How does increasing the early retirement age for women affect the labour supply of women and their husbands?

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Abstract

In 1995, the UK government legislated to increase the earliest age at which women could claim a state pension from 60 to 65 between 2010 and 2020. This paper uses data from the first two years of this change coming into effect to estimate the impact of increasing the early retirement age from 60 to 61 on the employment of women and their partners using a difference-in-differences methodology. Our methodology controls in a flexible way for underlying differences between cohorts born at different times. We find that women's employment rates at age 60 increased by 7.3 percentage points when the state pension age was increased to 61 or, equivalently, it increased average retirement age by about one month. Their probability of unemployment increased by 1.3 percentage points. The employment rates of the male partners also increased by 4.2 percentage points. The magnitude of these effects, and the results from subgroup analysis, suggest they are more likely explained by the increase in the early retirement age having a signalling effect rather than them being due to either credit constraints, wealth effects, or the effect of individuals responding to changes in their financial incentives to work. Taken together, our results suggest that the fiscal strengthening arising from a one-year increase in the female state pension age is 10% higher than a costing based on no behavioural change, due to additional direct and indirect tax revenues arising from increased earnings.

Key words: early retirement age; labour supply; policy reform; retirement

JEL classification: H55, J21, J26

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1. Introduction

Governments across the developed world have, over recent decades, legislated for increases in the early and normal claiming ages that apply to public pension schemes, often with the explicit intention of strengthening the public finances – not only by reducing payments to pensioners but also by increasing average retirement ages and thus generating additional tax revenues. In 1995, the UK government legislated to increase the state pension age (that is, the earliest age at which a pension can be claimed from the state) for women from 60 to 65. This was legislated to happen between 2010 and 2020. This paper uses evidence on labour market behaviour in the UK between 2010 and 2012 to examine what impact increasing the state pension age from 60 to 61 has had on the economic activity of the affected cohorts of women and their partners.

Women's economic activity could be affected by an increase in the state pension age through four main mechanisms. First, the increase reduces the length of time that individuals receive state pension income for and thus reduces their lifetime wealth; this will tend to increase labour supply. However, if those affected were forward looking and well informed, this response might have manifested as soon as the legislation was passed. Second, individuals who are credit constrained may have to continue working (or claim alternative out-of-work benefits) during the period when they are no longer able to receive their state pension. Third, the state pension age may anchor social norms about the 'appropriate' age at which to retire. Some evidence in favour of this was found in a survey carried out on behalf of the Department for Work and Pensions. This found that a significant proportion of individuals, who initially were ignorant of their true state pension age, changed their reported expected retirement age (such that it was equal to their true state pension age) when they were told their actual state pension age.[1] Fourth, increasing the state pension age will have some effect on individuals' marginal financial incentives to work, through changing marginal tax rates and eligibility for out-of-work benefits. However, this channel will not be as important in the UK as it is in some other countries because there is no earnings test for state pension receipt in the UK.

We identify the impact of increasing the state pension age by comparing cohorts who face different state pension ages, while allowing for a flexible specification of cohort, age and time effects. Our specification allows for considerably more underlying heterogeneity between cohorts and time periods than previous papers (such as Mastrobuoni, 2009). However, the specification we have chosen limits us to identifying only those effects that manifest between the old and new state pension ages; other differences in employment rates between treated and control cohorts that occur before or after these points will be subsumed into the cohort effects

[1] MacLeod et al., 2012, pp. 94–95.

that are included in our specification. For this reason, the effect we identify – which is sizeable – could be considered a lower bound on the true response to the policy. On the other hand, the effect we identify is the short-run effect, which could be larger than the long-run effect if individuals did not fully anticipate the policy change.

Earlier papers have predicted the effects of increasing early and normal retirement ages on labour force participation using out-of-sample predictions. Papers simulating changes in early and normal retirement ages in the US have suggested quite large effects on retirement ages (Fields and Mitchell, 1984; Gustman and Steinmeier, 1985; Rust and Phelan, 1997; Coile and Gruber, 2000), while for the UK Blundell and Emmerson (2007) estimate that a three-year increase in state pension ages for both men and women (and assuming that defined benefit occupational pension schemes respond with a three-year increase in their normal pension ages as well) would increase retirement ages by between 0.4 and 1.8 years, depending on the specification used.

One of the first papers to examine ex post the impact of a change in state pension ages was Börsch-Supan and Schnabel (1999), who looked at evidence from the reduction in the earliest age of pension receipt in Germany, which was reduced from 65 to 63 in 1972. Prior to this reform, the vast majority of men retired at age 65, whereas after the reform there was a significant shift towards retiring at age 63. More recently, there have been increasing numbers of reforms around the world, which have increased pension ages. Therefore, ex post evaluations have become more common in the literature, although none has yet examined the reforms in the UK.

Mastrobuoni (2009) finds that average retirement ages increase by one month for every two-month increase in the normal retirement age in the US. This is larger than the effects typically suggested by the previous simulation studies. Two main factors could be driving this difference. First, the simulation studies generally do not factor in social norms associated with legislated claiming ages, which could tend to increase retirement exactly at the claiming age (the exception being the upper estimate from Blundell and Emmerson, 2007). Second, the simulation studies focus on the steady-state impact on retirement ages; if the reforms were in part unanticipated, the short-run effect on retirement ages may be larger than the long-run effect.

Staubli and Zweimüller (2013) employ a very similar estimation strategy to that used in this paper to examine an increase in the early retirement age in Austria of 2 years for men and 3.25 years for women. They find that employment rates increased by 9.75 percentage points among affected men and by 11 percentage points among affected women, with increases in unemployment rates of a similar size.

A further set of papers have examined how reforms to pension claiming ages affect expected retirement ages. Coppola and Wilke (2010) examine how subjective expectations of retirement age were affected by the legislated increase in statutory retirement age in Germany from 65 to 67. They find that the reform had a large effect on expected retirement ages, with these having increased on average by nearly two years for younger cohorts following the reform – in other words, almost one-for-one with the reform. Meanwhile, Bottazzi, Jappelli and Padula (2006) find that revisions to retirement expectations were much smaller in response to reforms of the Italian pension system, with evidence that this was at least in part due to individuals underestimating the magnitude of these reforms.

By examining how the labour supply of women's partners responds to an increase in the female state pension age, this paper also contributes to the literature on complementarities of leisure within couples. Banks, Blundell and Casanova (2007) exploit differences in pension claiming ages for women in the US and UK to identify the impact of a woman leaving work on her (male) partner's employment and find significant evidence of joint retirement within couples. We exploit the differences in pension claiming ages for women induced by the 1995 reforms to identify whether there has been any knock-on effect on the labour supply of male partners.

The reform that we examine here is somewhat different from those studied by previous papers. First, unlike Mastrobuoni (2009), but similar to Staubli and Zweimüller (2011), we examine a change in the earliest age at which a pension can be received from the state. This means that credit constraints may be important in determining how people respond, as individuals may have to work for longer if they have no other source of non-work income. Second, in the UK system – unlike many other countries' pension systems – there is no earnings test for receipt of pension income; therefore, claiming and ceasing to work are – in theory at least – largely separate decisions. Indeed, the majority of men and women in the UK do not leave the labour market at the same age as they can first claim a state pension. This implies that the major effect of increasing the state pension age, for those who are not credit constrained, might be a reduction in lifetime wealth.

Since this policy reform was announced 15 years in advance, we might expect adjustments in employment rates around the state pension age to be quite small, as individuals have had a considerable period of time over which to adjust their behaviour. However, evidence suggests that – even many years after the legislation was passed – many of the women affected were unaware of it. Crawford and Tetlow (2010) find that six-in-ten of those women who face a state

pension age somewhere between 60 and 65 were unaware of their true pension age.[2] This suggests that some women may face a significant shock as they approach pension age and thus may have to adjust their behaviour sharply over a short period of time. Furthermore, if there are social norms attached to retiring at the state pension age, moving this age could have a greater impact on employment rates than the pure financial incentives would suggest.

We find that employment rates of women at age 60 increased by 7.3 percentage points when the state pension age was increased to 61; this result is statistically significant at the 1% level. This is equivalent to about a one month increase in the average retirement age. The result is robust to a number of specification tests, including using a linear probability model rather than probit, variations in the sample chosen to exclude repeat observations on the same individuals, and using a wild cluster bootstrap procedure to account for potential serial correlation in employment shocks (as suggested by Cameron, Gelbach and Miller, 2008). We find that employment rates among affected women's partners increased by around 4.2 percentage points (with this result being statistically significant at the 5% level and the point estimate being reasonably robust to different specifications). Looking at the employment of both members of couples, we find that – among couples where the wife is aged around the state pension age – the increase in the female state pension age has led to an increase in the proportion of two-earner couples (5.4 percentage points) and a decrease in the fraction of couples where neither is in paid work (4.7 percentage points) but no significant change in the fraction of couples where only the husband or only the wife is in paid work. We interpret this as evidence of complementarities of leisure within couples, rather than couples using alternative margins (male and female labour supply) to respond to the policy change.

The remainder of this paper proceeds as follows. Section 2 describes the institutional setting, the policy reforms we exploit and the data we use and presents evidence on how employment rates changed around the early claiming age prior to the reform. Section 3 describes our empirical strategy and Section 4 presents the results. Section 5 concludes.

2. Background and Data

a. Institutional details

The state pension age in the UK is the earliest age at which individuals can receive a state pension. There is no earnings test for receipt of the state pension (that is, the amount received is

[2] In 2011, a survey of women affected by the state pension age increases indicated that almost a fifth of women with a state pension age of at least 63 thought that their state pension age was 60 or below (Age UK, 2011).

not reduced if the individual also has earned income)[3] but individuals do receive an actuarial adjustment of benefits if they delay claiming beyond the state pension age. Those not claiming the state pension when they reach the state pension age receive a 10.4% increase in their income for each year that they delay claiming.[4] However, in practice, very few people choose to delay claiming.

