 accrued state second pension rights under the original SERPS system introduced in 1978. Under this system, an individual's rights were based on his earnings between the Lower Earnings Limit (LEL) and the Upper Earnings Limit (UEL) in the best twenty years of earnings between age 16 and the state pension age in all years from 1978 onwards. The accrual rate was 25%. Equation 1 shows how SERPS entitlement was calculated.

$$\left(\sum_{best\,20\,years} [(earnings \bullet \rho) - LEL] \bullet 0.25 \right) \Big/ 20 \qquad (1)$$

where ρ = revaluation factor

= average earnings growth between the year in which the income is earned and the year in which the individual reaches the state pension age

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[12] Pensions Policy Institute (2007), *The Pensions Primer – Second Tier Provision*, p.2 (http://www.pensionspolicyinstitute.org.uk/uploadeddocuments/Primer/2007/Primer_Second_Tier_Update_May 2007.pdf).

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The LEL used in this calculation is the LEL in the year before the individual reaches the state pension age.

C.2.2 Post-1986 SERPS System

This system (introduced in the 1986 Social Security Act) applied to anyone who reached the state pension age in 1998. Two major changes were made under this system. The first was that the accrual rate was reduced from 25% to 20%. The exact accrual rate that applies to each individual depends on when they reach the state pension age, as shown in Table C.1. These accrual rates only apply, however, to earnings from 1988 onwards (in other words, existing accruals were protected).

The second change was that earnings for all years between 16 and the SPA were used to calculate entitlement (including zero for years where earnings were below the LEL or the individual earned nothing). The overall effect of this was to reduce the generosity of SERPS considerably. Equation 2 summarises the calculation of SERPS entitlement under this system.

$$\sum_{age=16}^{SPA} \left[(earnings \bullet \rho) - LEL \right] \bullet accrual\_rate \Big/ (SPA - 16) \qquad (2)$$

The LEL used is the LEL in the year before the individual reaches the state pension age and the accrual rate is as shown in Table C.1 for earnings after 1988 or 25% for earnings before 1988.

Table C.1 - SERPS accrual rates applying to earnings in all years after 1988

Accrual rate	Date when contributor reaches SPA	Birth date if male	Birth date if female
25%	5/04/2000 or earlier	5/04/1935 or earlier	5/04/1940 or earlier
24.5%	6/04/2000 – 5/04/2001	6/04/1935 – 5/04/1936	6/04/1940 – 5/04/1941
24%	6/04/2001 – 5/04/2002	6/04/1936 – 5/04/1937	6/04/1941 – 5/04/1942
23.5%	6/04/2002 – 5/04/2003	6/04/1937 – 5/04/1938	6/04/1942 – 5/04/1943
23%	6/04/2003 – 5/04/2004	6/04/1938 – 5/04/1939	6/04/1943 – 5/04/1944
22.5%	6/04/2004 – 5/04/2005	6/04/1939 – 5/04/1940	6/04/1944 – 5/04/1945
22%	6/04/2005 – 5/04/2006	6/04/1941 – 5/04/1942	6/04/1945 – 5/04/1946
21.5%	6/04/2006 – 5/04/2007	6/04/1942 – 5/04/1943	6/04/1946 – 5/04/1947
21%	6/04/2007 – 5/04/2008	6/04/1943 – 5/04/1944	6/04/1947 – 5/04/1948
20.5%	6/04/2008 – 5/04/2009	6/04/1944 – 5/04/1945	6/04/1948 – 5/04/1949
20%	6/04/2009 or later	6/04/1945 or later	6/04/1949 or later

C.2.3 Post-1995 SERPS System

Two changes were made to the pension system in the 1995 Social Security Act. The first was that the state pension age for women was increased from 60 to 65 (this happens gradually for women reaching the SPA after 2010, eventually reaching 65 for women who reach the SPA in 2020). The effect this had on the SERPS calculation was that earnings were averaged over five extra years for women reaching the SPA after 2020 and, furthermore, that SERPS pension income would be received for five fewer years.

