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We study the effect of an increase in the UK state pension age from 65 to 66, a high level internationally, on labour market activity. Despite there being limited financial incentives to retire at the state pension age, we find large effects: the employment rate of 65-year-olds increased by 7.4 percentage points for men and 8.5 percentage points for women due to the reform. The employment response is driven disproportionately by full-time workers and self-employed men, and is larger for those with lower levels of education and those living in the most deprived areas of the country.

JEL codes: Early retirement age; labour supply; policy reform; retirement

Keywords: H55, J21, J26

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I. Introduction

In recent decades, governments across the developed world have legislated – and more recently implemented increases in the ages at which people can start claiming a public pension. These policies are often intended to relieve the pressures that ageing populations have on public finances by reducing payments to pensioners and by delaying the retirement of older workers, thereby generating additional tax revenue. A growing literature has studied these reforms, and typically finds large employment responses to increases in the earliest age that people can claim a state pension – known internationally as the *early retirement age*, and in the UK as the *state pension age* (SPA). However, as these ages continue to increase, it is unclear whether they will continue to have similarly large employment responses. Furthermore, a greater understanding of the heterogeneity of responses is necessary for evaluating the full fiscal and welfare implications of these reforms.

In this paper, we use survey data from the UK to analyse the effect of an increase in the state pension age from 65 to 66 that occurred between 2018 and 2020 on the labour market activity of men and women, and demonstrate how the responses differ for different groups. To do this, we use a difference-in-differences methodology, comparing the employment rates of birth cohorts who face different state pension ages despite being born only a few months apart, while controlling flexibly for age and time effects.

This paper demonstrates that this increase in the state pension age had a large effect on employment for both men and women: we estimate that being under the state pension age increased the probability of a 65-year-old being in employment by 7.4 percentage points for men and 8.5 percentage points for women, and that these findings are robust to a number of specification tests. The response for women is at least as large as the effect on the employment rate of the increase in the state pension age for women from 60 to 62 that took place in the early 2010s in the UK (Cribb, Emmerson and Tetlow, 2016), despite the fact that

a lower share of women are in paid work at these older ages.[1] The estimated effect on the employment rate is not statistically significantly different between men and women, despite differences in employment rates upon reaching the state pension, as well as private pension provision and labour market histories.

We exploit the rich demographic information in our survey data to demonstrate important heterogeneity in the magnitude of the effects, both by type of work, and by individual characteristics. We find that more of the response comes through full time work (which increased by 6 percentage points for men and 5 percentage points for women) than through part-time work (which rose by 1 percentage points for men and 4 percentage points for women). Relative to their relatively low prevalence at age 64, the reform also led to significant increases in the fraction of men who were self-employed at age 65 (+3 percentage points compared to a baseline of 14% of 64 year old men being self-employed pre-reform) and the fraction of women working in public sector at age 65 (+4 percentage points compared to a baseline of 13% of 64 year old women working in the public sector).

We also analyse how the employment effect varies for individuals with different characteristics. We estimate that the increase in the state pension age from 65 to 66 led to an increase in the employment rate of 65-year-olds with higher education by 4 percentage points, while the employment rate of people who left school without GCSEs (or equivalents) increased by more than 12 percentage points (a difference which is statistically significant). This is despite the fact that those with lower levels of education are less likely to be in paid work at age 64 to start with. Furthermore, we find a (statistically significantly) larger employment response in the most deprived quintile of local areas of England (10 percentage

[1] The importance of the pre-reform employment rate for explaining differences in estimated employment effects of SPA increases across settings has been raised by Atav et al. (2021).

points for men and 13 percentage points for women) than in local areas in the least deprived quintile (5 percentage points for men and 4 percentage points for women).

Our paper contributes to a recent literature examining ex-post how changes in the minimum age at which individuals can claim a state pension affects retirement behaviour. Large employment responses have been found in a variety of different countries, including Australia (Atalay and Barrett 2015; Morris 2021); Austria (Staubli and Zweimüller, 2013; Manoli and Weber, 2016), Germany (Geyer et al., 2020; Seibold, 2021), France (Rabaté and Rochut, 2019), and Norway (Johnson et al., 2021). However, most studies up to now have focused on increases in state pension ages at younger ages than the increase from age 65 to 66 that we examine. OECD (2021) finds that only Iceland and Norway have Normal Pension Ages above 66 (and many in Norway are eligible for early retirement) but that many countries have legislated increases in pension claiming ages to 66 and above in the near future, and so our evidence will be particularly relevant for these countries and any others considering such a change.