The UK state pension consists of two parts. The first-tier pension (known as the Basic State Pension) is based on the number of years (but not on the level) of contributions made.[5] The second-tier pension is related to earnings across the whole of working life (from 1978 onwards); enhancements are also awarded for periods spent out of work due to some formal caring responsibilities since April 2002. However, historically, the majority of employees have chosen to opt out of this second-tier pension in return for a government contribution to a private pension scheme.[6]

A full Basic State Pension in 2012–13 was worth £107.45 a week (17% of average full-time weekly earnings).[7] Most men and women now reaching the state pension age can qualify for the full award. The second-tier pension scheme replaces 20% of earnings within a certain band. The maximum total weekly benefit that can be received from the second-tier pension in 2012–13 is £161.94.[8] However, since most employees opted out of the second-tier pension scheme in the past, the majority of pensioners receive far less than this from the state.

Between 1948 and April 2010, the state pension age was 65 for men and 60 for women. The Pensions Act 1995 legislated for the female state pension age to rise gradually from 60 to 65 over the ten years from April 2010, with the state pension age rising by one month every two months for ten years. As a result, women born after April 1950 have a state pension age of greater than 60.[9,10] The total loss from a one-year increase in the state pension age is £5,587 for

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[3] The earnings test was abolished in 1989. Disney and Smith (2002) examine the labour supply impact of removing the earnings rule.

[4] This adjustment is prorated for partial years of deferral; each 5 weeks of deferral results in a 1% increase in pension income.

[5] Periods in receipt of certain unemployment and disability benefits and periods spent caring for children or adults can also boost entitlement.

[6] A full description of the UK state pension system can be found in Bozio, Crawford and Tetlow (2010).

[7] However, women approaching the state pension age earn, on average, much less than this and are more likely to work part time. Median earnings for 59 year old women who were in work in the two years prior to the increase in the state pension age were £254 per week.

[8] Page 2 of Pensions Policy Institute (2012).

[9] Further details of how the female state pension age is increasing, including the impact of more recent legislation which, if implemented, will see the state pension age of men and women rise to 66 for those born after October 1954, are shown in the appendix in Figure A.1.

[10] To our knowledge no occupational pension schemes adjusted their normal pension ages in line with the change in the female state pension age. Until very recently, the most common normal pension ages were 60 in public sector schemes and 65 in private sector schemes. We are not aware of any schemes that apply a different normal pension age to male and female scheme members.

a woman who qualifies for a full Basic State Pension and no additional pension, rising to £14,008 for a woman who qualifies for a full Basic State Pension and a full additional pension entitlement.[11]

State pension entitlements make up a significant fraction of total retirement resources for some individuals, while for others they are much less important. Table 2.1 shows statistics on the distribution of different types of wealth among the cohorts of women that are the focus of this paper. On average, these cohorts had accrued about £130,000 of state pension entitlements by 2010; this figure is calculated as the present discounted value of the estimated future stream of state pension income. However, these women's mean total family wealth is just over £800,000. On average, women's own state pension wealth accounted for one-quarter of their family's total wealth; but for one-in-nine women their state pension wealth accounts for more than half their family's total wealth.

Table 2.1 Distribution of wealth among women born between April 1949 and March 1952

£ thousands	Mean	25th percentile	Median	75th percentile
State pension wealth (individual)	128.0	98.8	131.4	160.5
State pension wealth (family)	226.4	169.1	235.9	294.3
Private pension wealth (individual)	90.2	0.0	23.4	104.9
Private pension wealth (family)	248.2	21.6	136.3	328.8
Net financial wealth (family)	84.3	1.4	24.2	90.6
Net housing wealth (family)	201.8	85.0	180.0	280.0
Other physical wealth (family)	56.1	0.0	0.0	4.5
Total net wealth (family)	820.5	399.6	660.5	1,026.3

Notes: Sample includes all ELSA core sample members born between 1 April 1949 and 31 March 1952. Sample size = 746.
Source: English Longitudinal Study of Ageing, wave 5 (2010–11). Weighted using cross-sectional weights.

Some other features of the tax and benefit system also change when an individual reaches the state pension age and potentially influence incentives to remain in paid work. First, employees are no longer liable for employee National Insurance contributions (i.e. payroll taxes decline); this increases the financial incentive to be in paid employment. Second, instead of being able to claim the main working-age unemployment and disability benefits,[12] households with one member above the female state pension age become eligible to claim the means-tested Pension

[11] This is based on a full Basic State Pension of £107.45 a week and a maximum State Second Pension entitlement of £161.94 a week being lost for one year.

[12] The main working-age unemployment benefit is known as Jobseeker's Allowance (JSA) and is paid at a rate of £71.00 per week. The main working-age disability-related benefit is known as Employment and Support Allowance (ESA) and is paid at a rate of £99.15 per week.

Credit Guarantee. This is more generous than the equivalent working-age benefits: not only is the amount received higher (£142.70 per week, with greater amounts for those with disabilities) but there are also no requirements for recipients to, for example, seek work or attend work-focused interviews. This reduces the incentive for individuals to be in, or to seek, paid work after reaching state pension age. Finally, those aged above the female state pension age are eligible for the Winter Fuel Payment (which is worth £200 a year) and for free off-peak bus travel. The impact of these payments on labour supply incentives is ambiguous but it is unlikely to be significant.

b. Data

We use data from the UK's Labour Force Survey (LFS).[13] This is conducted on a quarterly basis, with all individuals in a household followed for up to five consecutive quarters ('waves') and with one-fifth of households being replaced in each wave. The sample size is large – for example, during January to March 2012, 102,531 individuals were interviewed from 43,794 households – and the survey contains information on individual labour market activities combined with background information such as sex, age, marital status, education and housing tenure. Crucially for our study, the data contain month as well as year of birth, and the large sample sizes mean relatively large numbers of individuals are observed from each birth cohort at each age. For example, about 170 individuals born in the first quarter to be affected by the reform (1950Q2) are observed in each quarter of the LFS data that we use in our analysis (which runs from 2009Q2 to 2012Q2). Further details of the achieved sample size by age and cohort are shown in Table A.1 in the appendix.

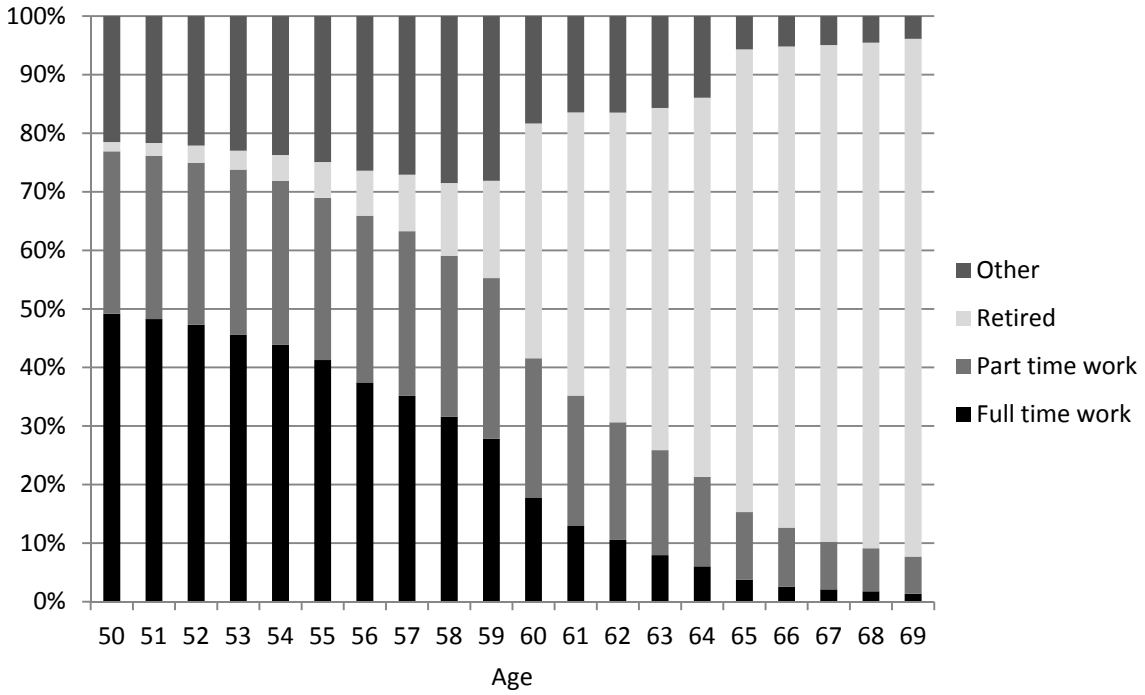
Data from the Labour Force Survey are used to produce internationally comparable unemployment statistics using International Labour Organisation (ILO) definitions of employment and unemployment. Therefore, we use ILO measures of economic activity in our analysis. Under these definitions, an individual is categorised as employed if they do any paid work (as an employee or self-employed) in the week of their interview, if they are temporarily away from paid work or if they are on a government training scheme (although this last category is rare for older people). Individuals are considered as being in full-time work if they work 30 or more hours in a usual week. If individuals are not in work, they are categorised as either unemployed (looking for work in the last four weeks or waiting for a job to start and they must be able to start work within the next two weeks), retired, sick or disabled, or a residual

[13] We do not use data from the English Longitudinal Study of Ageing, which was described in Table 2.1, as it does not yet provide sufficient observations of employment rates of older women since the state pension age started to increase. The sample size of women in the relevant cohorts is also much larger in the LFS than in ELSA.

category (these are all self-defined). Each individual is categorised as being in one and only one of these categories.