The second change was subtler but significantly reduced the generosity of SERPS. Rather than revaluing earnings below the UEL and then subtracting the LEL in the year before the individual reaches the SPA, under the post-1995 system the LEL is subtracted in the year earnings are received and then the earnings net of the LEL are revalued (using average earnings growth) to the SPA. The reason that this is less generous is because the LEL is

increased each year in line with prices, whereas eligible earnings are revalued each year in line with average earnings growth. Equation 3 summarises the calculation of SERPS under the post-1995 system.

$$\sum_{age=16}^{SPA} (earnings - LEL) \bullet \rho \bullet accrual\_rate / (SPA - 16) \qquad (3)$$

C.2.4 State Second Pension

The state second pension increased the generosity of the state second tier pension to low earners. Anyone earning between the LEL and a new Lower Earnings Threshold (LET) is credited with entitlement equal to 40% of the LET. Anyone earning between the LET and the Upper Earnings Threshold (UET) accrues additional entitlement equal to 10% of earnings in this range. Anyone earning between the UET and the UEL accrues further entitlement equal to 20% of earnings in this range. As before, earnings above the UEL do not accrue further entitlement. Figure C.3 shows how S2P entitlement varies by weekly income, using the 2002 gross earnings thresholds, and how this compares to the post-1995 SERPS system.

Individuals who are caring for people who receive certain benefits or caring for children under 6 are also credited with minimum S2P contributions (as if they were earning at the LET). However, we have not included these in our calculations of pension entitlement in the future. This is for two reasons. Firstly, the number of people in the sample receiving Child Benefit for a child under 6 is likely to be extremely small. Secondly, we cannot know in the future whether individuals under the SPA will be receiving carer's allowance for time they spend caring for someone else.

Figure C.3 - Accrual of SERPS/S2P using 2002 gross earnings thresholds
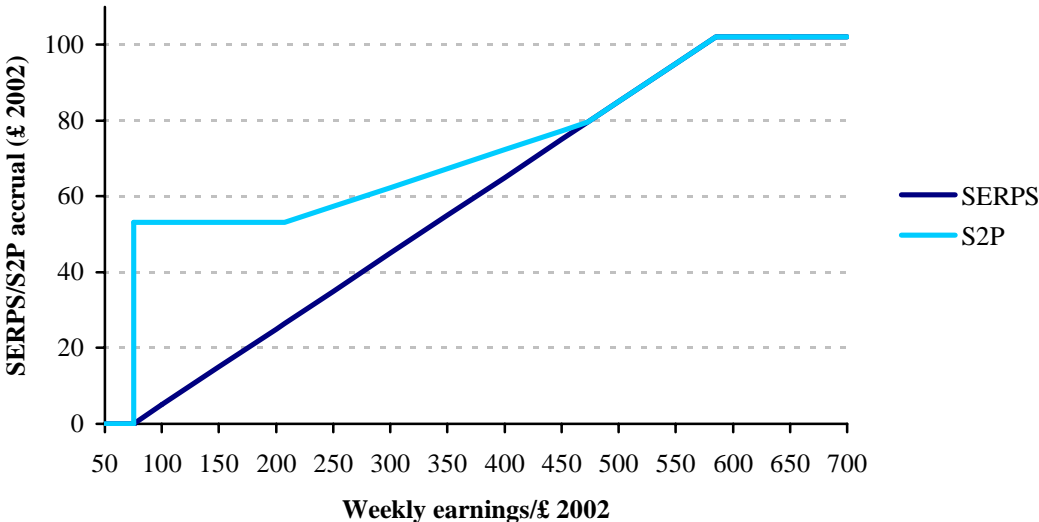
Combining these rules of the state second tier pension system with an estimate of each individual's earnings history allows us to calculate second tier pension wealth for everyone. We assume that individuals were contracted-in in all years. The estimate of an individual's SERPS/S2P wealth in 2001 is based on the value (in 2001) of the flow of SERPS/S2P income from the SPA to his life expectancy, assuming the individual stops accruing SERPS rights in 2001 and starts receiving their second tier state pension at the SPA. This is done in the same way as BSP wealth was calculated - we find the net present value of second tier pension entitlement by discounting back to 2002 (using a 2% real discount rate) the income from SERPS/S2P income in all years from the SPA to life expectancy. However, recipients' spouses are also entitled to survivor benefits if they outlive their spouse. The surviving spouse inherits between 100% and 50% of the SERPS/S2P income. The percentage inherited depends on the date of birth of the deceased spouse. Table C.2 shows how the proportion inherited varies with year of birth. We include this as wealth of the original individual. Therefore, we add the present value of the stream of income received by the spouse to the net present value of the stream of SERPS/S2P income received. This gives total individual wealth from the second tier state pension.

