Pension Incentives and the Pattern of Retirement in the UK

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Abstract

This paper provides a comprehensive evaluation of the economic incentives for retirement underlying the UK pension system and analyses the impact on retirement behaviour. The UK is shown to have experienced a significant reduction in employment among those over 55 years of age, especially among men. Using a sample of individuals aged 55 or older from the UK Retirement Survey, the paper models the probability of retirement in terms of the incentives underlying the individual's pension plan as well as other socio-economic factors. It follows an option value approach and allows a separate role for pension wealth and for spouse's economic and demographic characteristics. It distinguishes between the state earnings related pension scheme and private occupational schemes and also models eligibility to invalidity benefit in calculating the incentive for early retirement. It compares the option value approach with alternative, simpler formulations and finds the option value model to fit the data best but also finds a strong additional role for wealth variables. Simulations are presented for a set of reforms designed to delay early retirement.

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1. Introduction

Like many other OECD countries, the UK has been experiencing a trend towards earlier labour market exits among older, particularly male, workers. The proportion of men aged 60-64 in employment halved from 1968, when 80 per cent were employed, to less than 40% in 1996. The fall in the proportion of older men who were in *full-time* employment was even greater than the fall in the proportion in any form of employment with a relative shift within the employed to self-employment and part-time employment (see Figure 1). Female employment has not experienced the same downward trend – but this contrasts with rising participation among most other age groups across the same period.

This paper looks at the extent to which these trends might be explained by the financial incentives in the pension system that people faced when making their retirement decisions. In doing so, we focus not only on the pensions provided by the state, but also on employer-provided pensions and on other state benefits such as invalidity benefit, both of which have played a crucial role in the UK. Compared to many other European countries, the UK stands out as having a high level of coverage of private pensions and, at least in recent years, a trend towards less generous state pension provision.

This has not always been the case. In the 1970s, the trend was going the other way towards more generous state provision. The main element of the state pension system, the basic state pension, was increased each year in line with earnings or prices, whichever was the greatest. In 1978 a new second-tier earnings-related pension (the State Earnings Related Pension Scheme (SERPS)) was introduced that was originally intended to pay a pension worth 25% of an individual's best 20 years of earnings. However, SERPS was never a universal scheme for all employees. When it was introduced, workers who already belonged to a (defined benefit) occupational pension could opt out of the state scheme (and pay reduced National Insurance contributions) so long as their occupational scheme guaranteed at least the same pension as SERPS. This applied to more than half of all employees, and more than two-thirds of male employees.

Since the early 1980s successive reforms have cut back the generosity of state pension provision. The indexation of the basic state pension to earnings lasted only until 1982, since when it has been formally indexed to prices and has fallen relative to average earnings. Reforms to SERPS in 1986 and 1995 have reduced its generosity for anyone retiring after 2000. Also, the state pension age for women, currently 60, is set to increase to 65 by 2020. These reforms were coupled with further encouragement for individuals to make private pension provision. In 1988 the right to opt out of SERPS was extended to those with a defined contribution scheme. In

practice this meant a growth in individual retirement accounts (personal pensions) and the development of defined contribution occupational pensions, although these are still a minority of all employer schemes. The growth in personal pensions was rapid. By the early 1990s they covered nearly one-quarter of employees and an even higher proportion of younger workers.

The trend towards less generous state pension provision means that, in spite of an ageing population, the future cost of the state pensions is set to fall as a proportion of GDP by 2050 (see Table 1), making the situation in the UK different to most other OECD countries.[2]

Table 1 Projected state spending on pensions in the UK

	2000	2010	2020	2030	2040	2050
% GDP	4.5	5.2	5.1	5.5	4.0	4.1

Source: Banks and Emmerson (2000)

However, it is worth bearing in mind that spending on pensions represents only part of total Government spending on benefits for older non-workers. In the 1980s there was a very large increase in the number of older non-workers on disability benefits[3] (see Figure 2) and spending on these benefits has more than doubled in real terms since 1990. Also, as the level of the basic state pension has now fallen below the level of means-tested benefits for pensioners, many pensioners are eligible for means-tested benefits on top of their state pension. By 2000-01 more than one-third of pensioners were receiving means-tested benefits. Means-testing is becoming an increasingly important element in state provision for pensioners with the introduction of an earnings-indexed means-tested Minimum Income Guarantee for pensioners from April 1999.

In this paper we consider a cohort of workers retiring at the beginning of the 1990s and study the impact of the incentives in public and private pension schemes on their retirement. This cohort was in employment when coverage of defined benefit occupational pensions was at its peak. Most men in the cohort belonged to an occupational pension scheme and this is likely to be the key financial determinant of when they retire. Previous analysis has shown clear differences in the retirement behaviour of people with and without occupational pensions (see Disney, Meghir and Whitehouse (1995) and Blundell and Johnson (1999)). Those with occupational pensions are more likely to remain in employment up to age 60 than those without, but more likely to leave after this age (see Figure 3). This difference in behaviour has been attributed to the incentive structure of occupational pensions, but this has never

[2] See Johnson (1999) for a discussion.

[3] The main benefit was invalidity benefit, which was replaced by incapacity benefit in 1995.

been modelled explicitly. This paper therefore represents an important contribution to increasing understanding of the incentive effects of occupational pensions on retirement.

The state pension scheme is likely to have a smaller incentive effect on retirement behaviour in the UK than that in other countries. The earnings-related element (SERPS) was adopted only in 1978 and is of relatively smaller magnitude than in other European countries. It will also be irrelevant to those people who opted out into occupational pension or personal pension schemes (and to many married women who opted out of the state pension system altogether). Only a minority of people in our sample of retirees remained in SERPS, although they form an interesting group to look at since SERPS was nearing its peak in terms of generosity at the time they were retiring.

This paper models retirement incentives for the cohort of individuals in the UK Retirement Survey. This is a two-wave panel survey of a sample of individuals born between 1919-1933. The first wave, conducted between November 1988 – January 1989, collected information on 3543 'key respondents' then aged 55-69. About two-thirds of the original sample were re-interviewed in 1994. The Retirement Survey has a larger sample of individuals in the relevant age range than any general household or individual surveys in the UK and is therefore the best currently available data for analysing retirement behaviour. However, it is considerably smaller than the administrative data sets used in other countries' studies. It also lacks complete earnings histories and full information on the rules of individuals' occupational pension schemes. Instead we match earnings profiles from cross-section surveys on the basis of cohort, education and industry. We also model the individual's occupational pension entitlement according to the rules of the most common scheme in the sector that the individual works in.

The plan of the paper is as follows. The next section describes the UK pension system and the key elements that are likely to affect retirement behaviour. Section 3 provides further information on the Retirement Survey and the selection criteria that we use for choosing a sample of individuals for analysing retirement behaviour. Section 4 describes the construction of earnings and pension incentive measures. Sections 5 contains the results from estimating Probit models of retirement including these incentive measures and discusses their implications for retirement behaviour by means of alternative scenarios for reforms to the pension system. In section 6 we present simulation results from two policy reforms designed to reduce the incentives for early retirement in the current pension system. Section 7 concludes.

2. The Policy Environment

The UK pension system is two-tiered. The first tier, provided by the state, consists of the basic state pension and a significant level of means-tested benefits (made more significant by the introduction of the Minimum Income Guarantee for pensioners in April 1999). The second tier, compulsory for all employees with earnings above a certain floor, is made up of the State Earnings-Related Pension Scheme (SERPS)[4] and a large and growing level of private provision (see Figure 3).

2.1 The Basic State Pension

The basic state pension is a flat-rate contributory benefit payable to people aged over the state pension age (65 for men and 60 for women[5]) who have made sufficient contributions throughout their working lives.[6] From April 2000, the basic state pension is worth £72.50 a week for a single pensioner. Prior to 1978 married women could opt to pay a reduced rate of National Insurance which meant they did not qualify for a basic state pension in their own right. Couples in which one partner does not qualify for the basic state pension receive a dependant addition, irrespective of whether they have ever worked or not. Since 1989 there has been no earnings test for receipt of the basic state pension,[7] although individuals who choose to defer will increase the value of their pension by 10% for each year of deferral.[8]

2.2 The State Earnings Related Pension Scheme (SERPS)

The first part of the second tier of pension provision is the State Earnings Related Pension Scheme (SERPS). Introduced in 1978, this pays a pension equal to a fraction of an individual's qualifying annual earnings (above a specified lower earnings limit) each year since 1978. When it was introduced, SERPS was intended to pay a pension worth one-quarter of an individual's best twenty years' earnings (up to a specified upper earnings limit). Subsequent reductions in the generosity of SERPS mean that it is worth only 20 per cent of average lifetime earnings to anyone retiring after 2000. Married women who opted to pay reduced rate National Insurance

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[4] SERPS will be replaced by the state second pension from 2002. This will effectively be a flat-rate top-up to the basic state pension, more generous than SERPS to low earners. Most workers will be encouraged to opt out into private provision.

[5] The retirement age for women will be raised by six months each year from 2010 to 2020 so that equalisation is achieved in 2020.

[6] To qualify for the basic state pension, individuals need to have made or be credited with National Insurance contributions for 90 per cent of their working lives. Credits are available for periods of illness, disability or unemployment.

[7] See Disney and Smith (2000) for a discussion of the effects of the abolition of the earnings test on labour supply.

[8] Increased from 7.5% in 1995

contributions do not qualify for SERPS. Currently widows can claim their husbands' SERPS pensions in full if they receive no additional pension in their own right.[9] After retirement the SERPS pension is uprated each year in line with prices.

2.3 Income Support and Invalidity Benefit

In addition to the basic state pension and SERPS, there are two other state benefits that are taken up widely by older non-workers – income support and incapacity benefit (formerly invalidity benefit). Income support is a flat rate, non-contributory means-tested benefit. It is paid automatically to people aged 60 or more who do not work. Unlike people in younger age groups, the over-60s do not have to show that they are actively seeking work in order to qualify. From April 1999, income support for pensioners was renamed the Minimum Income Guarantee and made more generous with an increase in the level and a commitment to uprate in line with earnings, at least for the short-medium term.