The pattern of economic activity of older women by age is shown in Figure 2.1. This uses LFS data pooled across the eight years before the female state pension age was increased. The percentage of women in paid work (either full-time or part-time) declines with age (which will be due to a combination of age and cohort effects). Between age 59 and age 60, there is a 13.7 percentage point drop in employment and a 23.5 percentage point increase in the percentage reporting themselves as retired. Both of these changes are bigger than any of the changes observed between other consecutive ages. However, prior to the female state pension age being increased, it was not possible to separate out the extent to which this was an impact of hitting the state pension age as opposed to an impact of hitting age 60.[14]

Figure 2.1 Economic activity of women prior to state pension age reform, by age



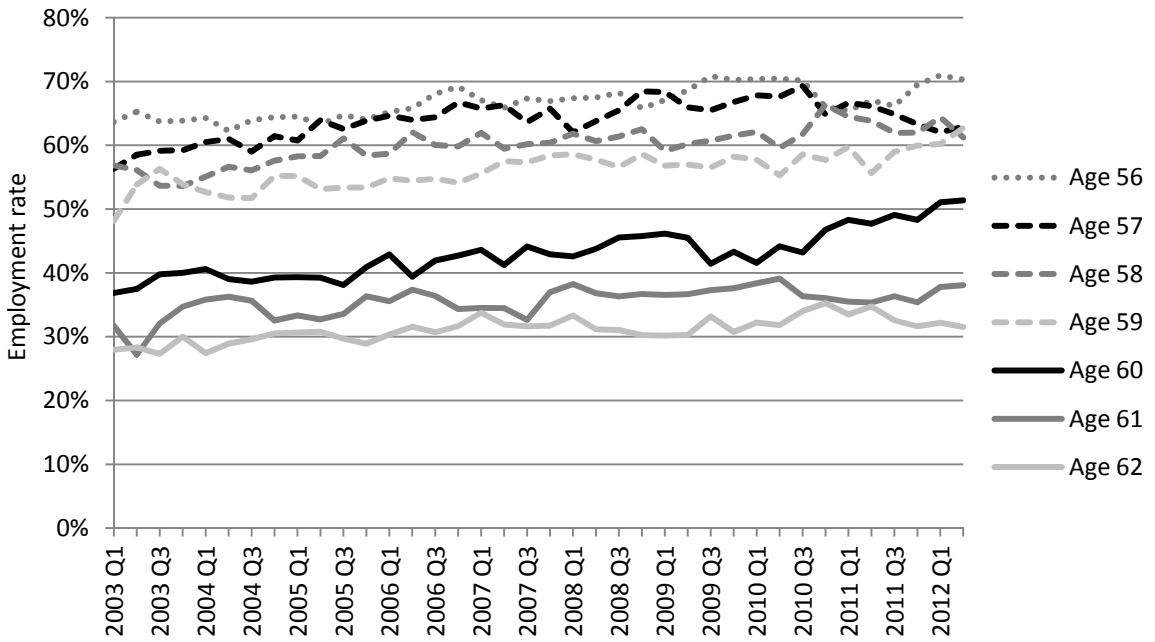
Notes: Averages over the period 2003Q1 to 2010Q1.
Source: Authors' calculations using the LFS. Based on 404,428 observations. The equivalent figure for men is shown in Figure A.2 in the appendix.

An initial indication of what the impact of increasing the state pension age on employment has been is provided by Figure 2.2. This shows how employment rates of older women have evolved since 2003 by single year of age. While employment rates at each age have generally been increasing over time (due, at least in part, to later cohorts of women having greater labour force

[14] One approach has been to assume a parametric relationship between labour market exit and age (for example, a quadratic in age) and also allow for an additional impact of hitting the state pension age. But this assumes that all of the additional retirements that occur at age 60, over and above those explained by the relationship with age measured at earlier and later ages (and other covariates in the model), are due to this age being the state pension age. See, for example, Blundell and Emmerson (2007).

attachment), a particularly large increase has been observed for 60-year-old women from April 2010 onwards, which is when the state pension age started to rise. In 2010Q1 (just prior to the increase in female state pension age), the employment rate of 60-year-old women was 41.5%; by 2012Q2 (the first quarter in which all 60-year-olds were under the state pension age), it had increased to 51.4%. This 9.8 percentage point increase is statistically significant (t-stat = 3.57) and is the largest increase over any two years shown in Figure 2.2. During the same two-year period, the employment rate of 61-year-olds fell slightly (by 0.3 percentage points, from 38.4% to 38.1%). This change is not statistically significant at the 10% level. A simple difference-in-differences estimate, comparing the change in employment rate between 2010Q1 and 2012Q2 of 60-year-old women with the change in employment over the same period among 61-year-old women suggests that the increase in the female state pension age from 60 to 61 has increased employment rates among 60-year-olds by 10.1 percentage points. Sections 3 and 4 present more formal approaches to estimating this effect, controlling in a more sophisticated manner for time effects, cohort effects and differences in observed characteristics between the different cohorts of women.

Figure 2.2 Employment rates of older women, 2003–12, by single year of age



Source: Authors' calculations using the LFS, 2003 to 2012. Based on 190,429 observations. The equivalent figure for men is shown in Figure A.3 in the appendix.

A description of the background characteristics, and the variation in economic statuses by these characteristics, of women close to the state pension age immediately before and after it started to rise from age 60 is shown in Table 2.2. Among those not in paid work, the most common reported activities are being 'retired', being 'sick or disabled' and 'other' (which most commonly refers to looking after the home or family). Relatively few women in this group report

themselves as being unemployed. Full-time employment is more common among single women than among those in couples. Those who own their own home are much more likely to be in work (either full- or part-time) than those who rent their home, while those in the latter group are relatively more likely to be unemployed or sick/disabled (indeed, almost one-third of renters report being sick or disabled). There is relatively little difference in the economic statuses of those who have worked in the public sector (defined as education, health, care or public administration) most recently and those who have worked in the private sector most recently. Employment rates are positively correlated with levels of education, with those with lower levels of education being more likely to report being sick/disabled or having 'other' as their main economic activity.

Table 2.2 Economic activity for women born between April 1949 and March 1952, in the period 2009Q2 to 2012Q2

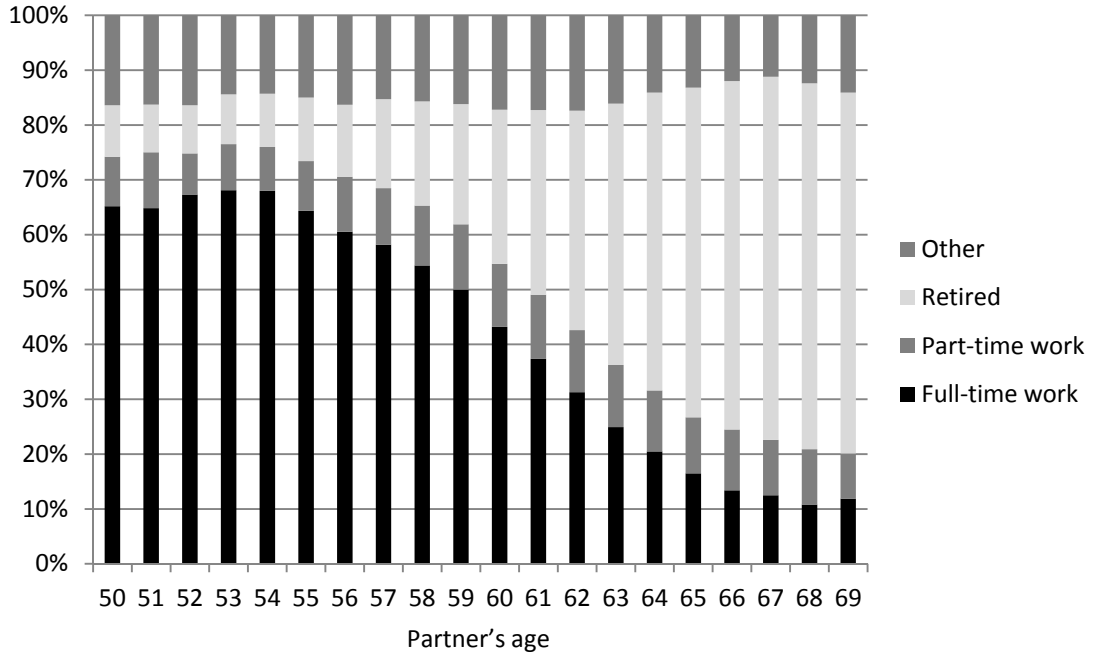
	Percentage of sample in each economic activity						*Number of observations in sample*
Sample	Full-time work	Part-time work	Retired	Unemployed	Sick or disabled	Other	
Full sample	28.2	25.0	23.9	1.9	12.5	8.5	30,297
Single women	32.8	18.8	19.5	3.3	19.8	5.7	8,818
Women with a partner	26.3	27.5	25.7	1.3	9.5	9.7	21,479
– *whose partner is older*	25.1	26.6	27.2	1.2	9.7	10.1	15,955
– *whose partner is younger*	29.6	30.1	21.3	1.5	9.0	8.5	5,524
Rent house	20.5	15.3	18.3	3.5	31.5	10.9	5,853
Own house	30.0	27.3	25.2	1.5	8.0	8.0	24,444
Non-missing sector	35.5	31.5	20.3	2.1	5.8	4.8	24,029
'Public sector'	36.4	30.8	22.3	1.3	5.1	4.0	12,017
'Private sector'	34.5	32.2	18.4	2.8	6.5	5.5	12,012
Degree or other HE	34.7	26.4	25.9	1.8	5.7	5.5	8,416
Secondary education	30.4	27.3	22.1	1.9	10.4	7.9	14,756
No qualifications	15.8	18.6	25.2	2.0	24.9	13.5	7,125

Notes: Totals may not sum to 100 due to rounding. Public sector is defined as those who work or most recently worked in education, health, care or public administration. Private sector is those in all other industrial categories.
Source: Authors' calculations using the LFS.

The data also allow us to explore the impact of the increase in the female state pension age on the labour market activity of the male partners of those directly affected by the reform. Data from prior to the reform show that, among men aged 55 to 69 who are partners of women aged between 50 and 69, employment rates do typically fall as wife's age increases and the largest

drop (of 7.2 percentage points) is between those whose female partner is aged 59 and those whose female partner is aged 60 (see Figure 2.3).

Figure 2.3 Economic activity of men (aged 55–69) with partners prior to female state pension age reforms



Notes: Averages over the period 2003Q1 to 2010Q1. Number of observations = 193,738.
Source: Authors' calculations using the LFS.