Table C.2 - Percentage of SERPS entitlement inherited by a surviving spouse

% SERPS entitlement for surviving spouse	Date when contributor reaches SPA	Date of birth of contributor: Husband	Date of birth of contributor: Wife
100%	5/10/2002 or earlier	5/10/1937 or earlier	5/10/1942 or earlier
90%	6/10/2002 – 5/10/2004	6/10/1937 – 5/10/1939	6/10/1942 – 5/10/1944
80%	6/10/2004 – 5/10/2006	6/10/1939 – 5/10/1941	6/10/1944 – 5/10/1946
70%	6/10/2006 – 5/10/2008	6/10/1941 – 5/10/1943	6/10/1946 – 5/10/1948
60%	6/10/2008 – 5/10/2010	6/10/1943 – 5/10/1945	6/10/1948 – 5/10/1950
50%	6/10/2010 or later	6/10/1945 or later	6/10/1950 or later

Source: The Pension Service (2004)

Appendix D. Accrued private pension rights

There are three main types of private pension from which an individual may derive an income in the future. First, there are pensions provided by an individual's current employer. These may provide an income based on an individual's earnings and years of service (known as a defined benefit scheme) or based on an annuity bought with contributions made to a fund which then grow over time (known as a defined contribution scheme). Second, an individual may have a stock of wealth held in a personal pension. Finally, in addition to a pension provided by his current employer, an individual may have retained rights to income from a pension provided by a previous employer. The calculation of wealth from each of these types of pensions is described in more detail below.

D.1 Occupational Defined Benefit pensions

Pensions provided by employers can be either defined benefit or defined contribution in nature. Each year the BHPS survey has asked if an individual is a member of their employer's pension scheme. However, it was only in the 2001 survey that additional questions were asked to ascertain whether the scheme was defined contribution or defined benefit (see Appendix A for a list of the questions which were asked in 2001). This section discusses the calculation of wealth derived from occupational defined benefit schemes and section D.2 describes the calculation of wealth from defined contribution schemes.

The value of a defined benefit scheme depends on how income from the scheme is calculated. In general, this is done by multiplying the number of years in the scheme by an accrual rate and a measure of final salary[13]. These elements determine the income from the scheme in the first year of receipt. After this the actual income depends on the indexing rules of the scheme. Most schemes are indexed to inflation but some are indexed above inflation. Equation 4 shows how we calculate the income to which an individual will be entitled in their first year of retirement.

$$b = \alpha \bullet y \bullet t \qquad (4)$$

Where b is annual retirement income, α is the accrual fraction, t is the length of pension scheme membership (in years) and y is gross annual earnings in 2001.

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[13] Part time workers accrue pension entitlement each year equivalent to the fraction of full time hours that they work. This fraction of a year's accrual is then multiplied by their fulltime-equivalised salary. For individuals who have always been part time workers, an equivalent calculation will be to assume they have accrued a full year for each year of part time employment but multiply the number of years by their annual part time salary, which is what we do. However, this method of calculating pension entitlement will over-estimate pension income for individuals who used to work part time but now work fulltime, whilst it will underestimate pension income for individuals who used to work fulltime but have now moved into part time employment.