Incapacity benefit (formerly invalidity benefit) is a contributory benefit paid to the long-term sick and disabled. In the case of invalidity benefit an individual qualified on the basis of medical certificates from their GP showing them to be incapable of work that was 'reasonable' to expect them to do (given their age, qualifications etc). With the introduction of incapacity benefit in 1995 this was changed to a stricter 'all work test' carried out by a doctor employed by the Benefits Agency Medical Service. The change from invalidity benefit to incapacity benefit was a response to very rapid growth in receipt during the 1980s. A key feature of iincapacity benefit (and invalidity benefit) is that, before April 2001, it was not means-tested and could be received in conjunction with private pension income (unlike income support). From April 2001, it will be means-tested against occupational pension income.

2.4 Occupational and Personal Pensions

Compared to most other European countries the UK has a high level of coverage of private pensions, including both occupational pensions and individual retirement accounts, known in the UK as Personal Pensions. Any individual can choose to contract out of SERPS, into one of these two types of secondary private pension (and from April 2001 people will also be able to choose to opt out into a stakeholder pension, which is effectively a benchmarked individual retirement account). Members of defined benefit occupational schemes pay a reduced rate of

[9] This was due to be reduced to half from April 2000. However the failure of the Government to properly inform individuals of the change in entitlement led to the reform being delayed.

National Insurance, while those with defined contribution occupational pensions or personal pensions receive a National Insurance rebate paid directly into their fund.

Occupational pensions currently cover around 45 per cent of employees, down from a peak of over 50 per cent in the early 1980s. They are typically defined benefit schemes (see Table 2), although since 1988 employees have also been allowed to opt out into defined contribution occupational schemes and there has been a gradual shift from DB to DC schemes since then (see Disney and Stears (1997)). The decline in coverage of occupational pension schemes is due to a number of factors. It reflects changing employment patterns and a shift to smaller employers. Also, it reflects increasing pension choice among individuals working for employers offering occupational pensions who, since 1988, can no longer be compelled to join the scheme.

Table 2 Occupational schemes, DB versus DC

	% private sector schemes	% public sector schemes	% all schemes
DB plans	78	98	80
DC plans	16	2	14
Hybrid	6	—	6

Source: National Association of Pension Funds Annual Survey of Occupational Schemes, 1997

Since 1988 individuals have been able to contract out of SERPS (and leave their occupational scheme) and take out a personal pension. To kick-start these schemes when they were introduced a bonus National Insurance contribution of 2 per cent was paid by the government, in addition to the contracted-out rebate. By the mid-1990s, around 6 million people (more than one-quarter of all employees) had taken out a personal pension. Take-up was higher among younger workers as would be expected. However, there is a serious issue over the number of older workers who were ‘mis-sold’ personal pensions by financial advisers who wrongly advised them that they would be better off leaving their occupational pension scheme.

Table 3 summarises labour market participation and income receipt by age using data from the Family Expenditure Survey 1994-95 (corresponding to the second wave of the Retirement Survey). It shows relatively high rates of labour market withdrawal among men before the state pension age. The two most important sources of income before state pension age are income from private (predominantly occupational) pensions and disability benefit. It is important to stress that these two sources of income are not always alternative pre-retirement income sources, but are typically received together by the same people. The fact that disability benefit was not means-tested meant that it could be received in conjunction with other forms of income. Three-quarters of people in receipt of disability benefit income also received some money from a private pension.

Table 3 Labour market participation and benefit receipt

	FT work	PT Work	Not working	Public pension	Private pension	Disab Benefits	DisBen+ Private	Other Benefits
Men								
50-54	0.6447	0.2053	0.1500	0.0000	0.0947	0.0737	0.0237	0.0658
55-59	0.4620	0.1881	0.3598	0.0000	0.3432	0.1386	0.0825	0.0728
60-64	0.2680	0.1787	0.5533	0.0000	0.5395	0.2096	0.1478	0.1237
65-69	0.0213	0.0816	0.8972	0.8121	0.7411	0.1667	0.1312	0.0532
Women								
50-54	0.4667	0.2427	0.2907	0.0507	0.1040	0.0400	0.0133	0.0480
55-59	0.2936	0.2385	0.4679	0.0975	0.1988	0.0398	0.0061	0.0520
60-64	0.0909	0.1394	0.7697	0.7970	0.3606	0.0242	0.0152	0.0485
65-69	0.0156	0.0688	0.9156	0.9594	0.4125	0.0000	0.0000	0.0469

Source: Family Expenditure Survey 1994-95

3. Data Overview

3.1 The Retirement Survey

The main data used for analysing retirement behaviour are drawn from the UK Retirement Survey (RS), a household panel survey collected by the Office for Population and Census Surveys on behalf of the Department for Social Security. This is the first large-scale panel data set in the UK to focus on individuals around the time of retirement. Two waves of data were collected on a national random sample of individuals born between 1919-1933. The first wave of the survey was conducted between November 1988 – January 1989 and collected information on 3543 'key respondents' (who were aged 55-69). The key respondents include spouses if they were in the relevant age range. In addition, information was also collected on 609 spouses outside this age range. About two-thirds of the original sample were re-interviewed in 1994. 11% of respondents disappeared in this interval due to mortality; the residual attrition is a combination of non-response and (perhaps) unreported mortality.[10]

The Retirement Survey offers a relatively large sample of people in the relevant age range, compared to more general panel surveys such as the British Household Panel Survey. It also offers very rich demographic, economic and health information on individuals – and their spouses – in both waves. And it has employment history information and private pension history information dating right back to individuals' first jobs.[11] However, compared to the administrative datasets available in other countries, the sample in the Retirement Survey is relatively small

[10] The high attrition rate is largely due to the fact that the survey was not originally intended to be a panel survey. Hence, little attempt was made to keep in touch with respondents after the first wave.

[11] For a good overview of information in the Retirement Survey see Disney, Grundy and Johnson (1998)

(and is reduced by the high attrition rate between the two waves). Also, the survey does not collect earnings history information which is needed to calculate exact pension entitlements for each individual. Instead, as we describe in the next section we have to impute earnings histories on the basis of employment history information.

The analysis of retirement behaviour in this paper is based on a sub-sample of people in the Retirement Survey. The group we look at comprises those who were

- below the state pension age in Wave 1, i.e. men aged 55-64 or women aged 55-59 in 1988/89
- working in Wave 1 with non-missing earnings information and no income from occupational pension schemes/ unemployment benefit/ income support,
- and interviewed in both waves.

Excluding people who fail to meet any one of these criteria leaves 456 individuals – 283 men and 173 women. Each of these individuals remains in the sample from 1989 until they leave employment, leaving a total sample of 1,998 person-observations. Summary sample characteristics based on all person-observations are given in Table 4.

Table 4 Sample characteristics

	Men	Women
Number of person observations	1276	722
Mean age	61.50	59.87
Proportion currently married	0.8659	0.7659
Age difference between individual and spouse (years)	2.80	-1.17
Net earnings ($)	18,157	9,064
Proportion with an occupational pension	0.6857	0.3850
Proportion of women paying reduced rate NI	0.0000	0.7410
Length of time in current job (years)	12.16	9.85
Proportion of time since leaving educ in FT employment	0.6143	0.2341
Industry = energy	0.0940	0.0000
Industry = engineering	0.0030	0.0457
Industry = manufacturing	0.2014	0.1191
Industry = distribution	0.1951	0.1551
Industry = services	0.2429	0.6053
Industry = government	0.0635	0.0748
Zero financial wealth	0.1897	0.1856
£1 - £3,000 financial wealth	0.4036	0.4460
£3,000 - £10,000 financial wealth	0.2045	0.1717
>£10,000 financial wealth	0.1575	0.1399
Missing financial wealth	0.0447	0.0568
School dropout	0.4397	0.6108
High school education	0.4287	0.3047
College	0.1317	0.0845

Health in 1988 (severity score)	0.3017	0.3670
Variable definitions		
High school dropout	No qualification	
High school graduate	O levels, A levels, School certificate, Certificate of sixth form studies, clerical and commercial qualifications (eg typing/ shorthand/book-keeping/commerce), City and Guilds, Nursing qualifications, other qualification, recognised trade apprenticeship	
College	University degree or diploma, teaching qualification, membership of professional institution	
Severity score	Measure of self-assessed health status based on the international classification of impairments, disabilities and handicaps based on the international classification of impairments, disabilities and handicaps (ICDIH). Separate scales are constructed for areas of locomotion, reaching and stretching, dexterity, seeing, hearing, continence, communication, personal care, behaviour, intellectual functioning, consciousness, digestion and disfigurement. The severity score is constructed as a weighted average of the three highest severity scores from the 13 areas: Highest + 0.4(second highest) + 0.3(third highest).	

3.2 Earnings Histories and Projections

To calculate state pension entitlements we need individual earnings profiles going back to 1978 when SERPS was introduced. These are absent in the Retirement Survey. But the survey does provide detailed work histories documenting spells in employment, whether the employment was part-time or full-time and in which industry the individual worked, which, together with information on age and education, allow us to match earnings profiles from cross-section data. There is no single dataset with consistent information on these variables going back to 1978. Instead, we combine information from two datasets to get consecutive cross-section waves of data from 1978-89 – the Family Expenditure Survey (1978-86) and the General Household Survey (1987-89). Projecting forward from 1989 we assume constant real wages.

We also exploit the earnings information that is available in the first wave of the Retirement Survey to construct an individual fixed effect, which we use to adjust the individual's entire earnings profile. We assume that the wage of individual i in cohort/education/industry sub-group g in period t can be expressed as

$$W_{igt} = \theta_i W_{gt}$$

where θ_i is a constant individual fixed effect, W_{ig88}/W_{g88} where W_{ig88} is taken from the Retirement Survey and W_{g88} is calculated from the cross-section data. Our underlying assumption is that macro shocks affect everyone in the cohort/education/industry sub-group in the same way.

4. Construction of Incentive Measures

Each individual's total pension wealth and pension accrual measures are built up from combining four separate elements of the pension system – the basic state pension, the state earnings related scheme SERPS, occupational pensions and invalidity benefit.[12] In this section we discuss how each of these individual elements are constructed. We also discuss potential sources of variation in total pension wealth and accrual rates by which we might identify the impact of pension incentives on retirement behaviour.