3. Empirical Methodology

Using data on the labour market behaviour of women who face different state pension ages allows us to estimate what impact increasing the state pension age for women from 60 to 61 has had on labour market behaviour. To do this, we employ a difference-in-differences methodology. The 'treatment' (being under the state pension age) is administered at some point to all women but, since the reform was introduced, is administered for longer to women born more recently. The equation below sets out the specification we use to estimate the impact of increasing the state pension age.

$$y_{ict} = \alpha(underspa_{ict}) + \gamma_t + \lambda_c + \sum_{a=1}^{A} \delta_a [age_{ict} = a] + X_{ict}\beta + \varepsilon_{ict} \qquad (1)$$

Our aim is to estimate the effect on an outcome, y, of being below (rather than above) the state pension age. Fixed effects are used to control for time period (γ_t), cohort (λ_c) and age. In other words, we assume that there are cohort- and time-constant age effects, time- and age-constant cohort effects and age- and cohort-constant time effects. The last is the usual common trends assumption required for identification in difference-in-differences estimation. We might be particularly concerned about this identifying assumption being violated in our application if the policy of interest has affected our control group through general equilibrium effects in the

labour market. For example, if increasing the state pension age for younger cohorts led to more 60-year-olds wanting to remain in work, this could have reduced employment opportunities for 61-year-olds. Such an effect would bias upwards our estimated effect of increasing the state pension age on women's employment rates. We cannot rule out this possibility.

The age- and time-constant cohort effects control in a flexible way for underlying differences in employment patterns between different cohorts of women. However, this comes at the cost of subsuming within this 'cohort effect' any impact of the state pension age reform that manifests itself in time-constant changes in economic activity rates among the affected cohorts before age 60.[15,16]

We also control for a vector of individual characteristics, *X*. These include education, relationship status, housing tenure, ethnicity, geography, as well as partner's age and partner's education for those with a partner – the full set of covariates included is laid out in Table A.2 in the appendix.

We also estimate the impact on (male) partners' outcomes, for which we use a similar specification. The impact of increasing a woman's state pension age on her partner's economic activity is estimated, controlling for the woman's cohort, woman's age and time in the same way that we control for these when estimating the effect on female employment. Additional controls are also used, which most importantly include controls for the man's own age, which we control for using a quadratic plus indicators for being aged over the female state pension age and for being aged 65 or over.[17] The identifying assumption is that – after controlling for own age, partner's age, time and cohort effects – any difference between the employment rates of men with female partners who are aged above and below the state pension age is due to the impact of their partners reaching the state pension age. This identifying assumption is cleaner than the one used in identifying the effect on women's economic activity. Whereas all women of the same age at a given time are either above or below the state pension age, for men of a given age at a certain time, they may have a partner who is either above or below the state pension age.

The primary outcome of interest is the effect of increasing the state pension age on employment. This is estimated using both ordinary least squares (OLS) and a probit model, calculating the

[15] An alternative approach would have been to specify a functional form for the cohort effects and attribute any deviations from this pattern between cohorts who were affected by the 1995 legislation and those who were not as being the result of the policy change. This is essentially the approach adopted by Mastrobuoni (2009).

[16] Any other policy changes that affect cohorts (and their behaviour) differently, but in a time-constant way, will also be absorbed into these cohort effects. This could apply, for example, to the reforms legislated in Pensions Act 2007, which changed the way that pension entitlements were calculated (in a way that made the system more generous on average) for all those born after 5 April 1950.

[17] The full specification as estimated by OLS is set out in Table A.3 in the appendix.

average marginal effects of the treatment.[18] However, we are also interested in the other possible economic states. To assess these, multinomial probit models are used to examine the impact of increasing the state pension age on: first, whether an individual is in full-time or part-time work or not in paid work; and, second, whether an individual is in work, retired, sick or disabled, unemployed and a residual category.

Since the LFS tracks individuals over up to five consecutive quarters of data, our sample contains multiple observations on the same individuals and so the observations are not independent of one another. We control for this by clustering standard errors at the individual level and also conduct a sensitivity analysis using only the first observation on each individual; we show that this changes the estimated marginal effect very little but increases the standard errors as the sample size is substantially reduced. Our results are also robust to allowing for serially correlated cohort–time shocks.

4. Results

a. Effect of increasing the state pension age on women's employment rates

All the models are estimated on data from 2009Q2 to 2012Q2 – from one year before the reform began to the latest available data – and the cohorts included are those born in 1949–50 to 1952–53, which includes one cohort unaffected by the reform (1949–50) and three cohorts whose state pension age was changed by the reform. Cohort is controlled for using financial year (e.g. 1950–51) fixed effects. Time is controlled for using year and quarter fixed effects and there are age fixed effects in years and quarters to control finely for age, which is particularly important in ensuring that the estimate of being under the state pension age is not simply capturing the effect of being younger.

Calculating whether each individual woman is above or below the state pension age involves calculating her state pension date, and then comparing the date of interview to the state pension date. Under the reform, people born from the sixth day of one month to the fifth day of the next month have the same state pension date. While the exact day of interview is observed in the LFS, only an individual's year and month of birth are available, not their date of birth. This means that those women born between the first and fifth days of any month are allocated a state pension date that is 2 months after they actually reach their state pension age. If dates of

[18] Since being under the state pension age is a function of both a woman's cohort and time, the variable *underspa* is an interaction. In a non-linear model, calculating marginal effects on an interaction term does not produce a difference-in-differences treatment effect as it does in a linear model. To estimate the treatment effect in a non-linear model, we estimate the model and then, for each observation, look at the difference in the predicted probability of employment if above and below the state pension age and then average across all observations to calculate the average marginal effect across the whole distribution of other regressors.

birth are distributed uniformly within each month, we will have misclassified whether the woman is over or under her state pension age for 2.7% of women.[19]

Table 4.1 reports the results from estimating equation (1) using a variety of econometric specifications where the dependent variable is being in employment. Our preferred specification is specification 6, which is a probit model with standard errors clustered at the individual level. This shows that being under the state pension age increases the probability of being in work by 7.3 percentage points, with this impact being statistically different from zero at the 1% level.[20] This is consistent with a one-year increase in the female state pension age from 60 to 61 leading to 27,000 more women in paid work.[21]

Table 4.1 Effect of increasing the state pension age from 60 to 61 on women's employment

Specification	*Number of waves*	*Estimated by*	*Standard errors clustering*	*Effect of being under SPA*	*Standard error*	*N*
(1)	5	OLS	Not clustered	+0.075***	[0.015]	30,297
(2)	5	OLS	At individual level	+0.075***	[0.019]	30,297
(3)	1	OLS	Not clustered	+0.074**	[0.030]	6,907
(4)	1	OLS	At cohort level	+0.074**	[0.033]	6,907
(5)	1	OLS	Wild cluster bootstrap	+0.074**	[N/A][a]	6,907
(6)	5	Probit	At individual level	+0.073***	[0.019]	30,297
(7 - pseudo SPA)	5	Probit	At individual level	–0.007	[0.017]	37,804

[a]Using the wild-cluster bootstrap-t procedure calculates a correct p-value with small numbers of clusters, not standard errors. The estimated p-value using this procedure was 0.046.

Notes: *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level, * at the 10% level. Specifications 1–6 estimated on women born in 1949–50 to 1952–53 from 2009Q2 to 2012Q2. Specification 7 ('pseudo SPA') estimated on women born in 1947–48 to 1950–51 from 2007Q2 to 2010Q2. Probit models estimated using maximum likelihood estimation, and standard errors calculated by bootstrapping the marginal effect 1,000 times. Cohort-level clusters are at year and month of birth level.

[19] Although state pension date is mismeasured for those born between the first and fifth days of the month, in only two months of the year are they incorrectly observed to be under the SPA when they are actually over the SPA. For the same reasons, age in years and quarters may be mismeasured for a small number of individuals, by at most one quarter.

[20] While ethnicity and education (in practice) are fixed for older women, the increase in the state pension age could affect relationship status or housing tenure, so these characteristics could be endogenous. Running the model (specification 6) without controls for relationship status, partner's characteristics or housing tenure leads to a coefficient estimate of +0.076 , very similar to the estimate including them. As it is unlikely that the increase in the state pension age has had any important effects on housing or relationship status, we include these as explanatory variables in our preferred specification.

[21] Our model, as set out in equation 1, only allows there to be an effect of raising the state pension age on labour supply at age 60 or above. It is possible that some women reacted to the increase in their state pension age (and resulting loss of state pension wealth) by working longer into their fifties, but still retiring before reaching age 60. Any change like this would be subsumed into the cohort fixed effects included in our model. To see whether there is any evidence of women reacting by increasing labour supply in their fifties, we have calculated the change in average retirement ages between age 55 and 59 for each cohort compared to the 1949 cohort. The results of this exercise are presented in Appendix B. In summary, we find no evidence that increasing the state pension age lead to delayed retirement (and therefore increased labour supply) between the ages of 55 and 59.

To test whether the inclusion of multiple waves of data has an impact on our results and whether our clustering is appropriate, we compare specifications estimated by OLS. Specification 2 is the OLS counterpart to specification 6; this shows a 7.5 percentage point effect of being under the state pension age. Using only one wave of data (specification 3) to test the importance of including non-independent observations on the same individuals, the estimated impact is slightly smaller, at 7.4 percentage points, than when using all waves, but we estimate the impact with less precision owing to the considerably smaller sample size (although the estimated impact is still statistically significant at the 5% level). Our preferred approach is, therefore, to include all waves of data, but cluster at the individual level.

A further worry may be that there are shocks at the cohort–time level. If the correlation in employment shocks between people from the same cohort at the same time is positive, this would tend to bias standard errors downwards: in other words, we would be too likely to conclude that raising the state pension age affected employment even if it did not (see, for example, Moulton, 1990; Donald and Lang, 2007). We may also worry that there is serial correlation in employment shocks, at the individual and/or cohort level. Ignoring such serial correlation has been shown seriously to bias standard errors (Bertrand, Duflo and Mullainathan, 2004; Cameron, Gelbach and Miller, 2008). To test the implications of these concerns, we first, in specification 4, account for clustering at the cohort (defined here as month and year of birth) level using cluster-robust standard errors (Liang and Zeger, 1986). This makes little difference to the standard error. However, these standard errors are only consistent as the number of clusters goes to infinity, and we have only 48 clusters. Therefore, in specification 5, we implement a wild-cluster bootstrap-t procedure, as suggested by Cameron et al. (2008), to account both for any cohort–time-level shocks and serial correlation in individual and/or cohort–time shocks.[22] The p-value calculated rises by only 0.018, such that the impact is still significant at the 5% level. Therefore, serially correlated cohort–time shocks do not seem to present a problem in estimating standard errors in this case.