The 2001 BHPS survey collects information on when the individual joined their employer pension scheme[14], whether the scheme is defined benefit or defined contribution in nature and the amount contributed by the individual to the pension. In order to be able to estimate the wealth in these schemes, we had to make some further assumptions about the scheme rules. In particular we had to make an assumption about the accrual fraction, the normal pension age in the scheme and the indexation arrangements in payment. We have assumed that for public sector workers the accrual fraction is 1/80th, with individuals also getting a lump sum worth 3/80ths of their final salary, and that the normal pension age is 60. For workers in the private sector we have assumed that the accrual fraction is 1/60th and the normal pension age is. These are the most prevalent scheme rules in each of these sectors. We also assume that all pensions will be indexed to prices in payment. It has been a legal requirement since 1997 that pension incomes are indexed by at least Limited Price Indexation[15] (LPI) however a minority of schemes actually offer more generous indexation.

We treat as defined benefit schemes any cases where the individual knows their employer scheme is DB (58% of those who report being in an employers pension) and also any cases where the individual knows they have an employer scheme but does not know whether it is DB or DC (which is the case for 15% of those who report being in an employers pension scheme).

The present discounted value of wealth from a defined benefit pension is equal to the discounted sum of the stream of income that an individual will receive from the normal pension age until death (which is assumed to occur at their age- and sex-specific life expectancy).

D.2 Occupational Defined Contribution pensions

A defined contribution pension is one to which an individual (and his employer) makes regular contributions. These contributions (c) are then invested and so the total fund grows over time as a result of additional contributions and real returns (r) earned on the underlying fund. Equation 5 shows the value of the fund at any date s.

$$fund_s = \sum_{t=0}^{s} c_t (1 + r)^{s-t} \qquad (5)$$

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[14] In the case of the 91 individuals with an employer DB pension (4.2%) who did not report when they joined it, we assume they joined when they started their current job, apart from in one case where this information was also missing where we assumed that they had been in the pension for 8 years (which is the median defined benefit pension tenure).

[15] Since 2005, Limited Price Indexation has been the minimum of growth in the Retail Price Index or 2½%.

An individual can then use this fund to buy an annuity upon retirement, which will provide him with an income until he dies. The present discounted value of the wealth from such a pension is then calculated as the discounted sum of the stream of income received from this annuity from retirement (R) until death (D), as shown in equation 6.

$$PDV_s = \sum_{t=R}^{D} \frac{\rho \bullet fund_R}{(1+\delta)^{t-s}} \qquad (6)$$

Where ρ if the annuity rate and δ is the intertemporal discount rate.

The discounted present value of the wealth therefore depends on the annuity rates available when the individual annuitises the fund. We assume that the annuity rates that will be available when the individual annuitises will be the second-best currently available age- and sex-specific individual life annuity rates.[16] While annuity rates may well actually fall as life expectancies increase in future, using the current annuity rates is consistent with our assumption that life expectancies will also not increase (and as long as long-term real interest rates do not change the increase in life expectancy and the fall in annuity rates should, approximately, cancel each other out).

The 2001 BHPS survey asked people who were members of employer pension schemes how much (as a percentage of their salary) they contributed to the scheme. 62% of those with an employer DC scheme knew how much they contributed. For the remaining 38% who did not know how much they were contributing we assume that they contributed 4.6%. This is the average member contribution observed amongst members of the DC pension schemes run by the FTSE 100 companies.[17] We assume that individuals have contributed the same percentage their salary in each year that they have been a member of the scheme.

Most employers also make a contribution in addition to the contribution made by the employee. The BHPS survey did not ask, however, how much the individual's employer contributed to the scheme. Based on figures relating to average employer and member contributions from Watson Wyatt (2005), we assume that the individual's employer makes a core contribution of 4.6% of salary and in addition matches 1:1 any member contributions above 2% of salary.

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[16] As quoted by the Financial Services Authority (FSA) on 13 March 2007 on the basis of a £100,000 fund, http://ww.fsa.gov.uk/tables.

[17] Watson Wyatt (2005), FTSE 100 Defined Contribution Pension Scheme Survey 2005, http://watsonwyatt.bright-talk.com/webcasts/047227330302e353/assets/FTSE100%20survey%20report%202005%20LR.pdf

In order to calculate the size of the pension fund in 2001, we need to know two things. First, how much was contributed in previous years and, second, what investment return was earned on these contributions. We assume that the individual and their employer contributed the same percentage of his salary to the scheme in all previous years of membership as they did in 2001. We also assume that these contributions received a real return of 2½% a year. This allows us to calculate the value of the fund in 2001.