4.1 The basic state pension

Calculation of basic state pension entitlement is straightforward. It depends on the total number of years' contributions and, for a married woman, on whether she opted to pay reduced rate National Insurance contributions. This latter piece of information is known directly from the Retirement Survey.

Although the basic state pension is flat rate, total wealth will vary across individuals because of the dependant's allowance and because of the fact that widows not entitled to a pension in their own right can claim their former spouse's pension in full when their spouse dies. In these cases, we need to compute husbands' total pension wealth over the life of the couple, based on the age difference between the spouses. Obviously, the larger the age difference between husband and wife, the greater the husband's total pension wealth.

4.2 State Earnings Related Pension Scheme

The precise formula for calculating an individual's SERPS pension is given by:

$$SERPS = \sum_{t=1978}^{R} (\tilde{W}_t \frac{Y_R}{Y_t} - LEL_{R-1})\chi_{Rt}, \; where \;\; \tilde{W}_t = \max[W_t, UEL_t]$$

Earnings up to the annual upper earnings limit (*UEL*) are re-valued to the year of reaching state pension age (*R*) using an index of economy-wide average earnings (Y_R/Y_t). The lower earnings limit (*LEL*) in the year prior to the individual reaching state pension age is deducted from each year's re-valued earnings figure and the net of LEL earnings are multiplied by an accrual factor (χ_{Rt}).[13] For people retiring before

[12] We ignore income support since it is a universal benefit.

[13] From April 2000 this formula changes. Instead of up-rating annual earnings and then subtracting the LEL from the year prior to retirement, the lower earnings limit from the year worked is subtracted from earnings first and then the

2000 the accrual rate was 1.25% a year. Details of earnings factors, upper and lower earnings limits and accrual rates are given in Appendix A1. Having calculated earnings profiles for each individual in the Retirement Survey, their SERPS entitlements are fairly straightforward to calculate. We assume zero SERPS pension for people who are in occupational pension schemes and for married women who have opted to pay reduced rate National Insurance contributions.

There are several potential sources of variation in SERPS pension wealth across individuals. Total wealth, but not accrual, will be affected by an individual's employment history since 1978 – both the number of years they have been in employment and their earnings, while projected earnings in the future will have an impact on expected total wealth and accrual. Another important factor for determining total wealth (but not accrual) will be the individual's age in 1978. This was when SERPS was introduced and an individual's age in that year will determine the period over which they are able to accrue rights to a SERPS pension before reaching state pension age. The maximum SERPS pension to which an individual could be entitled, for each year of retirement since 1978 is shown in Figure 5 (and also the SERPS entitlement based on average earnings). For example, someone reaching state pension age in 1979 would receive practically no SERPS pension since they would only have been building up entitlement for one year.[14] Someone retiring in 1998 could have accrued rights to a SERPS pension of up to £5,000 a year by earning the upper earnings limit for 20 years.

As shown in Appendix A1, accrual rates will change after 2000, but this reform will not affect the cohort of individuals in the Retirement Survey all of whom will have reached the state pension age before then. Finally, the fact that widows can claim their former husbands' SERPS pensions if they receive no pension in their own right means that, as with the basic state pension, a man's marital status, and the age difference between them and their spouse also affects their total pension wealth and accrual.

Table 5 compares our estimates of individuals' SERPS pension with the actual SERPS pension they received where this information is available (i.e. for individuals who had retired by the second wave of the Retirement Survey and reported pension receipt). On average, we under-predict individuals' SERPS pensions and while the correlation coefficient is positive and significant, it is fairly low (compared to that for occupational pensions (see below)). One possible explanation is that individuals who are in SERPS – and not therefore in occupational pension schemes – are likely to have

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difference is uprated in line with earnings growth. Since the LEL is annually uprated in line with the Basic State Pension, i.e. with prices, this has the effect of reducing the generosity of SERPS.

[14] Individuals cease to build up entitlements once they pass the state pension age.

had more variable employment histories than those who are in occupational schemes. Our method for estimating earnings profiles may be missing a lot of variation in their previous earnings, which would also matter more for SERPS than for occupational pensions which are typically determined only according to recent years' earnings.

Table 5 Predicted and actual SERPS pensions

Actual SERPS pension received in 1994	4315
Imputed SERPS pension in retirement year	3849
Correlation coefficient	0.3334
N	102

4.3 Invalidity benefit

One possible way to treat entitlement to invalidity benefit would be to assume that only individuals who received the benefit were eligible, and that all those who satisfied the eligibility conditions received the benefit. However, given the potential for subjective evaluation of 'incapacity for work' and 'reasonable work' and in the light of significant variation in the number of people receiving the benefit over time, as well as anecdotal evidence of differences between doctors in their willingness to certify individuals as being incapable of work, this assumption is inappropriate. Instead, we calculate an individual's invalidity benefit wealth on the basis of an assigned probability that they will receive the benefit. These probabilities are derived from a probit model for receipt of invalidity benefit as a function of characteristics such as age, education, region, tenure, marital status and spouse's employment status, which we estimate using data drawn from the Family Expenditure Survey from April 1988 – March 1994. We impute probabilities for individuals in the Retirement Survey on the basis of matched characteristics. The probit results are reported in Appendix A2.

4.4 Occupational pensions

The pension received in a defined benefit occupational pension scheme is typically determined by a formula of the type:

$$P = \chi(PE_R — \beta LEL_{R-1})N$$

where P is the annual occupational pension, χ is the scheme-specific accrual rate, PE_R is 'pensionable earnings' at the time of retirement which are typically the individual's average earnings in the last year, or last few years, before retirement, β is the 'integration factor' and N is the number of years that the individual has belonged to the scheme. From information in the Retirement Survey, we know N, the number of

years the individual has belonged to the scheme. However, we have to make reasonable assumptions about χ_{Rt}, PE_R and β.

The key distinction that we make is between individuals who work in the public sector versus those in the private sector. We assume that different typical schemes apply in the two sectors with different accrual rates, definitions of pensionable earnings and integration factors. This assumption, and the choice of parameter values that we adopt, are based on information from the 1997 National Association of Pension Funds Survey of Occupational Pension Funds which shows a clear difference between public and private sector schemes (see Tables 6a – 6c).

We assume an accrual rate of 1/60th for private sector and 1/80th for public sector. For pensionable earnings we take the best three out of last ten years' earnings for individuals working in the private sector and the best year's earnings out of the last ten years for individuals working in the public sector. We assume an integration factor of 1 for private sector schemes and 0 for public sector schemes.

By construction, total occupational pension wealth – and accrual rates – will vary across individuals according to whether they work in the public or private sector. But there are other sources of variation in both total wealth and accrual rates. Total wealth will vary according to the number of years that the individual has belonged to the scheme, while projected earnings in the future will have an impact on expected total wealth and accrual.

Table 6a Accrual rates

	Private schemes %	Public schemes %
1/80th	15	92
1/60th	65	8
Other	20	0

Table 6b Definition of pensionable earnings

	Private schemes %	Public schemes %
Actual earnings at retirement	11	2
Actual earnings at fixed date	4	3
Average earnings over the last 12 months	23	9
Best year's earnings within 3 – 10 years	25	86
Best 3 years' earnings within 10 – 13 years	30	—
Other	7	—

Table 6c Integration with state schemes

	Private schemes %	Public schemes %
Integration		
No	44	92
Yes	56	8
Adjustment based on		
Basic state pension	43	50
Lower earnings limit	55	50
Other	2	—

Source (all tables): NAPF Annual Survey of Occupational Pension Schemes, 1997

Further variation in accrual rates comes from differences across occupational schemes in the age at which individuals are entitled to start drawing their pension, also asked in the Retirement Survey.[15] We assume that people can continue to accrue rights to occupational pensions beyond this age (up to a maximum of forty years), but for each year that they continue to work beyond this age they lose a year's pension. This is clearly a simplification of the actual rules of occupational pension schemes, not least because around this time many firms implemented early retirement schemes to encourage exits. With no information about the availability of these schemes in the Retirement Survey, we are almost certain not to capture the actual set of retirement incentives facing some individuals. Even so, we do appear to estimate fairly well the level of occupational pension income received in retirement. Table 7 compares our estimates of individuals' occupational pension with the actual occupational pension they received where this information is available (i.e. for individuals who had retired by the second wave of the Retirement Survey and reported pension receipt). As with SERPS, we under-predict individuals' total level of occupational pension income, but the correlation coefficient is positive and significant and high.

Table 7 Predicted and actual occupational pensions

Actual occupational pension received in 1994	8140
Imputed occupational pension in retirement year	7762
Correlation coefficient	0.7868
N	172

[15] The survey asks "At what age will you start to receive the pension" and then asks "is that the usual age for drawing a pension", which it is for 90% of respondents. Where information on usual pension age is missing, we assume that it is 65 (the modal age).

4.5 Total pension wealth and accrual measures

To identify the effects of incentive measures on retirement behaviour requires these measures to vary across individuals and/or over time conditional on the other socio-demographic covariates that would be included in a model of retirement. As the previous discussion of the construction of the pension incentive measures has shown, there are a number of potential sources of variation in total wealth and in the forward-looking accrual measures for each of the four separate elements of the pension system. Table 8 summarises these sources of variation, indicating which of the four elements of the system – the basic state pension, SERPS, occupational pension and invalidity benefit – is affected and whether the source drives variation in total pension wealth or forward-looking accrual measures (or both). Almost all of the sources of variation affect both total pension wealth and accrual. However, future earnings will affect forward-looking accrual measures but not current total pension wealth, while total wealth (but not accrual) varies with past earnings and with the individual's date-of-birth (in the case of individuals with SERPS).