A further test of the validity of our model is to conduct a placebo test – that is, to test whether there is an effect when we would not expect to see one. One way to do this is to imagine that the reform was introduced in 2008 instead of 2010 and look for the impact of being below, rather than above, a 'pseudo SPA' for these earlier cohorts. We would expect to see no effect of this pseudo SPA and specification 7 shows that there is, indeed, no impact. The size of the marginal

[22] Cameron et al. (2008) show that a wild-cluster bootstrap-t procedure can be used to obtain hypothesis tests of the right size even with few clusters.

effect is small and of the opposite sign to that found for our main specifications, and is not statistically different from zero.

Although our preferred specification is the probit model (specification 6), the small difference between the estimated impact using OLS and a probit model implies that we can use linear probability models to test whether the effect is the same across all subgroups, which we do to examine whether any particular groups respond more strongly to reaching the state pension age. Table 4.2 presents marginal effects of being under the state pension age, estimated separately for different subgroups using OLS. Although there is substantial variation in the point estimates, there are no significant differences in the estimates between subgroups. Single women, if anything, respond more strongly than those in couples. This might be expected given that the latter potentially have an additional margin (their partner's labour supply) on which they can adjust to the loss of state pension wealth. This is explored in more detail in Section 4c.

Table 4.2 Effect of increasing the state pension age from 60 to 61 on women's employment for different subgroups

	Effect of being under SPA	*Standard error*	*N*
Full sample	+0.075***	[0.019]	30,297
Single women	+0.126***	[0.034]	8,818
Women with a partner	+0.054**	[0.023]	21,479
– *whose partner is older*	+0.045*	[0.027]	15,955
– *whose partner is younger*	+0.080*	[0.048]	5,524
Rent house	+0.070*	[0.039]	5,853
Own house	+0.078***	[0.022]	24,444
Non-missing sector	+0.070***	[0.022]	24,029
'Public sector'	+0.082***	[0.031]	12,017
'Private sector'	+0.052*	[0.031]	12,012
Degree or other HE	+0.045	[0.037]	8,416
Secondary education	+0.087***	[0.028]	14,756
No qualifications	+0.067*	[0.036]	7,125

Notes: *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level, * at the 10% level. All models are estimated using OLS estimated on women born in 1949–50 to 1952–53 from 2009Q2 to 2012Q2 with standard errors clustered at the individual level.

Women who own their own home have a very similar estimated effect (economically and statistically) to those who rent their home. Home owners are less likely to be credit constrained because they are more likely to have savings or access to credit than renters. This suggests that credit constraints may not play a significant role in determining how women respond to

increasing the state pension age. Those with no educational qualifications might have been expected to respond more strongly to the increase in the state pension age as they are more likely to be eligible for means-tested retirement benefits on reaching the state pension age, but we find no evidence that this group responded more than those with higher levels of qualifications. Finally, even though public sector workers typically face a normal pension age of 60 for their final salary occupational pension, the estimated impact of increasing the state pension age is larger for public sector workers than for private sector workers (who typically are not members of a final salary scheme or, if they are, are more likely to have a normal pension age of 65), although the difference is not statistically significant.

b. Effect of increasing the female state pension age on broader measures of women's economic status

The effect of increasing the state pension age on employment is important in determining how raising the state pension age will affect the public finances by generating additional tax revenues. However, the larger public finance picture and individuals' welfare will also be affected if individuals work full-time rather than part-time or if increasing the state pension age increases the number of individuals claiming unemployment or disability benefits. Therefore, we have also examined how increasing the state pension age affects the propensity to work full- or part-time or to engage in other economic activities. Figure 2.1 showed that, prior to the reform, at age 60 there was a drop in both full- and part-time employment and the increase in self-defined retirement was larger than the fall in employment.

We first use a multinomial probit model to estimate the impact of being above the state pension age on whether a woman is in full-time work, in part-time work or not in paid employment. These results are presented in the top panel of Table 4.3. While both full-time and part-time employment is found to have increased as a result of increasing the state pension age, the impact on full-time employment is slightly larger (at +4.3 percentage points) than the impact on part-time employment (+3.0 percentage points). This model implies that, of the 27,000 extra women in work due to this reform, 16,000 will be in full-time work and 11,000 in part-time work.

Table 4.3 Effect of increasing the state pension age from 60 to 61 on women's economic status

	Effect of being under SPA	*Standard error*
Multinomial probit model		
Full-time work	+0.043**	[0.017]
Part-time work	+0.030*	[0.017]
Out of work	–0.073***	[0.019]
Multinomial probit model		
In work	+0.060***	[0.019]
Retired	–0.096***	[0.017]
Sick or disabled	+0.013	[0.012]
Unemployed	+0.013***	[0.004]
Other	+0.010	[0.011]

Notes: *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level, * at the 10% level. There are 30,297 observations in both models. Standard errors are clustered at the individual level and estimated by bootstrapping with 1,000 replications. Estimates were successfully produced on all replications for the multinomial probit with three outcomes and on 990 of these replications for the multinomial probit with five outcomes .

We also use a multinomial probit model to estimate simultaneously the impact of increasing the state pension age on the prevalence of five different economic states. As the bottom panel of Table 4.3 shows, the estimated impact on being 'retired' (–9.6 percentage points) is larger in absolute terms than the impact on being in paid work (+6.0 percentage points). This model also suggests that there was a significant increase in the proportion of women reporting being unemployed when the state pension age was increased (+1.3 percentage points).[23] These estimates imply that a one-year increase in the state pension age led to an additional 22,000 women in work, 5,000 more women unemployed and 36,000 fewer women reporting themselves to be retired.[24] The increase in prevalence of unemployment when the state pension age is increased could arise because individuals continue actively seeking work until they reach state pension age, when they qualify for non-employment income sources (such as state and private pensions), which do not have the same job search requirements as working-age out-of-work benefits.[25]

[23] Using labour force participation as the outcome variable in a probit model, we estimate that being under the SPA increases labour force participation by 8.2 percentage points, significant at below the 1% level.

[24] The increase in employment derived from this specification is different from that quoted above because of the different methodology used to estimate the answer.

[25] By February 2012, (the last month for which the Department for Work and Pensions release data on number of benefit recipients before the state pension age reaches 61) 1.1% of 60 years old who were under the SPA were on jobseeker's allowance. This figure is consistent with our estimate of a 1.3ppt increase in the proportion of women who are unemployed due to the increase in the state pension age. 13.2% of the same group were claiming disability benefits (incapacity benefit or employment support allowance). Offsetting this to a large extent, there will have been a reduction in the numbers able to claim pension credit. However, published administrative data sources do not allow us to observe this.

c. Effect of increasing the female state pension age on the economic status of men

It is also possible to estimate the effect of changing the female state pension age on (male) partner's employment. It is unlikely that there is an impact of this change on partners who are particularly young (because they are likely to work, whether or not their partner is over the state pension age) or particularly old (because they are likely to be retired whatever the age of their partner). We therefore restrict our attention to men aged 55 to 69. Results from estimating probit models of husband's behaviour are presented in Table 4.4. Full results for a specification estimated using OLS are reported in Table A.3 in the appendix.

The impact on men's employment of increasing the female state pension age is estimated to be between 4.2 and 4.5 percentage points, depending on whether a probit or multinomial probit is used; this effect is consistently significant at the 5% level.[26] Our preferred model, the probit, gives an estimated impact of 4.2 percentage points, which is consistent with a one-year increase in the female state pension age from 60 to 61 leading to 8,300 more men in paid work. The results suggest that this is mainly due to an increase in the number of men in full-time work, rather than an increase in part-time work. There are no statistically significant impacts on any other reported economic statuses of men.

Table 4.4 Effect of increasing partner's state pension age on men's economic status

	Effect of partner being under SPA	*Standard error*
Probit model		
In work	+0.042**	[0.022]
Multinomial probit model		
Full-time work	+0.037*	[0.022]
Part-time work	+0.008	[0.015]
Not in work	–0.045**	[0.022]
Multinomial probit model		
In work	+0.044**	[0.021]
Retired	–0.026	[0.017]
Sick or disabled	–0.024	[0.014]
Unemployed	+0.003	[0.007]
Other	+0.004	[0.006]

Notes: *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level, * at the 10% level. There are 18,774 observations in all models. Estimation run on men aged 55–69 who have partners born in 1949–50 to 1952–53 and are observed 2009Q2 to 2012Q2. Standard errors are clustered at the individual level and estimated by bootstrapping with 1,000 replications. Estimates were successfully produced on all replications of the probit and multinomial probit with three outcomes and on 911 replications for the multinomial probit with five outcomes.

[26] The point estimate is also robust to using just the first wave of data on each individual (although significance is reduced due to the lower sample size), and no evidence is found of any impact on male partners' employment rates of a pseudo female state pension age reform introduced two years earlier in 2008.

As mentioned above, there are two possible reasons that husbands may have changed their employment behaviour in response to the increase in the female SPA. First, there may be complementarities of leisure within couples. Second, couples might choose to adjust the husband's employment to compensate for the policy change rather than the wife working more. The results presented in Table 4.4 are consistent with both of these explanations. To unpick which of these alternative explanations is most important, we estimate a multinomial model of the joint work behaviour of couples. The dependent variable can take four possible values: both members of a couple in paid work, only husband works, only wife works, neither works. Summary results from estimating this model are presented in Table 4.5. (The sample and the other covariates included in the regression are the same as used in the models reported in Table 4.4.)

The right-hand column of Table 4.5 shows the prevalence of different joint working behaviours among couples (prior to the reform) in which the wife was aged 59 (and the husband was aged between 55 and 69). This shows that 24% of such couples had no one in work, 14% had just the wife working, 20% had just the husband working, and 42% had both partners working.