There are reasons to believe that the employment effects of increases in the SPA could be dampened at older ages, as fewer people are in paid work by the time they reach 65, and people's health and capacity to work decline on average as they age. Despite this, we find a comparable percentage-point increase in the employment rate due to the SPA increase from 65 to 66 as found for women responding to a slightly earlier increase in the SPA from younger ages.

The rest of this paper proceeds as follows. Section II describes the institutional setting and the policy reforms we exploit, while Section II introduces the data used for our analysis. Section IV describes our empirical strategy and presents some graphical evidence on the effect of the increase in the state pension age. Section V contains our results and Section VI concludes.

II. Institutional background

The state pension age is the earliest age at which a state pension can be claimed in the UK. In 1948, this was set at 60 for women and 65 for men (having previously been 65 for both women and men), and this remained unchanged until April 2010. The UK now has a flat-rate state pension system, meaning that, conditional on 35 years of contributions being made (either through paying National Insurance contributions, years of caring for young children or claiming unemployment or incapacity benefits), each individual received a state pension of £175.20 (in 2020–21, the year the state pension age reached 66). Some people will receive different amounts to this. People with fewer than 35 years of contributions receive a pro-rata reduction in their state pension based on number of years contributed, as long as they have made at least 10 years of contributions. On the other hand, people who had accrued significant amounts in their earnings-related state pension prior to 2016 can potentially receive a higher state pension than this.

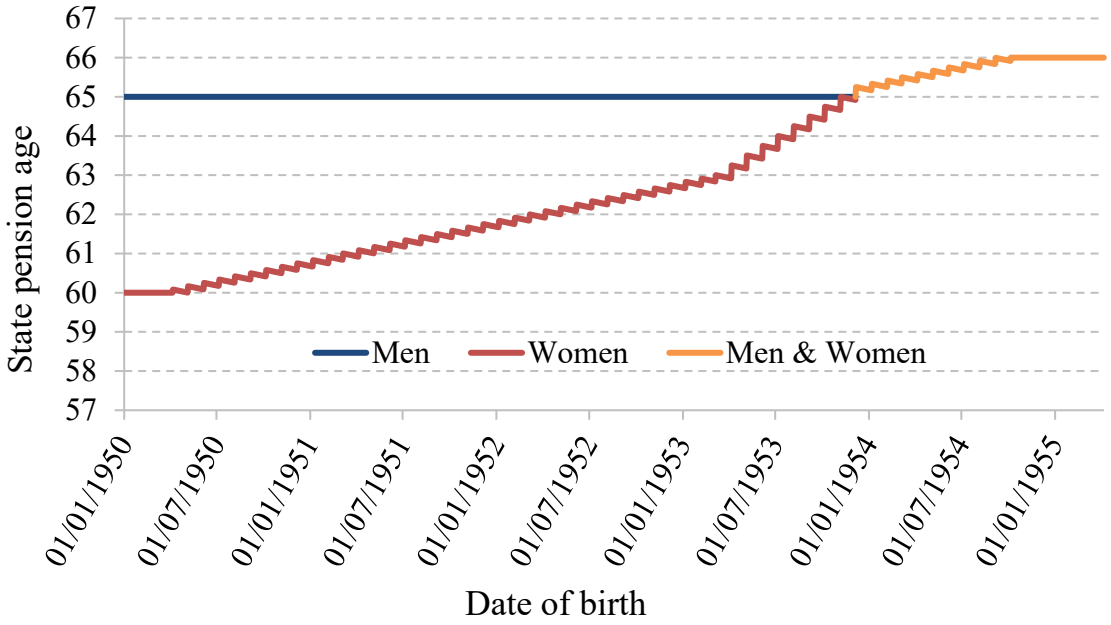
The flat-rate state pension is equivalent to around 30% of median weekly earnings and therefore provides a relatively low replacement rate for most people. This means the total loss from a one-year increase in the SPA is just over £9,000 for someone who qualifies for the full state pension. There is no earnings test on the state pension, but it is subject to income tax. Receipt of the state pension can be deferred – in return for an increased entitlement – but the vast majority choose to receive the state pension as soon as they are eligible.[2]

Increases in the UK's female SPA were first legislated in the 1995 Pensions Act. This legislated an increase in the SPA for women from 60 to 65 between 2010 and 2020. The 2011 Pensions Act accelerated this increase for the increase from age 63 to 65, so that the SPA for women reached 65 in early December 2018. This Act also legislated to bring forwards a

[2] Crawford and Tetlow (2010) find that only 5% of those aged between state pension age and 75 in 2008/09 deferred receipt of their state pension.

further increase in the SPA, for both men and women, from 65 to 66 so that it now occurred between 6th December 2018 and 6th October 2020 (this increase had previously been legislated to occur between 2024 and 2026). This increase from age 65 to age 66 is the reform we analyse in this paper.