Table 8: Sources of variation in pension incentives across individuals

		Wealth	Accrual
Marital status and age of spouse (survivors' benefits)	BSP, SERPS, OP	✓	✓
Whether paid reduced rate NI (married women)	BSP, SERPS	✓	✓
Whether spouse paid reduced rate NI (married men)	BSP, SERPS	✓	✓
Past earnings	SERPS, OP	✓	
Future earnings	SERPS, OP		✓
Date-of-birth	SERPS	✓	
Number of years with current employer	OP	✓	✓
Accrual rate – SERPS/Public sector/ private sector	OP	✓	✓
Pensionable earnings – public/ private sector	OP	✓	✓
Normal retirement age	OP	✓	✓
Region, tenure, spouse's employment, education, age	IVB	✓	✓

In our analysis of the incentive effects of pensions on retirement, three different forward-looking measures of accrual are used. The first is simply the one-period accrual, i.e. how much an individual can add to their total pension wealth by working this period. The second is peak value. This represents the difference between total pension wealth accumulated by the start of the period and the maximum total pension wealth an individual could accumulate looking forward across all future years. This is a more appropriate measure if it is assumed that labour market exits by older workers are irreversible. In this case, when someone leaves the labour market they are giving up all possible future additions to their pension and will therefore consider how much they could increase their pension by staying in the labour market

not just this period, but in all future periods. By not retiring now, individuals retain an option to retire in the future and, thereby, to increase their pension. This is very similar in spirit to the option value (Stock and Wise (1990)), which is the third measure used.

In the option value model individuals are assumed to compare the value of retiring now to the maximum of the expected values of retiring at all future ages, where the value of retiring at future ages includes both possible pension additions and future earnings, i.e.

$$OV = V_t(r^*) - V_t(t) \text{ where } V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} Y_s^{\gamma} + \sum_{s=r}^{T} \beta^{s-t} (kB_s(r))^{\gamma}$$

where Y_s is earnings and B_s retirement benefits. The option value differs from the peak value by incorporating the future value of earnings until retirement and by incorporating utility parameters k, the differential value of income in leisure compared to earned income and γ, the coefficient of relative risk aversion. In our calculation of option values we assume $k = 1.5$ and $\gamma = 0.75$. We assume a discount factor, β, of 0.97 throughout.

Tables 9a – 9c summarise the distribution of pension incentive measures for men and women by age. These are calculated across all men and women of the same age who remain in our sample (i.e. those who have not yet exited the labour force) and will therefore be affected by differential selection into the sample at each age. All the figures are expressed in 1998 prices and in dollars.[16]

Table 9a summarises pension incentive measures for men, pooling those with and without an occupational pension. There is a clear effect of the state pension age – 65 for men – on the incentive measures. For men over 65, median accruals are negative and total pension wealth starts to fall.[17] It is worth pointing out that the selection effects will tend to increase average accrual measures – and reduce average total wealth – since those with lower accrual rates and higher total wealth will tend to exit the labour market earlier and so drop out of the sample.

The peak values and option values yield more pronounced incentives for people to stay in work at younger ages than the single period accruals. The median option values remain positive up to age 70, reflecting relatively low replacement rates in the UK. With the assumption that real earnings remain constant indefinitely, this

[16] Assuming an exchange rate of \$1.50:£1

[17] Individuals can choose to defer their pension after the state pension ages. However, since deferral is actuarially unfair for an average male and with no earnings test we assume that all men start to draw their state pension at age 65.

appears to create an incentive for some individuals to carry on working even at older ages. This will be reinforced by increasing selection of high-wage individuals into the sample with age.

Table 9b compares the incentive measures for men with and without occupational pensions. Figure 3 showed a clear difference in the labour market exit behaviour of these two groups, with men with an occupational pension being more likely to stay in work at younger ages. Table 9b shows that men with occupational pensions tend to have higher median peak values and option values up to the state pension age - and higher wealth. These incentives could work in either direction towards earlier or later retirement. The observed pattern of exits suggests that the effect of the higher option values is likely to dominate at least at younger ages, encouraging men with occupational pensions to stay in employment. It is worth pointing out that although the typical annual occupational pension is considerably higher than the typical SERPS pension (comparing Tables 5 and 7), the difference between total pension wealth for people with occupational pensions and those without is reduced by the more generous survivors' benefit provisions of SERPS. In the case of SERPS, the surviving spouse inherits the pension in full; in the case of occupational pensions, they inherit only half.[18]

Table 9c summarises the incentive measures for women. The large number of zeroes arises as a result of the number of married women who are not eligible for a pension in their own right. This means that the median single period accruals and median peak accruals are all equal to zero. As with men, the effect of the state pension age is clear with the 10^{th} percentile single period accruals and peak values turning negative at age 60. The 90^{th} percentile peak values and option values remain positive after this age because of occupational pension schemes which may have normal pension ages for women which are actually higher for women than their state pension age.

[18] The survivors' benefit was due to be cut to half in SERPS from April 2001. However, in the run up to the pre-announced reform many people were issued the wrong information in the form of leaflets that did not refer to the reform. The change has been delayed to October 2002 and those who can show that they were mis-informed will keep their original entitlement.

Table 9a: Incentive measures ($, 1998 prices), men

	Wealth	One year ahead accrual				
	Median	Median	10%	90%	SD	N
56	89821	3017	1164	7796	4402	31
57	93850	2544	970	13862	5335	64
58	97320	3137	1301	13819	6537	104
59	103990	3146	1115	13248	5142	133
60	108244	2932	1026	9099	3927	155
61	113266	2829	791	7947	3577	170
62	117994	2781	692	8886	5095	162
63	123886	3080	182	9560	4645	144
64	127333	3326	801	9254	4545	124
65	128514	-6038	-10570	-1914	4068	96
66	111329	-5976	-10210	-3525	2546	36
67	84831	-6857	-9859	-4975	2062	24
68	68720	-7162	-9564	-4826	1695	17
69	43102	-7892	-9277	-4976	1540	12
70	27458	-7864	-9024	-4826	1799	4

	Peak values				Option values			
	Median	10%	90%	SD	Median	10%	90%	SD
56	15936	3209	37966	13088	10476	5375	13813	3268
57	12766	2377	37675	25228	8857	4237	12711	3270
58	12764	2650	31027	18650	7449	3524	11162	2938
59	10916	1666	24728	10250	6168	2920	10581	3047
60	8824	1190	23424	9974	5034	2332	9083	2975
61	7234	884	19690	8447	4060	1675	7938	2821
62	5118	653	14313	6227	2745	1214	7165	2652
63	2993	182	8541	4355	1615	534	6316	2298
64	3269	770	9091	4471	1072	268	4864	2085
65	-6038	-10570	-1914	4015	681	-298	5089	2308
66	-5976	-10210	-3525	2546	312	-207	4190	1851
67	-6857	-9859	-4975	2062	126	-283	3616	1831
68	-7162	-9564	-4826	1695	322	-418	4629	1875
69	-7892	-9277	-4976	1540	1480	-219	6041	2369
70	-7864	-9024	-4826	1799	2129	-585	3466	1720

Table 9b: Incentive measures ($, 1998 prices)

Men with an occupational pension

	Median wealth	Median peak value	SD peak value	Median OV	SD OV	N
56	89813	20617	12318	11060	2429	22
57	94818	16313	28814	9509	2873	44
58	100479	15433	20429	8128	2745	77
59	106350	12622	10697	7041	3042	95
60	111982	10424	10793	5858	3098	112
61	115244	8406	9287	4898	2984	123
62	119875	6407	6956	3742	2858	113
63	129065	3932	4940	2443	2466	102
64	129262	4906	5033	1301	2326	86
65	134894	-4710	4264	1147	2526	62
66	120887	-5248	1630	1795	1941	18
67	88656	-6300	1947	682	2012	10
68	73094	-7162	1622	340	1760	7
69	45510	-7785	435	1566	2636	3
70	28010	-9024		2441		1

Men without an occupational pension

	Median wealth	Median peak value	SD peak value	Median OV	SD OV	N
56	94040	3636	7777	5585	2474	9
57	81424	4374	6166	4976	2488	20
58	89181	5658	4944	4776	2133	27
59	92931	4403	4931	4002	1756	38
60	98296	4267	4116	3358	1342	43
61	105402	3949	3277	2543	1129	47
62	110036	2575	2185	1727	964	49
63	116857	1373	1145	863	573	42
64	122692	1576	1174	926	1010	38
65	126471	-9286	2314	-45	1104	34
66	103687	-8614	2254	-29	1334	18
67	82364	-8355	1915	43	1708	14
68	50315	-7550	1832	305	2045	10
69	41864	-8000	1772	1394	2387	9
70	26906	-7760	1757	1817	2037	3

Table 9c: Incentive measures ($ 1998 prices), women

	Wealth	Accrual				
	Median	Median	10%	90%	SD	N
56	3018	0	0	7200	5905	38
57	4633	0	0	9841	6809	68
58	2324	0	0	8081	5203	98
59	4124	0	0	6739	6068	114
60	1231	0	-5039	2231	3183	142
61	0	0	-4888	2089	3316	107
62	604	0	-4741	1899	3447	68
63	0	0	-4599	1409	3703	43
64	303	0	-4473	3809	4994	25
65	0	0	-4413	631	2135	17
66	19916	154	0	307	217	2

	Peak values				Option values			
	Median	10%	90%	SD	Median	10%	90%	SD
56	0	0	35228	18676	6191	2028	12753	3855
57	0	0	29180	15825	5646	647	11485	3720
58	0	0	20693	10208	4910	421	10868	3343
59	0	0	17108	10558	4277	322	9254	3070
60	0	-5039	14269	10236	3877	-308	8858	3609
61	0	-4888	13120	9199	3445	-346	8208	3349
62	0	-4741	8724	8177	3833	-391	7901	3219
63	0	-4599	4886	7051	3375	-295	6149	2707
64	0	-4473	10106	5268	2291	-329	5119	2456
65	0	-4413	3644	3319	2593	-377	4472	1840
66	39	0	78	55	3427	3005	3848	596

5. Estimated Pension Incentives and the Probability of Retirement

5.1 The Statistical Model

We estimate the impact of the incentive and wealth variables on retirement decisions by modelling the conditional probability of exit from employment for individuals in the Retirement Survey.