To calculate the present discounted value of the wealth in 2001 we assume that the individual and their employer stop contributing immediately and annuitise the fund immediately if possible. As it is not possible to buy an annuity under the age of 50, those individuals currently aged under 50 are assumed to leave their fund accruing interest until they reach 50 and then annuitise it.

D.3 Personal & Stakeholder Pensions

Since 1987, individuals have been able to take out personal pensions. These are schemes to which individuals can make contributions each year (subject to an annual cap). The resultant stock of contributions then earns a return each year.

Ideally we would therefore like to know exactly how much an individual contributed in each year to their personal pension and what real return was earned. Each year the BHPS asks respondents how much they had contributed in the last year to a personal pension (over and above the contracted-out rebate received from government, if this was applicable). Therefore, in each year that an individual responded to the BHPS we know whether and how much he contributed to a personal pension and also when he joined this pension. For those years either before BHPS fieldwork began or in which they did not respond to the BHPS, we assume that the individual contributed the same percentage of his salary as he was observed to contribute in the next year in which he is observed in the BHPS, subject to the following rule.

Data on personal pension contributions amongst different age groups within the BHPS suggests that mean and median contributions increase with age. We therefore assume that an individual's contribution (as a percentage of his salary) increases by 0.5 percentage points when he reaches ages 45, 50 and 55 and by a further 1 percentage point when he reaches age 60.

Given this stream of annual contributions (in the same way as we did when calculating the value of employer DC pensions) we calculate the present discounted value of current personal pensions in 2001 by assuming that past contributions earned a real return of 2½% a year, that the individual stops contributing in 2001 and either annuitises immediately or else leaves the

fund accruing interest (at 2½% a year in real terms) until he reaches age 50 and then annuitises it.

D.4 Past Employer Pensions

The final type of pensions for which we have calculated wealth are employer pensions which an individual used to be a member of but to which he is no longer contributing. In each year of the BHPS, though we do not observe any information about the rules of the scheme, we do observe whether or not an individual belongs to his employer's pension scheme. We assume that individual's have not ever been a member of a personal/employer pension that was not at some point mentioned in the BHPS.

Taking the past pension spells that are reported in the BHPS we assume that these schemes were of equal generosity to a defined benefit pension scheme with a 1/60th accrual rate and a normal pension age equal to the individual's state pension age. Under this assumption, and the estimates of individuals previous earnings (the computation of which is described in Appendix B.2) the accumulated pension wealth in past employer schemes can be calculated.

If the individual was in fact a member of a defined contribution scheme our estimate of past pension wealth will only be wrong to the extent that the accumulated value of the defined contribution pension arrangement is different to the assumed value calculated on the basis described above. Furthermore, we will underestimate pension wealth to the extent that individuals have wealth held in pension schemes which they left prior to first appearing in the BHPS. However, evidence from the *English Longitudinal Study of Ageing*, which asked individuals for some details of past pensions that were not yet in payment, suggested that under 15% of those aged between 50 and the State Pension Age reported having more than one past pension (Table 2.7 of Banks, Emmerson and Oldfield, 2005). Moreover estimates of accumulated wealth in past pensions that were not yet in receipt represented less than 6% of the total pension wealth of those aged between 50 and the State Pension Age (Figure 3.3 of Banks, Emmerson, Oldfield and Tetlow, 2005). For individuals younger than 50 – which will be the majority of those in this study – past pensions might be expected to be relatively less important than for those closer to retirement.

Appendix E. Prospective pension rights

In addition to estimates of pension rights accumulated for each wave of the BHPS from 1991 (wave 1) to 2001 (wave 11) we also estimate how pension rights might evolve in the future. This requires assumptions on how pension contributions evolve. For defined contribution pension arrangements – both those to individually arranged (i.e. personal or stakeholder) pensions and those to employer provided schemes – we assume that total contributions (i.e. individual and, where relevant, employer) remain constant as a share of earnings[18], and that the underlying value of funds increases by 2½% per year after inflation. For defined benefit pension arrangements we compute future pension wealth on the assumption that individuals remain in that pension scheme (an alternative would be to model likely future pension tenures, but the complexity is, as described in Section 3.1, that these are potentially endogenous with respect to pension accrual).