Complementarities of leisure within couples would suggest we should see an increase in the number of two-earner couples and a corresponding decrease in the number of couples where neither partner is in paid work in response to the reform. The alternative explanation instead suggests that we would expect to see a decrease in the number of couples where the husband does not work and an increase in both the number of couples where both partners work and the number of couples where just the husband works.

Table 4.5 Effect of increasing wife's state pension age on employment of couples

	Effect of wife being under SPA	*Standard error*	*Prevalence when wife aged 59 (average 2003–2009)*
Multinomial probit model			
No one in work	–0.047**	[0.021]	0.24
Wife only in work	+0.003	[0.017]	0.14
Husband only in work	–0.010	[0.020]	0.20
Both in work	+0.054**	[0.025]	0.42

Notes: *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level, * at the 10% level. Sample size = 18,766. Estimation run on couples in which the man was aged 55–69 and in which the woman was born in 1949–50 to 1952–53 and are observed 2009Q2 to 2012Q2. Standard errors are clustered at the couple level and estimated by bootstrapping with 1,000 replications. Estimates were successfully produced on 989 replications of the multinomial probit.

The coefficient estimates in Table 4.5 suggest that increasing the female SPA reduced the number of couples in which neither partner was in paid work and increased the number in which both were working, while having no significant effect on the fraction of couples with just the wife or just the husband working. (If anything, the fraction of couples in which just the husband worked declined in

response to the reform.) These results suggest that complementarities of leisure within couples are important.

d. Effect of increasing the state pension age on the public finances

Our estimates of the labour supply effect of increasing the female state pension age can be used to inform a costing of how much an increase in the female state pension age might strengthen the public finances. In this subsection, we compare a simple costing of a one-year increase in the female state pension age from 60 to 61 based on no change in labour market behaviour and a costing that incorporates the increased numbers in paid work implied by the estimates earlier in this section.

On average, those women receiving the state pension aged between 60 and 64 receive just over £100 a week in state pension income. Given there are about 370,000 women aged 60,[27] removing this amount of state pension from them would save the exchequer £2.0 billion a year. Taking into account a reduction in income tax revenues from this state pension, reduced spending on means-tested retirement benefits, increased spending on working-age benefits (JSA and ESA), an increase in payroll taxes from those women aged 60 in paid work, and a fall in indirect taxes from the fall in net household incomes, the overall estimated strengthening in the public finances falls slightly to £1.9 billion a year.[28]

However, this figure does not allow for any additional tax revenue from individuals increasing their employment and earnings in response to the increase in the state pension age. Controlling for age, cohort, time and background variables in the same functional form as in Section 3, we use OLS to estimate the impact of increasing the female state pension age on the weekly earnings of 60-year-old women (those not in paid work are included, having earnings of zero) and find that increasing the state pension age increases the earnings of 60-year-old women by an average of £22.36 a week and that of their partners by an average of £24.02 a week. Under the assumption that this comes entirely from those entering (or staying in) the labour market as a result of the higher state pension age, this equates to average earnings of these women being £306 a week and average earnings of their partners being £571 a week. Our calculations based on these estimates suggest that the increase in earnings of women and their partners arising from a one-year increase in the female state pension age from 60 to 61 would increase receipts

[27] See Office for National Statistics, 2010 mid-year population estimates, http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-231847.

[28] These figures are all based on calculations using the Department for Work and Pensions tabulation tool (http://research.dwp.gov.uk/asd/index.php?page=**tabtool**). The increases in JSA and ESA spending (of £36 million and £12 million) are taken directly from information on the amounts now received by women aged 60. We assume that workers only have a high enough income to pay income tax on their state pension if they have other income from employment. NICs revenues estimated using the LFS. Indirect taxes assumed to fall by 10% of the fall in net incomes.

of income tax, National Insurance contributions and indirect taxes by £190 million a year. This is 10% of the saving calculated above that does not allow for any behavioural response and brings the total strengthening in the public finances from this policy up to an estimated £2.1 billion a year (or 0.14% of national income). This is comparable to the saving that DWP estimated would be generated by a one-year increase in state pension ages for both men and women (from 65 to 66 in the mid-2020s) in the 2006 Pensions White Paper; at that time, it estimated this reform would save 0.3% of national income in 2030.[29]

5. Conclusion

Many countries have legislated to increase early or normal pension claiming ages over the last few decades, partly but not exclusively motivated by a desire to reduce the future cost of public pension promises. Ex ante simulation estimates of the impact of such reforms suggested quite large equilibrium effects in many countries (Fields and Mitchell, 1984; Gustman and Steinmeier, 1985; Rust and Phelan, 1997; Coile and Gruber, 2000). But ex post evaluations of reforms that have now been conducted suggest, in many cases, even larger (short-term) responses (for example, Börsch-Supan and Schnabel, 1999; Mastrobuoni, 2009; Coppola and Wilke, 2010).

In 1995, the UK government legislated to increase the earliest age at which women could claim a state pension from 60 to 65 between April 2010 and March 2020. This paper is the first to examine (ex post) the impact of this policy on women's economic activity at older ages and that of their partners, using data covering the period up to June 2012. Our results, which allow for a flexible specification of cohort effects, suggest that employment rates did increase significantly as a result of the change in state pension age – by 7.3 percentage points using our preferred specification. We find statistically significant rises in both full-time and part-time female employment as a result of the reform.

In addition to the impact on employment rates, we find the policy has also led to a 1.3 percentage point increase in the fraction of women who are unemployed and actively seeking work at age 60. These increases in employment and unemployment are offset by a reduction in the proportion reporting themselves to be retired. No significant differences were found in other economic activities (sick/disabled and looking after home/other).

We also find a significant effect of the policy on employment rates of affected women's partners, with men's employment rates being found to increase by 4.2 percentage points as a result of their female partners' state pension age increasing. This suggests that the policy of increasing

[29] Source: Figure 9 of Department for Work and Pensions (2006).

the female state pension age has had a knock-on effect on men's employment rates. In principle this could reflect either complementarities in leisure or the fact that couples who make joint financial decisions decide to cushion the impact of the woman's higher state pension age through a combination of both the man and the woman working for longer, rather than adjusting solely on the female labour supply margin. Evidence from looking at the employment of both members of the couple suggests that the increase in the female state pension age has led to an increase in two-earner couples, a decrease in the fraction of couples where neither is in paid work and no significant change in the fraction of couples where only the husband or only the wife is in paid work. We interpret this as evidence of complementarities of leisure within couples, rather than couples using alternative margins (male and female labour supply) to respond to the policy change.

The effect on employment rates of women is not significantly different between a variety of subgroups – home owners and renters, singles and couples, public and private sector employees, those with older and younger partners, higher- and lower-educated groups. That the effect is not significantly larger for renters than for owners suggests that credit constraints may not be a significant factor in explaining why there was such a large increase in employment rates when the state pension age was increased. The lack of a larger response among those with lower levels of education also suggests that the greater incentive to remain in work provided to those eligible for means-tested retirement benefits when the state pension age is increased is not a driving factor behind the increases in employment rates.

Overall, we find a large impact of the increase in the state pension age on female labour market behaviour despite the UK system having no earnings test for receipt of state pension income. This, combined with the lack of any evidence suggesting the response is coming from those more likely to be credit constrained or those more likely to be eligible for means-tested benefits, suggests that the impact of the increase in the female state pension age on labour market behaviour is coming from a combination of two possible routes: first, a 'shock', with many women failing to adjust to the increase in the female state pension age until they reach age 60; and, second, a 'signal', with the state pension age indicating when labour market exit might be appropriate.

There is mixed evidence from previous work about the importance of social norms around retirement ages. Lumsdaine, Stock and Wise (1996) found that there are excess peaks in retirement in the United States at age 65 (the Social Security Normal Retirement Age at the time), over and above those explained by the financial incentives generated by Social Security and Medicare, implying that there is a 'social norm' to retire at 65. Conversely, others have found no evidence to support the existence of such social norms – for example, Asch, Haider and

Zissimopoulos (2005), who examined the retirement behaviour of civil service employees in the US, who face different financial incentives to retire from the majority of the population who are covered by Social Security.

We find strong effects of the pension age reform on older women's labour market behaviour. However, we cannot here test between the two main competing hypotheses that could explain this (wealth shocks and social norms), nor can we categorically rule out other explanations, such as the importance of credit constraints. However, the English Longitudinal Study of Ageing (ELSA) is likely to offer valuable evidence on this in the future, when further waves of data have been collected. It should then be possible to examine these alternative hypotheses in more detail. Since ELSA asked respondents as long ago as 2006 what they thought their state pension age was, we will ultimately be able to examine whether behavioural responses are different among those who knew about the policy reform in advance and those who did not. We will also be able to distinguish more precisely between groups who are more or less likely to be credit constrained or to have faced larger or smaller wealth shocks by making use of the detailed information on wealth holdings (including state pension entitlements) available from ELSA. We could also test whether the effects vary across other characteristics of interest – such as health – that are observed in ELSA but not in the LFS. We will pursue this in future work.

Taken together, these results suggest that the increase in the female state pension age will have strengthened the UK's public finances not only by reducing payments to pensioners but also by increasing tax revenues from earned income among older women and their partners. Our estimates suggest that a one-year increase in the female state pension age from 60 to 61 led to 27,000 more women, and 8,300 more men, being in paid work. The overall saving to the exchequer (both from changes in spending and changes in tax revenues) from this one-year increase in the female state pension age is estimated to be £2.1 billion a year after taking the resulting increase in earnings into account. This is 10% higher than an estimate that does not take into account any change in labour market behaviour.