For each individual i, we write $D_{it}=1$ if the individual has left the labour market in period t (conditional on being in the labour market in period t-1). The probability of this event is then modelled as a function of observable household and individual characteristics as well as the pension incentive variables. The pension incentive variables, defined in the previous section, are discounted wealth, option value (or single period accrual), spouse's pension wealth and the pension age. The latter measures the earliest age at which someone can draw their pension. This varies across gender but also across type of pension plan. Denoting the observable characteristics as Z_{it}, and the pension incentive variables as I_{it}, our conditional probability model may be expressed as

$$\Pr[D_{it}=1] = G(a'Z_{it} + b'I_{it})$$

where G is the cumulative distribution function of unobservables in the conditional exit model and a and b are unknown response coefficients.

In estimation we assume G is a cumulative standard normal and consequently estimate a and b using a Probit model for the conditional exit probability, pooled over all five years of retirement information in the Retirement Survey. In constructing the standard errors we need to allow for dependence over time in the unobservables for the same individual who survives in the panel more than one period before retiring. This is implemented using the block bootstrap method.

5.2 The Impact on Retirement

The discussion in section 4 has highlighted the sources of variation in the pension incentive variables. We argue that there is sufficient variability in the pension variables, conditional on the full set of other variables included in the regressions. Generally it is difficult to gauge how much variation one needs for a credible estimate – after all this crucially depends on the amount of variance in the errors. However we note that, for our most general specification, 40% of total pension wealth in the case of men and 43% of total pension wealth in the case of women remains unexplained by all the other included regressors, including option values (see Tables A3.1a and

A3.1b in appendix A3). For the option value, 24% of that for men and 32% of that for women remains unexplained by the other regressors, including total pension wealth. Overall, the pension variables, conditional on our functional form assumptions and exclusion restrictions, seem to display sufficient variability.

Turning to the conditional exit probability estimates, Table 10(a) presents the marginal effects and standard errors from a Probit regression for a variety of specifications estimated using data on our sample of men in the Retirement Survey. Table 10(b) provides the equivalent estimates for women. The results are separated into three panels according to the specification of the incentive variable. Panel (i) includes single accrual, panel (ii) the peak value and panel (iii) the option value. These are precisely as defined in the previous section and in particular allow for the basic pension, SERPS and Occupational Schemes where the individual is eligible. They also allow for eligibility to invalidity benefit according to the assigned probability model described in section 4.3.

The columns in each panel differ according to the specification of age effects. In the first column a linear age term is allowed. It may be that all other age effects are simply due to the wealth and pension incentives in which case this specification will be adequate. However, given that we are mixing different date of birth cohorts in this survey and that age effects may represent preferences as well as incentives, the next two columns allow for alternative age specifications. The second column includes a date of birth cohort dummy and the final column adds a full set of age dummies to this specification.

Each panel is further separated according to whether a dummy for age at which individuals become eligible to receive a pension is included – the "pension age". For recipients of the basic state pension and SERPS this is the normal state pension age, 65 for men and 60 for women. For individuals with an occupational pension we use the age at which they are entitled to start drawing their occupational pension.[19] This varies across individuals in occupational pension schemes so that it has potential explanatory power even when added to the specification with the full set of age dummies in the final column.

A broad look across the results in Table 10(a) is quite encouraging for the retirement model. In all cases the pension wealth and incentive variables are jointly significant. In all but one of the 18 specifications the signs are as we would expect - a positive wealth effect and a negative accrual effect. These results are consistent with the presence of both income and substitution effects in retirement decisions.[20] The

[19] The results presented in the tables in this section focus only on the pension measures. Table A3.2 shows the impact of other demographic and economic characteristics on the probability of retirement.

[20] The option value and total pension wealth measures are in $100,000s while net earnings are in $1,000s.

positive coefficient on the total pension wealth variable points to an income effect, whereby individuals who accumulate a lot in earlier years retire earlier. The impact of the option value reflects foregone future opportunities from stopping working now; the negative coefficient on this term indicates that the greater those foregone opportunities, the less likely individuals are to retire. Since the incentive variables are measured in $100,000, the coefficient of -.8495 on the option value in the final column of panel (iii) for example, implies that a $10,000 rise in the option values (leaving pension wealth unaffected) reduces the probability of retirement by a little under eight and one half percentage points. The counterfactual simulations in the next section are intended to shed more light on what these magnitudes are likely to mean in reality.

The significance of these coefficients requires some discussion. The panel nature of the survey means that the standard errors calculated from the standard formula for the Probit model will not account for the dependence across time periods. In Appendix A, table A3.3, we present bootstrap confidence intervals that do allow for this dependence. Interestingly these intervals maintain the significance in the wealth and incentive variables found in Table 10(a).

Table 10 (a): The probability of male retirement (N=1276)

(i) Single period accruals

	Linear age		*Cohort dummies*		*Age and Cohort dummies*	
	Marg effect	*SE*	Marg effect	*SE*	Marg effect	*SE*
Excluding age first eligible						
Pension wealth	.0999	*.0183*	.1158	*.0197*	.0915	*.0196*
Single period accrual	-.4975	*.1574*	-.8890	*.1513*	-.1251	*.1761*
Spouse wealth	.0324	*.0154*	.0386	*.0164*	.0305	*.0159*
Pseudo R^2	.1961		.1885		.2352	
Log likelihood	-404.11		-407.93		-384.43	
X^2 test (PW, Acc)	34.59		60.44		21.43	
Including age first eligible						
Pension wealth	.0699	*.0188*	.0861	*.0206*	.0825	*.0201*
Single period accrual	-.1954	*.1623*	-.6365	*.1580*	-.1144	*.1769*
Spouse wealth	.0224	*.0155*	.0281	*.0166*	.0278	*.0158*
Penage dummy	.1787	*.0453*	.1586	*.0455*		
Pseudo R^2	.2235		.2087		.2386	
Log likelihood	-390.33		-397.77		-382.72	
X^2 test (PW, Acc)	13.50		26.67		16.68	

(ii) Peak value

	Marg effect	*SE*	Marg effect	*SE*	Marg effect	*SE*
Excluding age first eligible						
Pension wealth	.0883	*.0173*	.0999	*.0192*	.0892	*.0192*
Peak accrual	-.0946	*.0795*	-.3170	*.0780*	-.0257	*.0574*
Spouse wealth	.0296	*.0152*	.0297	*.0166*	.0293	*.0157*
Pseudo R^2	.1866		.1670		.2348	
Log likelihood	-408.88		-418.71		-384.62	

X^2 test (PW, Acc)	25.81		40.54		21.10	
Including age first eligible						
Pension wealth	.0629	*.0178*	.0696	*.0198*	.0802	*.0197*
Peak accrual	.0084	*.0765*	-.2025	*.0786*	-.0115	*.0760*
Spouse wealth	.0194	*.0153*	.0199	*.0167*	.0266	*.0157*
Penage dummy	.1991	*.0452*	.2012	*.0471*	.0962	*.0636*
Pseudo R^2	.2220		.1987		.2382	
Log likelihood	-391.07		-402.77		-382.92	
X^2 test (PW, Acc)	12.09		16.75		16.33	

(iii) Option value

	Marg effect	*SE*	Marg effect	*SE*	Marg effect	*SE*
Excluding age first eligible						
Pension wealth	0.7706	*.0205*	.0509	*.0206*	.0717	*.0213*
Option value	-.3619	*.4196*	-1.7598	*.3675*	-.8481	*.3840*
Spouse wealth	.0244	*.0153*	.0188	*.0165*	.0223	*.0163*
Pseudo R^2	.1858		.1731		.2402	
Log likelihood	-409.25		-415.68		-381.92	
X^2 test (PW, Acc)	25.06		44.58		27.22	
Including age first eligible						
Pension wealth	.0531	*.0209*	.0246	*.0209*	.0626	*.0218*
Option value	-.3739	*.4201*	-1.5893	*.3653*	-.8495	*.3842*
Spouse wealth	.0175	*.0154*	.0105	*.0164*	.0210	*.0163*
Penage dummy	.1977	*.0440*	.2142	*.0465*	.0887	*.0582*
Pseudo R^2	.2228		.2111		.2436	
Log likelihood	-390.68		-396.54		-380.24	
X^2 test (PW, Acc)	12.78		27.43		22.07	

Notes: The full set of demographic controls include earnings (and earnings squared), education, health, job tenure, industry, proportion of time spent in full-time employment, whether individual has an occupational pension, housing tenure, financial wealth, age difference within couples, spouse's earnings, spouse's health and whether spouse is retired.

A more detailed examination of Table 10(a) reveals some further interesting features. On pure likelihood grounds, the specifications that include the option value dominate specifications with the more ad-hoc incentive variables. The dummy for the age at which the pension is first eligible is typically significant, although slightly less so for the option value specifications. The inclusion of date of birth cohort effects, in the second column of each panel, tends to reduce the impact of the wealth variables. This seems consistent with the strong differences in wealth across cohorts. At the same time it leads to a strong increase in the incentive variable. Indeed, for the peak value specifications in panel (ii), it is the only case where the incentive variable remains significant.

Including a completely unrestricted set of age effects reduces the magnitude of the substitution effect, although the wealth effect remains positive and significant. As we saw in the previous section the option value has quite a lot of variation even after including a full set of age effects. The estimates for the option value that also include the pension age dummy are the preferred on likelihood grounds and yield a marginally significant option value coefficient, albeit much reduced from the cohort

dummy specification. Interestingly the block bootstrap standard errors reported in Appendix Table A3.3, show a 95% interval that remains negative suggesting a significant negative effect even in this specification with age effects and the pension age dummy.