Under these assumptions future private pension wealth will depend on the evolution of earnings. This is also the case for future accrual of any entitlement to the State Second Pension. We compute these under three different assumptions for how wages might be expected to evolve. The first, and most simple, projection is done under the assumption that individuals earnings grow by 2% a year after inflation. However this might be unrealistic as earnings growth might not be stable over the life-cycle, and it might be expected to differ by other characteristics such as their education.

Therefore we estimate earnings equations using pseudo-panel data from the Family Expenditure Survey from 1978 to 2004–05. In order to try to smooth out economy-wide productivity shocks we deflate earnings by economy-wide earnings growth. We then estimate a component, which can be positive or negative, of earnings growth which can then be added to expected future economy-wide real earnings-growth (which we again assume to be 2% a year). This component is assumed to vary by the sex, age and education of the individual. This is our second scenario for simulating future earnings. We estimate this component by running a quantile (median) regression of the logarithm of earnings on a quadratic in age using the post-1978 pseudo-panel of Family Expenditure Surveys on groups differentiated by sex and education. In Figures E.1 and E.2, we plot the simulated age-earnings profiles (before any economy-wide earnings growth) for men and women respectively for three different education groups. These are shown by the dotted lines. We also compare this to a specification which includes a full set of (five-year moving average) age dummies, which are
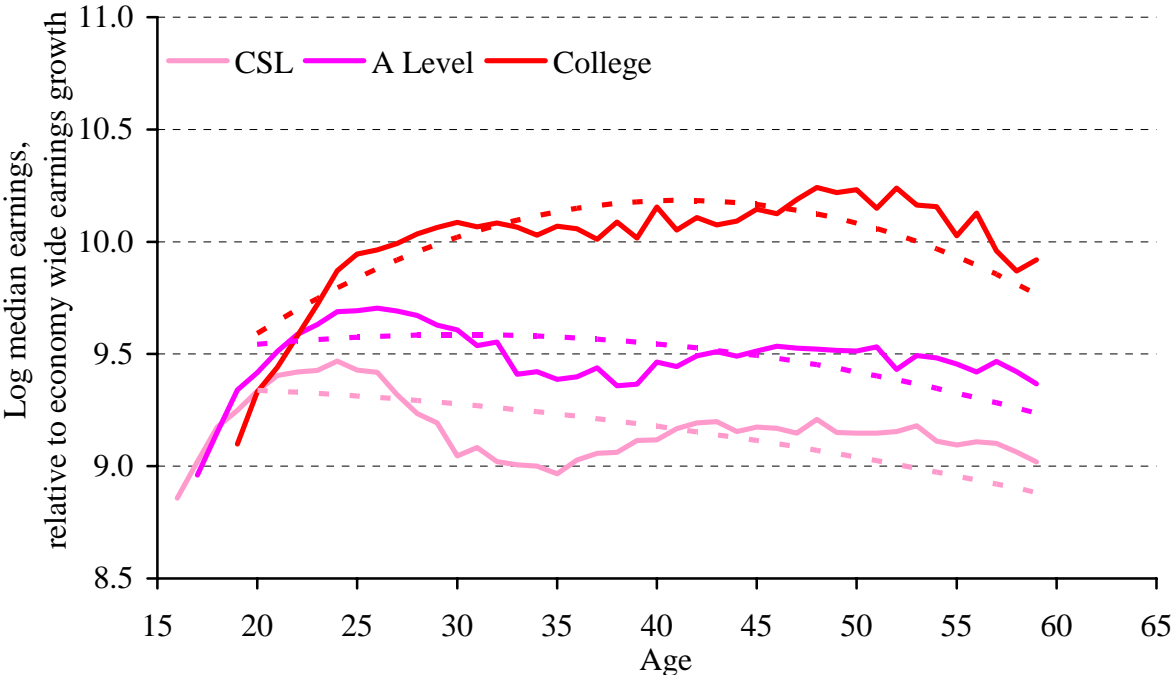
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[18] This is subject to the rule outlined in section D.3: contributions to personal pensions are assumed to increase by ½% of earnings when an individual reaches age 45, 50 and 55 and by a further 1% when individuals reach age 60.