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Appendix A

Table A.1 Number of women observed above and below state pension age

Birth cohort	*Age in years and quarters*															
	58 Q1	58 Q2	58 Q3	58 Q4	59 Q1	59 Q2	59 Q3	59 Q4	60 Q1	60 Q2	60 Q3	60 Q4	61 Q1	61 Q2	61 Q3	61 Q4
1949Q2								73	165	159	158	155	168	166	164	137
1949Q3							73	154	149	139	134	155	137	128	125	147
1949Q4						76	153	157	172	157	162	150	144	141	134	161
1950Q1					92	171	186	174	159	169	154	151	129	138	129	147
1950Q2				80	181	179	175	178	171	169	158	155	146	163	151	135
1950Q3			75	173	170	159	148	142	121	128	119	138	147	163	146	84
1950Q4		60	154	152	149	137	134	120	120	115	131	140	157	134	78	
1951Q1	72	145	137	137	139	138	121	123	123	126	150	152	154	76		
1951Q2	161	167	189	184	177	157	155	132	133	138	149	148	75			
1951Q3	139	129	133	131	121	125	110	112	128	144	141	82				
1951Q4	136	142	150	129	117	125	130	134	137	127	57					
1952Q1	158	153	137	151	129	122	142	150	145	82						
1952Q2	149	138	144	134	136	142	170	141	84							
1952Q3	141	130	114	126	137	142	126	63								
1952Q4	149	141	126	130	132	133	69									
1953Q1	117	132	129	144	132	84										

Notes: Dark shaded cells indicate women who are all over their state pension age. Light shaded cells indicate combinations of age and cohort where some women are above and some women are below the state pension age. Empty cells exist because cohorts are not observed at all ages in the period 2009Q2 to 2012Q2 which we use in our estimation. Number of women refers to number of observations in the LFS without data problems, and which are therefore used in estimation of impact of being aged under the state pension age.

Table A.2 Effect of state pension age on female employment: OLS regression results

	Effect on female employment	*Standard error*
Under SPA	0.075***	[0.019]
Cohabiting	0.063***	[0.024]
Single	–0.065**	[0.030]
Widowed	–0.047*	[0.028]
Divorced/Separated	0.019	[0.025]
Other HE	–0.069***	[0.018]
A level or equivalent	–0.034*	[0.019]
O level or equivalent	–0.065***	[0.017]
Other	–0.094***	[0.019]
No qualifications	–0.245***	[0.018]
Not white	–0.095***	[0.023]
Rents house	–0.172***	[0.013]
Partner's age (years and quarters)	–0.015	[0.013]
Partner's age squared	0.000	[0.000]
Partner's age: 60–64	–0.040**	[0.017]
Partner's age: 65–69	–0.094***	[0.029]
Partner's age: 70+	–0.073	[0.057]
Partner's education: other HE	0.069***	[0.023]
Partner's education: A level	0.070***	[0.018]
Partner's education: O level	0.076***	[0.023]
Partner's education: other	0.091***	[0.022]
Partner's education: no qualifications	0.058***	[0.022]

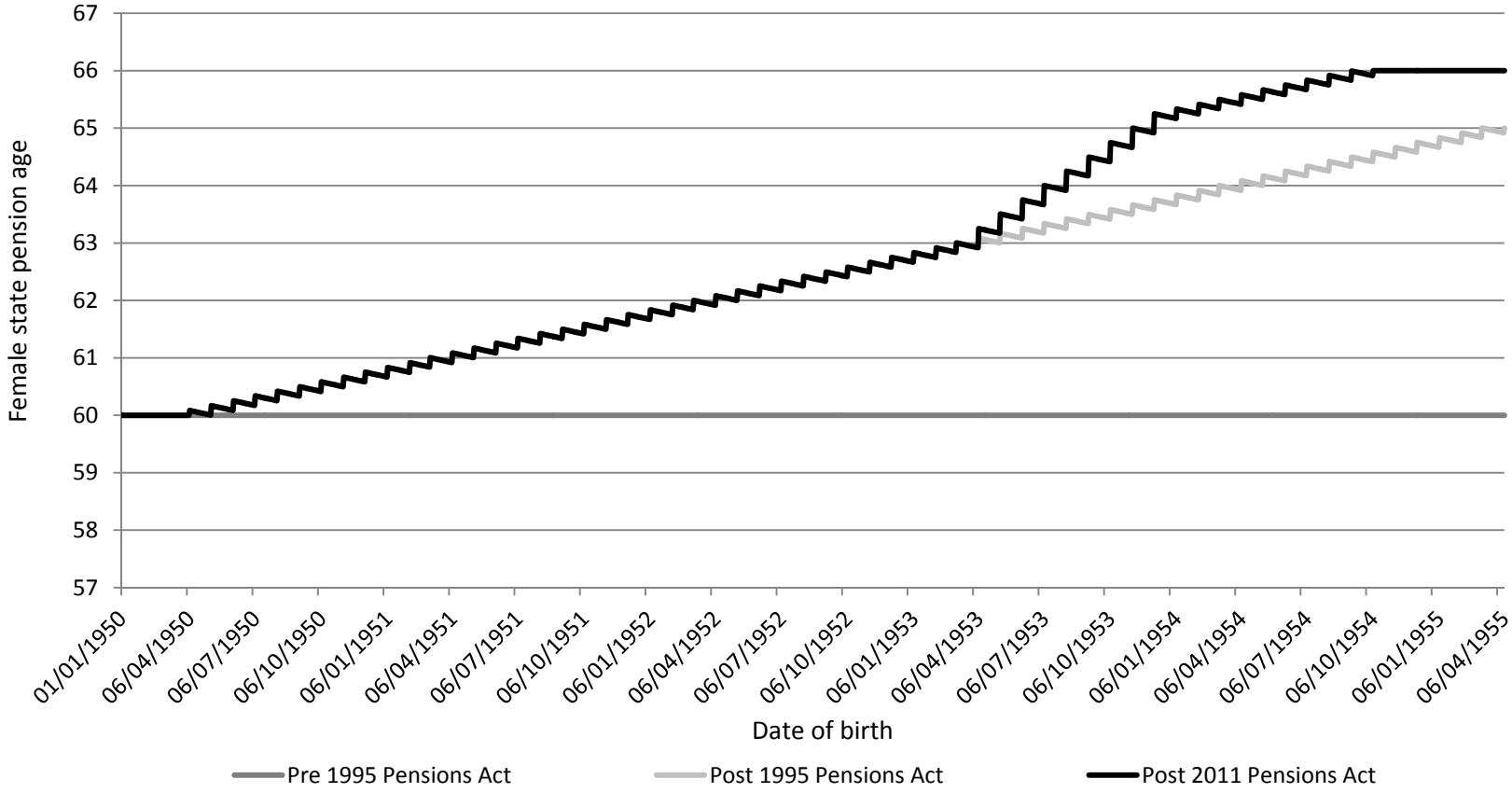
Notes: *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level, * at the 10% level. Estimated by OLS with standard errors clustered at the individual level. This regression model uses women born in 1949–50 to 1952–53 from 2009Q2 to 2012Q2. Nineteen geographical area dummy variables, 12 year and quarter dummy variables, dummies for age in years and quarters, dummies for financial year of birth, and a constant also included in the model. Effects estimated relative to baseline of cohort 1949–50, age 60Q1, married, white, owns house, with a degree, and with a partner with a degree. Number of observations: 30,297.

Table A.3 Effect of female state pension age on male employment: OLS regression results

	Effect on male employment	*Standard error*
Partner under SPA	0.044*	[0.023]
Own age	–0.086	[0.076]
Own age squared	0.000	[0.001]
Is 65 or older	–0.126***	[0.029]
Is over female SPA	–0.016	[0.021]
Cohabiting	0.019	[0.030]
Other HE	–0.017	[0.024]
A level or equivalent	–0.019	[0.019]
O level or equivalent	–0.033	[0.024]
Other	0.031	[0.023]
No qualifications	–0.076***	[0.024]
Not white	–0.117***	[0.034]
Rents house	–0.160***	[0.020]
Partner's education: other HE	–0.001	[0.023]
Partner's education: A level or equivalent	0.040*	[0.024]
Partner's education: O level or equivalent	0.012	[0.022]
Partner's education: other	0.028	[0.024]
Partner's education: no qualifications	–0.011	[0.023]

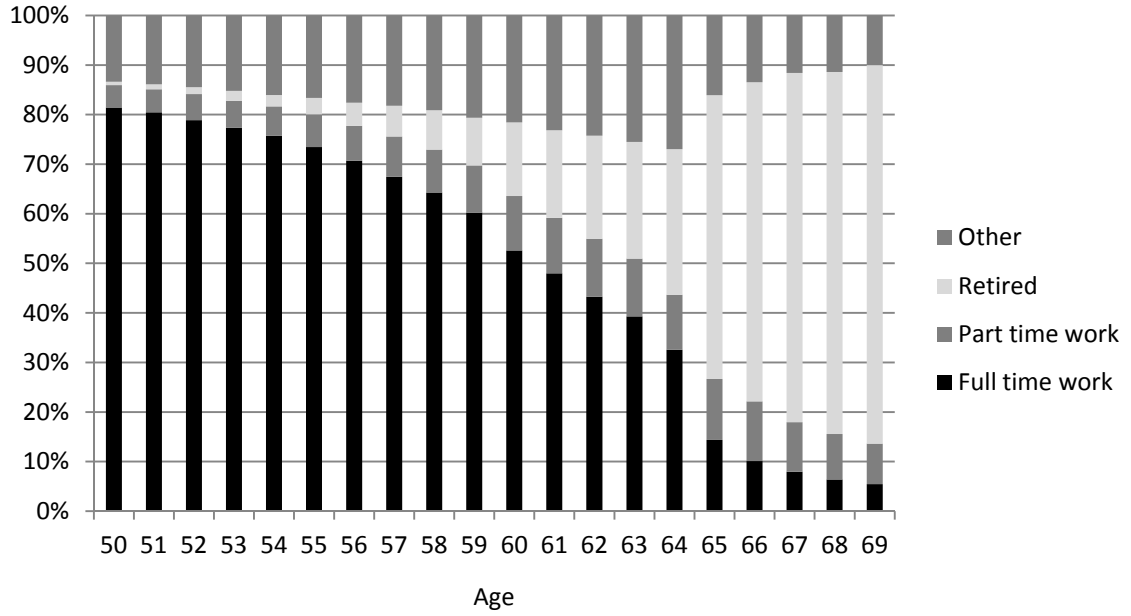
Notes: *** denotes that the effect is significantly different from zero at the 1% level, ** at the 5% level, * at the 10% level. Estimated by OLS with standard errors clustered at the individual level. Regression model using men aged 55–69 with female partners born in 1949–50 to 1952–53 from 2009Q2 to 2012Q2. Nineteen geographical area dummy variables, 12 year and quarter dummy variables, dummies for partner's age in years and quarters, dummies for partner's financial year of birth, and constant also included in the model. Effects estimated relative to baseline of partner's cohort 1949–50, partner's age 60Q1, married, white, owns house, with a degree, and with a partner with a degree. Number of observations: 18,774.