Figure 6 compares the within sample predictive performance of these model specifications. A number of immediate features stand out. First, even without including a full set of age dummies, we manage to predict a large amount of retirement before state pension age (65). This is due to the impact of invalidity benefit and early retirement incentives in the occupational systems. Second, the linear age and cohort effects specifications completely fail to capture the spike at 65. Note that

Table 10(b): The probability of female retirement (N=722)

(i) Single period accruals

	Linear age		*Cohort dummies*		*Age and Cohort dummies*	
	Marg effect	*SE*	Marg effect	*SE*	Marg effect	*SE*
Excluding age first eligible						
Pension wealth	.0677	*.0274*	.0726	*.0283*	.0568	*.0265*
Single period accrual	-.3856	*.3243*	-.5986	*.3300*	-.0744	*.3142*
Spouse wealth	.0343	*.0172*	.0344	*.0177*	.0346	*.0167*
Pseudo R^2	.1085		.1025		.1407	
Log likelihood	-285.17		-287.09		-274.86	
X^2 test (PW, Acc)	6.23		7.60		4.92	
Including age first eligible						
Pension wealth	.0536	*.0269*	.0590	*.0282*	.0536	*.0266*
Single period accrual	-.1176	*.3212*	-.3857	*.3307*	-.0391	*.3164*
Spouse wealth	.0308	*.0168*	-.0317	*.0175*	.0334	*.0167*
Penage dummy	.1309	*.0405*	.1077	*.0400*	.0546	*.0644*
Pseudo R^2	.1291		.1165		.1420	
Log likelihood	-278.58		-282.62		-274.44	
X^2 test (PW, Acc)	4.12		4.57		4.48	

(ii) Peak value

	Marg effect	*SE*	Marg effect	*SE*	Marg effect	*SE*
Excluding age first eligible						
Pension wealth	.0564	*.0255*	.0557	*.0263*	.0551	*.0250*
Peak accrual	-.2848	*.1683*	-.3934	*.1706*	-.2212	*.1572*
Spouse wealth	.0313	*.0171*	.0303	*.0176*	.0329	*.0167*
Pseudo R^2	.1111		.1065		.1440	
Log likelihood	-284.33		-285.80		-273.83	
X^2 test (PW, Acc)	7.72		9.70		6.76	
Including age first eligible						
Pension wealth	.0503	*.0252*	.0482	*.0262*	.0534	*.0251*
Peak accrual	-.1930	*.1638*	-.3277	*.1682*	-.2046	*.1588*
Spouse wealth	.0292	*.0168*	.0286	*.0175*	.0322	*.0167*
Penage dummy	.1268	*.0397*	.1070	*.0392*	.0430	*.0631*
Pseudo R^2	.1312		.1209		.1448	
Log likelihood	-277.90		-281.21		-273.56	
X^2 test (PW, Acc)	5.35		7.04		6.05	

(iii) Option value

	Marg effect	*SE*	Marg effect	*SE*	Marg effect	*SE*
Excluding age first eligible						
Pension wealth	.0470	*.0292*	.0277	*.0291*	.0463	*.0284*
Option value	-.4044	*.6307*	-1.2782	*.6113*	-.3528	*.6029*
Spouse wealth	.0322	*.0172*	.0298	*.0176*	.0336	*.0167*
Pseudo R^2	.1069		.1042		.1412	
Log likelihood	-285.69		-286.55		-274.72	
X^2 test (PW, Acc)	5.38		8.78		5.22	
Including age first eligible						
Pension wealth	.0429	*.0289*	.0205	*.0290*	.0452	*.0284*
Option value	-.2992	*.6195*	-1.2237	*.6073*	-.3112	*.6045*
Spouse wealth	.0297	*.0168*	.0168	*.0275*	.0326	*.0167*
Penage dummy	.1334	*.0397*	.1150	*.0393*	.0531	*.0640*
Pseudo R^2	.1293		.1208		.1424	
Log likelihood	-278.53		-281.23		-274.31	
X^2 test (PW, Acc)	4.26		7.28		4.73	

Note: The full set of demographic controls include earnings (and earnings squared), education, health, job tenure, industry, proportion of time spent in full-time employment, whether individual has an occupational pension, housing tenure, financial wealth, age difference within couples, spouse's earnings, spouse's health and whether spouse is retired

these specifications do not include the age first eligible to pension variable – we discuss this specification in more detail in our simulation of pension reforms. The linear age effects specification does not manage to capture the downturn in retirement hazards that occurs after 65.

The retirement model results for women, presented in Table 10(b), are similar to those for men, although the magnitude of the coefficients is typically smaller. For the majority of women, their decision to continue working – and their decision to retire – is completely unaffected by the incentives in their own pension scheme since they do not receive a pension in their own right. A lot of the identification of incentive effects is likely to come from exploiting variation between the set of women who do have their own pension and those who do not. In practice, however, these two groups of women are likely to differ in several other key respects which makes it difficult to measure the pension incentive effects with a high degree of accuracy.

Very few of the other included demographic and economic variables are individually significant (see Appendix A3, Table A3.3). Among those that are – for both men and women – are self-reported health status at the time of the first interview, the retirement status of the spouse (someone is more likely to retire if their spouse is already retired) and whether or not someone has an outstanding mortgage, which tends to reduce the probability of retirement. This is consistent with the idea that people might carry on working in order to pay off their mortgage. Typically, the occupational pension dummy is positive and significant. This might reflect

unmeasured incentives arising from occupational pension rules, or the fact that people tend to select into jobs with occupational pension schemes according to their underlying preferences for early retirement.

5.2 Evidence for Liquidity Constraints

An interesting feature of the results in Tables 10(a) and (b) is the significance of the pension age dummy. One possibility is that, prior to the age at which individuals become entitled to start drawing their pension, they are liquidity constrained and unable to borrow against their future pension wealth even if this is quite large.[21] Reaching pension age and being able to start drawing their pension therefore may have a significant effect on the probability of retirement in addition to the incentive effects. Table 11 is an attempt to examine this.

The first panel considers the complete sample of men used in Table 10(a) and includes two new variables – LiqPenW and LiqOV. These variables calculate wealth and incentives assuming that pension wealth only matter at the time the individual becomes entitled to start drawing on the pension income. Because individuals can't draw on their wealth before this age, it is assumed not to matter for retirement decisions.

At first sight this hypothesis seems quite plausible. However, the results presented in Table 11 are mixed. The LiqPenW variable, which is where one might think the dominant impact of such an effect would never significant and the original pension wealth variable always dominates. Perhaps the impact would be more important for those with smaller amounts of financial wealth. The second panel does not lend support to this. Here we just select those with financial wealth holdings less than 3000 pounds. There is no noticeable impact of the liquidity measures of pension wealth.

Why should this be? One fact we have pointed out is the low value of the state pension for most of those eligible for state pension. For many they will have their incomes in retirement topped up by welfare benefits. Moreover, if they retire before the state pension age they will often be eligible for disability benefits and will receive an income much like the state pension. Their net incomes out of employment as they age will stay quite stable and they have little reason to save or borrow. Moreover, since those eligible for state pension are typically lower skilled, their earnings in work are also quite low. The consequence is that their net replacement rates are little under 100%. Although they may implicitly face liquidity constraints these are never binding and therefore have no impact on retirement decisions.

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[21] It may well also be the case that they are uncertain about the amount they will receive. Although this should not be the case for state pension incomes.

The remaining panels of Table 11 further investigate the evidence for liquidity effects among those with occupational pensions and also those with lower educational qualifications. Again in neither case is there much evidence that such constraints are binding on the retirement decision.

Table 11: Evidence of Liquidity Constraints

	Marg effect	*SE*	Marg effect	*SE*	Marg effect	*SE*
All men (N=1276)						
Pension wealth	.0282	*.0195*	.0371	*.0202*		
Option value	-1.5592	*.3650*	-.3572	*.4390*		
LiqPenW			-.0083	*.0195*	.0039	*.0190*
LiqOV			-1.4586	*.3975*	-1.6173	*.3443*
Log likelihood	-397.33		-387.79		-390.63	
Financial wealth < £3,000 (N=757)						
Pension wealth	-.0186	*.0255*	-.0096	*.0307*		
Option value	-2.3928	*.4741*	-1.7453	*.6182*		
LiqPenW			-.0012	*.0266*	-.0096	*.0241*
LiqOV			-.6366	*.5145*	-1.5393	*.4244*
Log likelihood	-208.54		-207.07		-211.72	
Men with an occupational pension (N=875)						
Pension wealth	.0509	*.0239*	.0587	*.0250*		
Option value	-1.5178	*.4270*	-.1866	*.5295*		
LiqPenW			-.0102	*.0228*	.0060	*.0225*
LiqOV			-1.7021	*.5054*	-1.8349	*.4317*
Log likelihood	-293.12		-285.33		-288.86	
Men with no educational qualifications (N=561)						
Pension wealth	-.0338	*.0597*	.0388	*.0655*		
Option value	-2.4158	*.7419*	-.1174	*.9399*		
LiqPenW			-.0558	*.0595*	.0470	*.0568*
LiqOV			-2.9933	*.9198*	-3.0554	*.7341*
Log likelihood	-184.33		-176.77		-177.10	

Notes: Controls included for demographics, earnings, cohort dummies and age of first entitlement to pension.

6. Counterfactual Simulations

To illustrate the size of the estimated incentive effects on retirement behaviour, we consider the effects of reforms to the pension system on the predicted probabilities of retirement at different ages. Two alternative scenarios are considered.

The first counterfactual is to increase the pension age for everyone by three years. This means that the state pension age is 68 for men and 63 for women. We also augment the normal occupational pension retirement ages by three years. There is clearly a correspondence in practice between the state pension ages and the normal retirement ages in occupational pension schemes, so increasing the state pension is

likely to have a knock-on effect on occupational pension schemes. Moreover, the underlying demographic pressures that are likely to cause the government to reduce the generosity of the state pension system will have a similar effect on occupational schemes.

The second counterfactual assumes a pension system of the following form:

- An early entitlement age of 60
- A normal retirement age of 65
- A 60% replacement rate at age 65
- A 6% actuarial adjustment from 60 to 70
- No other pathways to retirement

The effects of each of these alternative scenarios on the distribution of total pension wealth and option values by age are presented in Table 12. We report results for men only since the majority of women, who have no pension in their own right, will be unaffected.