shown by the solid lines in the two figures. The quadratic specification 'fits' the data very well for men but tends to overstate the decline in wages for women over the life cycle by failing to pick up the decline in earnings in mid-life which is probably associated with reductions in hours worked. Therefore, the third scenario that we use for estimating future earnings is that economy-wide real earnings growth is again 2% a year but that both men and women receive a component that relates to their age and education using the estimated co-efficients from the quadratic age specifications estimated from men and presented in figure E.1. For women that do not expect their earnings to decline mid-life (for example because they do not anticipate doing fewer hours of paid work due to childcare reasons) it could be that the male wage profiles are a better approximation to their likely wage growth than those estimated over all females. Under all of these scenarios those in paid work remain in paid work and those not in paid work remain not in paid work.

Figure E.1. Simulated median log male earnings, by education, under two different specifications for age.
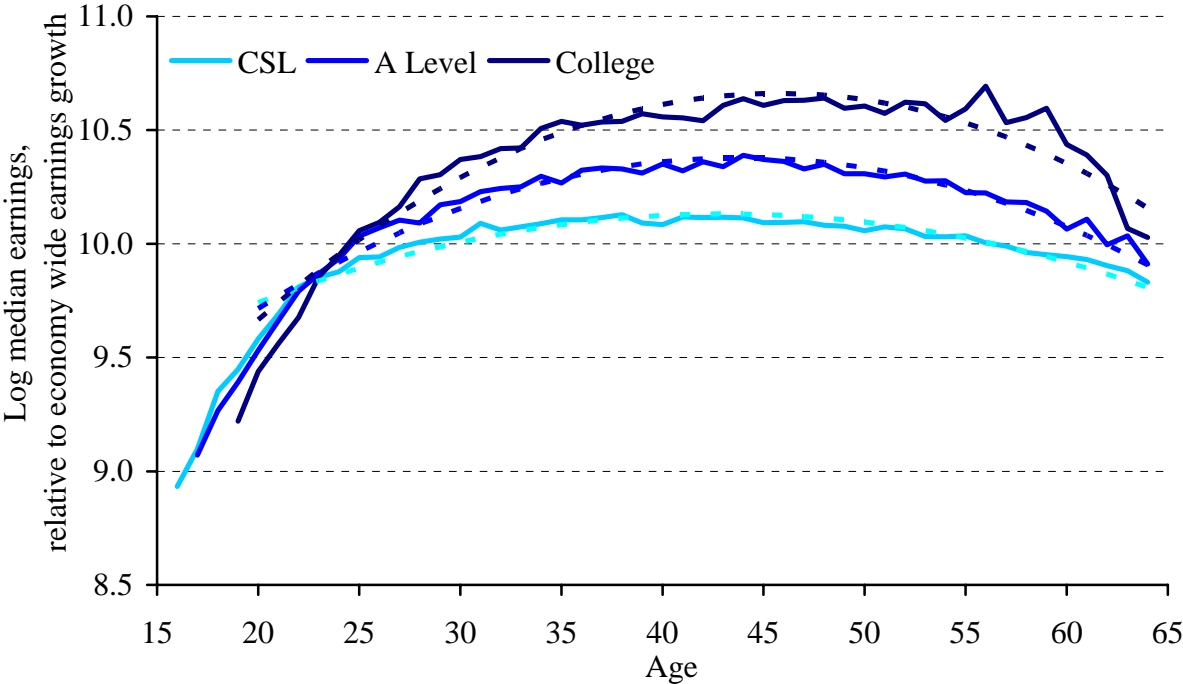
Figure E.2. Simulated median log female earnings, by education, under two different specifications for age.

Source: Family Expenditure Survey, 1978 to 2004–05.