Figure A.1 Female state pension age under different legislation



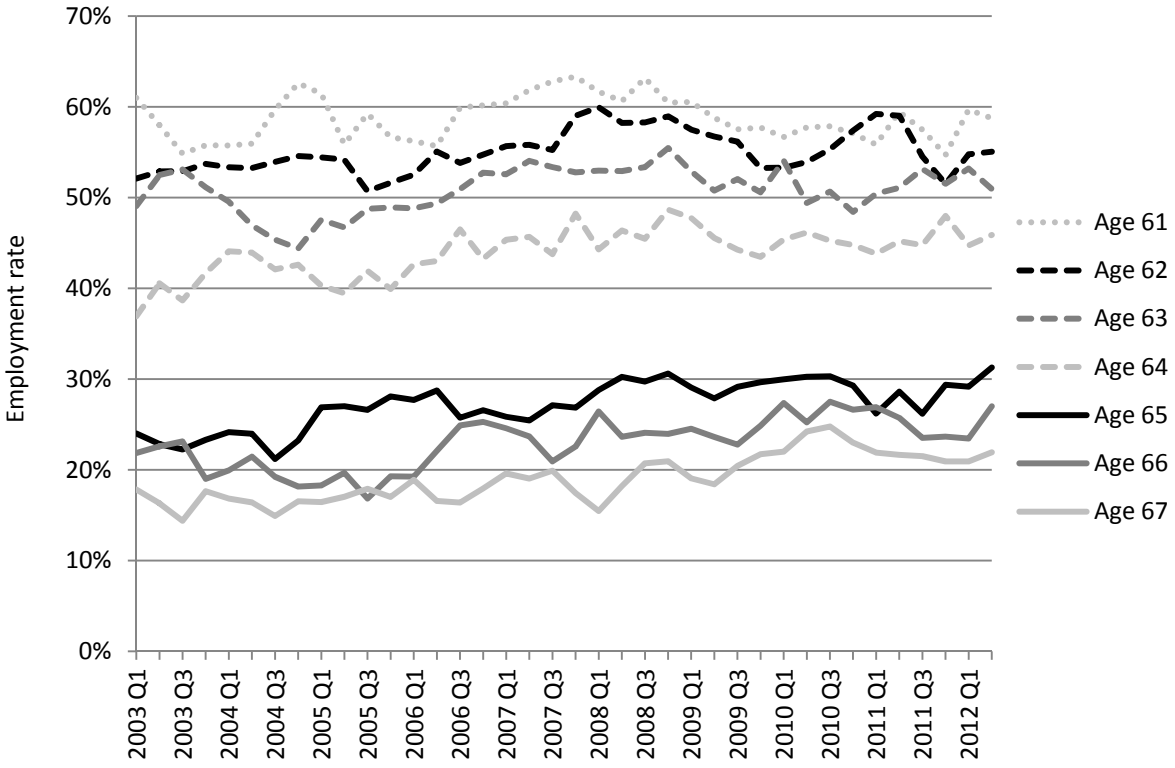
Source: Pensions Act 1995, schedule 4 (http://www.legislation.gov.uk/ukpga/1995/26/schedule/4/enacted); Pensions Act 2007, schedule 3 (http://www.legislation.gov.uk/ukpga/2007/22/schedule/3); Pensions Act 2011, schedule 1 (http://www.legislation.gov.uk/ukpga/2011/19/schedule/1/enacted).

Figure A.2 Economic activity of men prior to female state pension age reform, by age



Notes: Averages over the period 2003Q1 to 2010Q1.
Source: Authors' calculations using the LFS. Based on 372,229 observations.

Figure A.3 Employment rates of older men, 2003–12, by single year of age



Source: Authors' calculations using the LFS, 2003 to 2012. Based on 160,114 observations.

Appendix B: Effect of increasing the state pension age on employment rates before age 60

Raising the state pension age from 60 to 61 could potentially have an impact on women's labour supply and retirement before age 60. Our model, as laid out in equation (1), rules out any labour supply impact of the increase in the state pension age prior to age 60. Any response before age 60 will be subsumed within the cohort fixed effects included in the model and, as a result, the estimates we produce for the impact on employment above the old state pension age are over and above any increase that occurred at earlier ages. However, using a different methodology (that used by Mastrobuoni (2009)), we can estimate whether there has been any change in labour supply at other ages. In particular, we estimate whether there has been any change in employment rates of women between the ages of 55 and 59.[30] We first estimate the average retirement rates for each cohort of women at each age between 55 and 59 using the following equation:

$$y_i = \sum_{a=55Q1}^{59\,Q4} 1(A_i = a)\left\{\alpha_a + \sum_{c \neq 1949\text{–}50} \beta_{a,c} 1(C_i = c)\right\} + \gamma' X_i + \varepsilon_i \qquad (2)$$

Equation (2), which we estimate using OLS, includes a cohort-specific age (in year and quarter) effect $\beta_{a,c}$. The dependent variable is an indicator of not being in work (i.e. retirement). The vector of control variables (X_i) contains an indicator of owning a house, a measure of highest educational qualification, an indicator of being married, regional dummies, and the regional unemployment rate of women aged 45 to 54 in the quarter of observation. The last of these variables is included in order to pick up any potentially confounding macroeconomic trends. We estimate this model for all women born in the financial years 1945–46 to 1952–53.

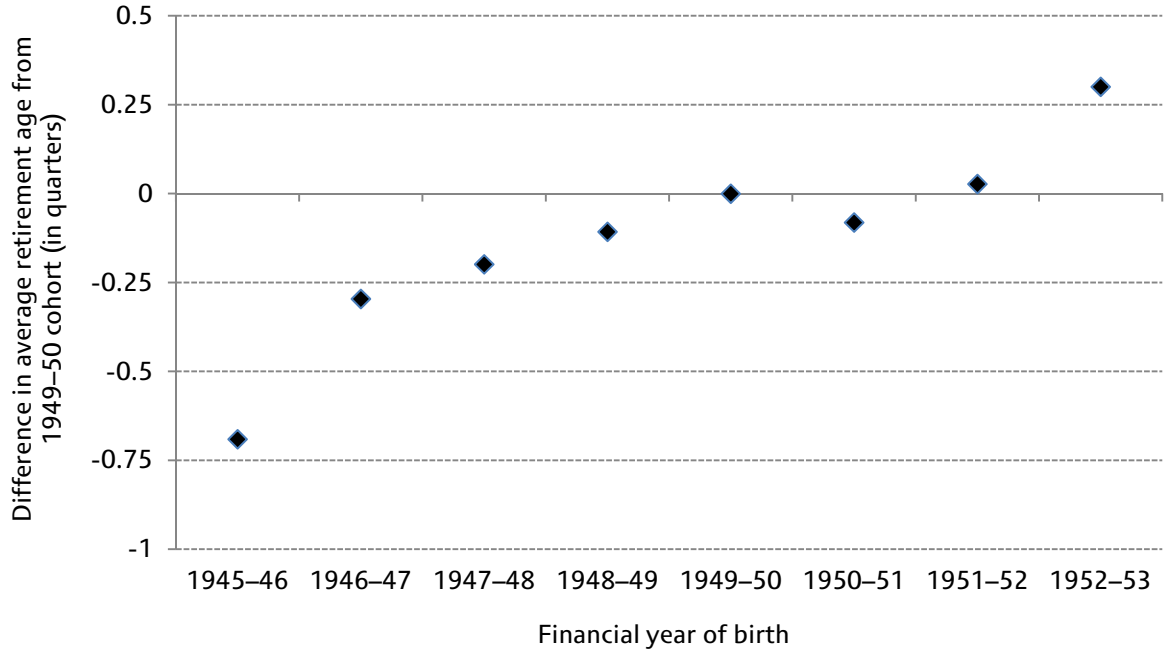
Using the results of this estimation, we can calculate the change in the average retirement age between cohorts, using women born in the 1949–50 financial year (i.e. the latest cohort to have a state pension age of 60) as the comparison group. In other words, $\beta_{a,1949\text{–}50} = 0\ \forall a$. The change in average retirement age (that manifests between ages 55 and 59) can be calculated using the following equation:

$$\begin{aligned} \Delta c &= \textstyle\sum_{a=55Q1}^{59Q4} 1(A_i = a)\{\alpha_a + \beta_{a,c} 1(C_i = c)\} - \sum_{a=55Q1}^{59Q4} 1(A_i = a)\alpha_a \\ &= \beta_{55Q1,c} + \beta_{55Q2,c} + \cdots + \beta_{59Q4,c} \end{aligned} \qquad (3)$$

[30] In principle, this methodology could be extended to examine employment rates after age 60 as well. However, we do not observe many of the cohorts of interest for very long beyond age 60.

The differences that we estimate in the average retirement age between each cohort and the 1949–50 cohort is graphed in Figure B.1.

Figure B.1 Difference in average retirement age between 1949–50 cohort and other cohorts



Notes: The difference in average retirement age shown is calculated based on differences in employment rates between the ages of 55 and 59, it excludes any differences in average retirement ages driven by employment rates before age 55 or after age 59.
Source: Authors' calculations using the Labour Force Survey, various years.

Figure B.1 shows that there is a gradual increase in average retirement ages across cohort – both for those who were affected by the state pension age increase and those who were not. This is not surprising, given that female labour supply at older ages has been increasing in the UK over many decades. If there were an effect of increasing the state pension age on retirement between the ages of 55 and 59, we would expect average retirement ages to increase more sharply across cohorts affected by the reforms than across those who were not, since each cohort born after 1949–50 has an average state pension age which is higher than the previous cohort. Figure B.1 shows no clear evidence of the change in retirement ages getting steeper for cohorts after 1949; indeed, the 1950–51 and 1951–52 cohorts have very similar non-employment rates between ages 55 and 59 to the 1949–50 cohort.