Table 12: Incentive measures, the impact of reform (men, N=1272)

	Base		Reform 1		Reform 2	
	Median TW	Median OV	Median TW	Median OV	Median TW	Median OV
56	89821	10476	76862	13353	102841	13660
57	93850	8857	80639	11785	101072	13019
58	97320	7449	83564	10320	105531	12880
59	103990	6168	88016	9430	113593	13200
60	108244	5034	90293	8084	116247	13384
61	113266	4060	93686	7113	119261	11962
62	117994	2745	97107	6046	118727	11112
63	123886	1615	101717	5252	127663	10182
64	127333	1072	103070	4229	125523	9768
65	128514	681	105048	3021	121037	9151
66	111329	312	114466	1544	131675	8332
67	84831	126	111553	1034	115668	7007
68	68720	322	109707	-119	115164	6211
69	43102	1480	82729	-138	105251	4574
70	27458	2129	67553	-217	71404	2990

Reform 1 raises the pension age by three years; Reform 2 introduced a pension system with a 60% replacement rate at the normal pension age of 65, an early retirement age of 60 and a 6% deferral rate.

The effect of raising the retirement age is to reduce the median level of total pension wealth and to increase option values, compared to the existing pension

system. The income and substitution effects work in the same direction and the combined effect is to reduce the conditional probability of retirement at younger ages. The effects can most clearly be seen by plotting and comparing the predicted retirement probabilities under the base case of the existing pension system and under the reform. This is done in Figures 7a and 7b, corresponding to the one-period accruals and option values respectively.

The precise magnitude of the effects of reforming the pension system depend on which specification is used. When a set of age dummies is included these tend to dominate any of the pension wealth and accrual incentives and the effect of reforming the pension system appears to be very small. To the extent that the age dummies pick up the incentive effects, these would need to be adjusted to reflect the pivotal ages in the new system. The bottom right hand graph in 7a and 7b shows the effect of changing the "pension age".

When a set of cohort dummies is included, the effect of the forward-looking accrual and option value measures is much stronger – as was seen from the regression results in the previous section and this is reflected in bigger predicted responses from increasing the retirement age by three years. Looking at Figure 7a, which shows the retirement probabilities based on the one-period ahead accrual, the effect is to halve the predicted probability of retirement at 65. Including option values tends to smooth the effects over a longer period, as would be expected from a more forward-looking model. The probability of retirement is reduced by between 3 – 7 percentage points between the ages of 60 and 66.

The effect of the second simulated reform is to increase the level of pension wealth and to increase the option values compared to the existing system. Under the simulated reform, the level of annual pension income that the simulated pension system produces is relatively generous compared to the existing UK system. The option value effect is reinforced by the absence of any non-pension benefits (such as disability benefits) before retirement age under the simulated reform which increases the incentive to stay in work.

The effect on one-period accruals is slightly different and worth commenting on. Under the simulated reform everyone is granted a full entitlement at age 60 and the level of pension is determined on the basis of earnings at age 65. Therefore, the decision to carry on working before age 60 has no effect on pension entitlement and up until age 60 the one-period ahead accrual is zero. Only after age 60 is the one-period accrual positive (and higher than under the existing system). If the decision to leave work were reversible then the optimal thing to do in terms of maximizing pension benefits might be to leave work until age 60 and then re-enter to increase pension entitlements. The option value approach implicitly rules this out – and before

age 60 gives a positive value to the option to increase pension value by working between 61 and 62.

The effects of this can be seen from the simulated retirement probabilities in Figures 7a and 7b. Looking at the simulations with cohort dummies and the one-period ahead accruals, the probability of retirement before age 60 is higher under the case of "reform 2" than it is in the base case. This reflects the higher level of pension wealth and the lower (effectively zero) accrual rate. After age 60, however, the one-period accrual is positive and higher than under the existing system. The income and substitution effects now work in the opposite direction, with the substitution effect being more powerful; the probability of retirement is lower under the reform. The option value makes the higher substitution effect count at younger ages and the probability of retirement is reduced at all ages.

7. Summary and Conclusions

The UK experienced a serious decline in labour market attachment among older workers in the 1980s and 1990s. This was especially acute among men aged 55 or older. The analysis we present shows that during the two recessions – the first in the early 1980s and the second in the early 1990s, the fraction of such men in employment declined by more than 30 percentage points to record low levels of little over 50% and has shown no sign of recovery. For older women this decline was less evident, reflecting the growing participation rate among younger cohorts which offsets the decline in employment. To what extent can these low levels of labour market attachment be attributed to the workings of the UK pension system; and to what extent can these trends be reversed by reforms to this system? These questions formed the motivation for this study.

We began the paper with a comprehensive evaluation of the economic incentives for retirement underlying the UK pension system. This accounted for the changing impact of the State Earnings Related Pension system, introduced in 1978 and of growing importance for those retiring in the 1990s. It also accounted for the complex set of private defined benefit occupation pension schemes, which provided coverage for nearly 70% of those approaching retirement in the 1990s. We highlighted the importance of invalidity benefit as a mechanism for income support in early retirement whose take-up approached nearly 1.5 million among individuals below state retirement age in the 1990s.

To examine the impact of these factors on retirement we used a sample of individuals aged 55 or older from the UK Retirement Survey. Their retirement probability was modelled in terms of the incentives underlying their own pension plans and other socio-economic factors. Our analysis followed an option value approach and allows a separate role for pension wealth. We also allowed for the

spouse's economic and demographic characteristics. The estimation results pointed to significant incentive and wealth effects through the pension system. The magnitude of these turned out to be quite sensitive to the specification of age effects. To allow for this we considered three basic specifications. The first restricted age effects to enter linearly. This is clearly rejected by the data in favor of more general specifications but we retain it as a baseline specification. The second allowed for cohort effects and the third allowed for a complete set of age dummies. Not surprisingly the full set of age dummies was found to provide the best fit. But even in this case the wealth and incentive variables remained correctly signed and significant. Overall the option value model performed better than models that used simpler and more ad-hoc incentive measures.

On their own the incentive and pension wealth measures were unable to explain the large increase in the retirement at the normal retirement age (65 for men and 60 for women). This explained the much improved fit of the age dummy specification. Nonetheless, the incentive and wealth variables alone managed to explain the most part of large amount of early retirement that occurs prior to the normal retirement age. This appeared to be due to a combination of the ability for invalidity benefit to act as an early retirement incentive and the significant incentives for early retirement that occur in occupational schemes in the UK. To explain the spike in the exit probability at the normal retirement age we included a dummy for the age at which the individual could first draw down his or her pension. This variable was shown to contain variation over and above the age dummies because this age varied across occupational schemes. Even with this variable included the option value incentive and pension wealth variables remained significant. Also investigated whether the significance of this variable could be attributed to a liquidity effect. That is a wealth effect that only became important at the point at which the pension could be drawn. We found little success in this explanation.

Each of these specifications was used to simulate two policy reforms. The first – Reform 1 - involved an increase by three years in the pension age. The second – Reform 2 - was more complex. This later reform had an early retirement age at 60 with a normal retirement age at 65. This was matched by a 60% replacement rate at 65 and a 6% actuarial adjustment from 60 to 70. Finally, all other pathways to retirement were eliminated. Reform 1 had a clear impact on retirement in all specifications – moving the retirement peak to a later age and significantly cutting the incidence of early retirement. Reform 2 had an even more dramatic impact on early retirement resulting in a smooth and lower rate of exit into retirement at all ages.

As a more cautious final note it should be pointed out that the data source we used had a number of drawbacks. Most notably the high attrition between waves and the resulting small sample size used in our analysis. In addition many of the features of the occupational plans that we would like to include are missing from the data.

More optimistically, the new English Longitudinal Survey of Ageing which is in the process of getting ready to go into the filed will remedy both of these defects and will also provide a comprehensive and detailed data source on health and retirement.

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Appendix A1 Calculating SERPS

Accrual rates

	Accrual rate on earnings	
Year of retirement	Between 1978-79 and 1987-88	1988-89 onwards
Before 1998-99	25/20 = 1.25	25/20 = 1.25
2000-01	25/21 = 1.19	25/21 = 1.19
2005-06	25/26 = 0.96	22.5/26 = 0.87
2010-11	25/31 = 0.81	20/31 = 0.65
2015-16	25/36 = 0.69	20/36 = 0.56
2020-21	25/41 = 0.61	20/41 = 0.49
2025-26	25/46 = 0.54	20/46 = 0.43
2027-28 onwards	25/49 = 0.51	20/49 = 0.41

Earnings factors

Year of earnings	Factor	Year of earnings	Factor
1978-79	377%	1988-89	69.5%
1979-80	320.7%	1989-90	53.5%
1980-81	251.6%	1990-91	43.1%
1981-82	194.8%	1991-92	30%
1982-83	167.6%	1992-93	22.1%
1983-84	148%	1993-94	16.3%
1984-85	129.6%	1994-95	11.7%
1985-86	115.5%	1995-96	8%
1986-87	97.9%	1996-97	5%
1987-88	84.4%		

Upper and Lower Earnings Limits

Year	LEL	UEL	Year	LEL	UEL
1978-79	17.5	120	1988-89	41	305
1979-80	19.5	135	1989-90	43	325
1980-81	23.0	165	1990-91	46	350
1981-82	27	200	1991-92	52	390
1982-83	29.5	220	1992-93	54	405
1983-84	32.5	235	1993-94	56	420
1984-85	34	250	1994-95	57	430
1985-86	35.5	265	1995-96	58	440
1986-87	38	285	1996-97	61	455
1987-88	39	295	1997-98	62	465

Appendix A2 Probit results, Invalidity benefit

	Men		Women	
	Coeff	*SE*	Coeff	*SE*
Yorks&Humberside	-.0958	*.0748*	-.1601	*.1129*
North West	.0217	*.0713*	.2176	*.0989*
East Midlands	-.4242	*.0857*	-.2936	*.1256*
West Midlands	-.3005	*.0773*	-.3128	*.1155*
East Anglia	-.6051	*.1189*	-.4210	*.1700*
South East	-.5109	*.0835*	-.2288	*.1165*
Greater London	-.5336	*.0731*	-.4302	*.1101*
South West	-.4568	*.0852*	-.3078	*.1253*
Wales	.2494	*.0809*	.3606	*.1088*
Scotland	.0179	*.0743*	.2237	*.0998*
Age	.5859	*.0246*	.4968	*.0354*
Age squared	-.0054	*.0002*	-.0048	*.0003*
College education	-.6891	*.0962*	-.0452	*.1019*
Spouse employed	.1476	*.0416*	-.1923	*.0467*
Homeowner with mortgage	.0109	*.0484*	-.0529	*.0614*
Outright owner	-.0850	*.0399*	-.2829	*.0595*
Constant	-15.7892	*.6933*	-13.5498	*.9405*
Number obs	9636		14192	
Pseudo R^2	0.2047		0.2013	

Source: Data from Family Expenditure Survey April 1988 – March 1994

Appendix A3 Further Estimation Results

Table A3.1a Wealth and accrual, Men (N=1276)

	Dependent variable							
	Total pension wealth		Accrual		Peak value		Option value	
Option value	-8.971	.5268	—	—	—	—	—	—
Total pension wealth	—	—	.0326	.0027	.0382	.0064	-.0211	.0012
Spouse pension wealth	-.2272	.0189	.0114	.0021	.0107	.0050	-.0042	.0009
Difference in ages	.0299	.0026	.0001	.0002	.0036	.0006	.0016	.0001
Job tenure	.0072	.0018	.0000	.0002	.0014	.0004	.0000	.0000
% FT employment	.0765	.0464	.0041	.0049	-.0189	.0117	.0016	.0022
Education	.1296	.0229	.0016	.0024	.0032	.0058	.0021	.0011
Health score	.0089	.0125	-.0001	.0013	.0033	.0031	-.0008	.0006
Spouse health score	.0094	.0075	-.0006	.0008	-.0018	.0018	-.0011	.0003
Renter	-.0205	.0279	.0034	.0029	-.0012	.0070	.0017	.0013
Mortgage	.2254	.0269	.0044	.0029	.0137	.0069	.0045	.0013
Industry = engineering	-.1137	.0415	.0066	.0044	-.0145	.0104	.0046	.0020
Industry = manufacturing	-.0927	.0425	-.0039	.0045	-.0400	.0107	-.0002	.0020
Industry = distribution	-.0401	.0413	.0031	.0044	-.0226	.0103	.0005	.0020
Industry = services	.0205	.0404	.0012	.0043	-.0265	.0101	.0001	.0019
Industry = government	.3681	.0541	-.0016	.0058	-.0476	.0138	-.0030	.0026
Spouse retired	-.0146	.0365	-.0072	.0039	-.0061	.0091	-.0011	.0017
Occup Pension	.1923	.0271	.0177	.0028	.0355	.0066	.0149	.0012
£1 - £3,000 wealth	-.0727	.0309	.0060	.0033	.0136	.0077	.0058	.0014
£3,000 - £10,000 wealth	-.0039	.0350	.0136	.0037	.0297	.0087	.0060	.0016
>£10,000 wealth	.3155	.0404	.0236	.0042	.0642	.0099	.0202	.0019
Missing wealth	-.0010	.0557	.0111	.0059	.0133	.0140	.0046	.0027
Earnings	.0272	.0019	.0001	.000	.0003	.0004	.0020	.0000
Spouse earnings	.0025	.0019	-.0008	.0002	-.0015	.0004	-.0003	.0000
Pension age	.4908	.0623	-.0166	.0068	-.0704	.0160	-.0012	.0031
Age dummies	Yes		Yes		Yes		Yes	
R^2	.6054		.5976		.4890		.7597	

Table A3.1b Wealth and accrual, Women (N=722)

	Dependent variable							
	Total pension wealth		Accrual		Peak value		Option value	
Option value	-10.84	.6996	—	—	—	—	—	—
Total pension wealth	—	—	.0329	.0027	.0183	.0064	-.0238	.0015
Spouse pension wealth	-.1515	.0211	.0031	.0018	-.0022	.0043	-.0013	.0010
Difference in ages	.0132	.0063	-.0007	.0005	-.0023	.0012	-.0005	.0003
Job tenure	-.0033	.0023	-.0003	.0001	-.0010	.0004	-.0001	.0001
% FT employment	.2429	.0631	.0110	.0054	.0468	.0126	-.0007	.0029
Education	.1602	.0396	.0087	.0033	.0324	.0078	.0044	.0018
Health score	-.0228	.0170	-.0019	.0014	-.0033	.0033	-.0014	.0007
Spouse health score	-.0029	.0164	.0010	.0013	-.0010	.0032	.0005	.0007
Renter	.0246	.0485	-.0055	.0041	-.0160	.0095	-.0015	.0022
Mortgage	.0890	.0402	.0026	.0034	.0118	.0079	.0015	.0018
Industry = engineering	-.3168	.1006	-.0133	.0085	-.0065	.0199	.0076	.0047
Industry = manufacturing	-.1573	.0771	-.0348	.0065	-.0486	.0152	-.0065	.0036
Industry = distribution	-.2116	.0747	-.0259	.0063	-.0341	.0148	-.0029	.0035
Industry = services	-.0207	.0648	-.0195	.0054	-.0107	.0128	.0008	.0030
Spouse retired	-.0413	.0572	-.0106	.0048	-.0188	.0112	-.0060	.0026
Occup Pension	.4871	.0466	.0159	.0041	.0865	.0095	.0160	.0022
£1 - £3,000 wealth	.0245	.0482	-.0122	.0040	-.0250	.0094	-.0054	.0022
£3,000 - £10,000 wealth	-.1071	.0574	-.0106	.0048	-.0200	.0113	-.0048	.0026
>£10,000 wealth	.2858	.0644	-.0101	.0055	-.0019	.0129	.0006	.0030
Missing wealth	-.1200	.0835	-.0139	.0070	-.0243	.0164	-.0063	.0039
Earnings	.0343	.0045	.0004	.0003	-.0003	.0007	.0036	.0001
Spouse earnings	-.0097	.0019	-.0001	.0001	-.0010	.0003	-.0002	.0000
Pension age	.0759	.0827	-.0183	.0070	-.0560	.0163	-.0056	.0038
Age dummies	Yes		Yes		Yes		Yes	
R^2	.5683		.4833		.4546		.6795	

Table A3.2 Retirement probabilities, option values

	Men				Women			
	Demographics, earnings and cohort dummies		Demographics, earnings, cohort and age dummies		Demographics, earnings and cohort dummies		Demographics, earnings, cohort and age dummies	
	Marg Effect	*SE*	Marg effect	*SE*	Marg effect	*SE*	Marg effect	*SE*
Total wealth	.0282	*.0195*	.0626	*.0217*	.0302	*.0282*	.0594	*.0280*
Option value	-1.559	*.3650*	-.8495	*.3842*	-1.253	*.6109*	-.3382	*.6152*
Spouse wealth	.0123	*.0162*	.0209	*.0162*	.0251	*.0172*	.0291	*.0166*
Net earnings	.0032	*.0014*	.0014	*.0014*	.0032	*.0036*	-.0014	*.0034*
Spouse net earnings	-.0031	*.0016*	-.0027	*.0015*	-.0017	*.0016*	-.0021	*.0015*
Pension age	.2135	*.0464*	.0887	*.0582*	.1126	*.0392*	.0523	*.0650*
Difference in ages	-.0010	*.0021*	-.0033	*.0021*	-.0067	*.0049*	-.0065	*.0048*
Job tenure	.0005	*.0013*	-.0001	*.0012*	.0028	*.0018*	.0029	*.0018*
% FT employment	.0213	*.0356*	.0419	*.0338*	.0361	*.0505*	.0307	*.0487*
Education	-.0147	*.0191*	-.0195	*.0187*	-.0143	*.0330*	.0035	*.0319*
Health score	.0158	*.0086*	.0205	*.0083*	.0229	*.0131*	.0265	*.0127*
Spouse health score	-.0078	*.0062*	-.0086	*.0059*	-.0210	*.0155*	-.0236	*.0147*
Renter	-.0021	*.0224*	-.0155	*.0202*	-.0154	*.0369*	-.0035	*.0374*
Mortgage	-.0254	*.0216*	-.0388	*.0197*	-.0346	*.0320*	-.0313	*.0307*
Industry = engineering	.0280	*.0354*	.0511	*.0384*	.0119	*.0847*	-.0107	*.0730*
Industry = manufact	-.0218	*.0306*	.0022	*.0335*	-.0397	*.0522*	-.0441	*.0492*
Industry = distribution	-.0187	*.0286*	-.0038	*.0306*	.0525	*.0689*	.0535	*.0674*
Industry = services	-.0547	*.0240*	-.0469	*.0241*	-.0179	*.0527*	-.0283	*.0515*
Industry = government	-.0285	*.0327*	-.0197	*.0340*	—	—	—	—
Spouse retired	.0769	*.0378*	.0604	*.0352*	.1496	*.0603*	.1325	*.0585*
Occup Pension	.0535	*.0184*	.0490	*.0182*	.0428	*.0428*	.0381	*.0412*
£1 - £3,000 wealth	.0237	*.0270*	.0260	*.0260*	-.0030	*.0405*	-.0052	*.0395*
£3,000 - £10,000 wealth	.0473	*.0351*	.0398	*.0335*	.0295	*.0509*	.0434	*.0523*
>£10,000 wealth	.0607	*.0423*	.0255	*.0363*	-.0097	*.0522*	-.0321	*.0457*
Missing wealth	.0330	*.0552*	.0405	*.0565*	-.0287	*.0658*	-.0534	*.0518*

Table A3.3 : Bootstrap Standard Error (Male Retirement Model)

	Linear age	*Cohort dummies*	*Age and Cohort dummies*
(a) Excluding age first eligible			
Sample size	1202-1375	1183-1347	1158-1345
	Marg effect	Marg effect	Marg effect
Pension wealth			
Mean estimate	.0749	.0464	.0692
5%	.0383	.0089	.0372
95%	.1083	.0808	.1014
Option value			
Mean estimate	-.3861	-1.9043	-.8380
5%	-1.2363	-2.6422	-1.5079
95%	.4071	-1.2743	.2747
(b) Including age first eligible			
Sample size	1194-1345	1179-1359	1106-1350
	Marg effect	Marg effect	Marg effect
Pension wealth			
Mean estimate	.0510	.0192	.0629
5%	.0156	-.0235	.0283
95%	.0815	.0555	.1068
Option value			
Mean estimate	-.3706	-1.7371	-.8515
5%	-1.1093	-2.4786	-1.6395
95%	.2624	-1.1214	-.2250