Figure 1 UK state pension age for men and women by date of birth



Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/310231/spa-timetable.pdf

Notes: the reason that the SPA increases in a "sawtooth" pattern, rather than a smooth line or a "step" pattern, is that women born in a given month are allocated a single "state pension date" at which they are eligible for a state pension. Therefore, those born later in the month can have a slightly lower SPA than those born earlier in the month.

Figure 1 shows the state pension age by date of birth for men and women born in the early 1950s. The structure of the increase means people born only a month or so apart will have different state pension ages, and that these increases happened gradually, rather than as a step change. Specifically, the increase from 65 to 66 was implemented by increasing the date someone can claim their state pension by two months every month (except in the first month, where it increased by four months). This means that everyone born between the 6th of one month and the 5th of the next month reaches their state pension age on exactly the same date (but obviously at very slightly different ages, explaining the "sawtooth" pattern in Figure 1). The increase in the state pension age has not led to increases in the ages at which funds can

be withdrawn from a defined contribution pension scheme (which remained at age 55 throughout this period), nor, for these birth cohorts, has it led to increases in Normal Pension Ages for public or private sector defined benefit occupational pension schemes.

In the UK, the tax and benefit system also changes when an individual reaches the state pension age, which potentially influences financial incentives to remain in paid work. But – in sharp contrast to many countries where there is an earnings test on state pension income – in the UK there are not large financial incentives to leave paid work at the state pension age. First, employees are no longer liable for employee National Insurance contributions (a payroll tax); this *increases* the financial incentive for some people to be in paid employment past state pension age.

Second, the generosity of the benefit system changes at the state pension age. Working age individuals on low incomes can quality for means-tested support, "universal credit", the presence of which can reduce their incentive to be in paid work. This is in contrast to the state pension which is not means-tested. Universal credit is generally less much generous than the state pension; for example a single homeowner in good health who lived alone in April 2020 who was just under the state pension age could qualify for universal credit of £74 a week, whereas an otherwise equivalent individual aged over the state pension age could receive a full new state pension of £175 per week. The means tested nature of the working-age support means that marginal financial incentives to work or earn more are actually likely to be stronger rather than weaker once the state pension age has been reached.

On the other hand, those receiving universal credit will have to comply with work search requirements and are subject to conditionality rules, whereas those receiving a state pension do not face such requirements. The cessation of these work search requirements at state pension age is likely to reduce the incentive to find work above state pension age.

III. Data

We combine information from two datasets for our analysis: the Labour Force Survey (LFS) and the Annual Population Survey (APS). The LFS is a household survey, representative of the whole population and conducted on a quarterly basis, designed to capture information on people's labour market activities. All individuals in a household are interviewed for up to five consecutive quarters ('waves') and with one-fifth of households being replaced in each wave. The APS contains data from two waves of the LFS, supplemented with Local Labour Force Survey (LLFS) data obtained using essentially the same questionnaire and interview methodology. Households in the LLFS survey are interviewed annually for four years, with roughly an equal number interviewed each quarter. We therefore add the Local Labour Force Survey data (contained in the APS) to our LFS data, boosting the sample size for our analysis, but drop duplication observations to ensure that none are double counted.

The surveys contain information on individual labour market activities combined with background information such as sex, age, marital status, education, self-reported health, and broad housing tenure. Crucially for our study, the data contain day, month and year of birth, allowing us to measure whether an individual is above or below the state pension age on their interview date (which is also observed), and relatively large numbers of individuals from each birth cohort are observed at each age. For example, over 1,300 individuals aged 65 are observed in each quarter of the data that we use in our analysis (which runs from 2017Q4 to 2021Q2).

Since the LFS data are used to produce internationally comparable employment and unemployment statistics, we use the International Labour Organization (ILO) definitions of economic activity. 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

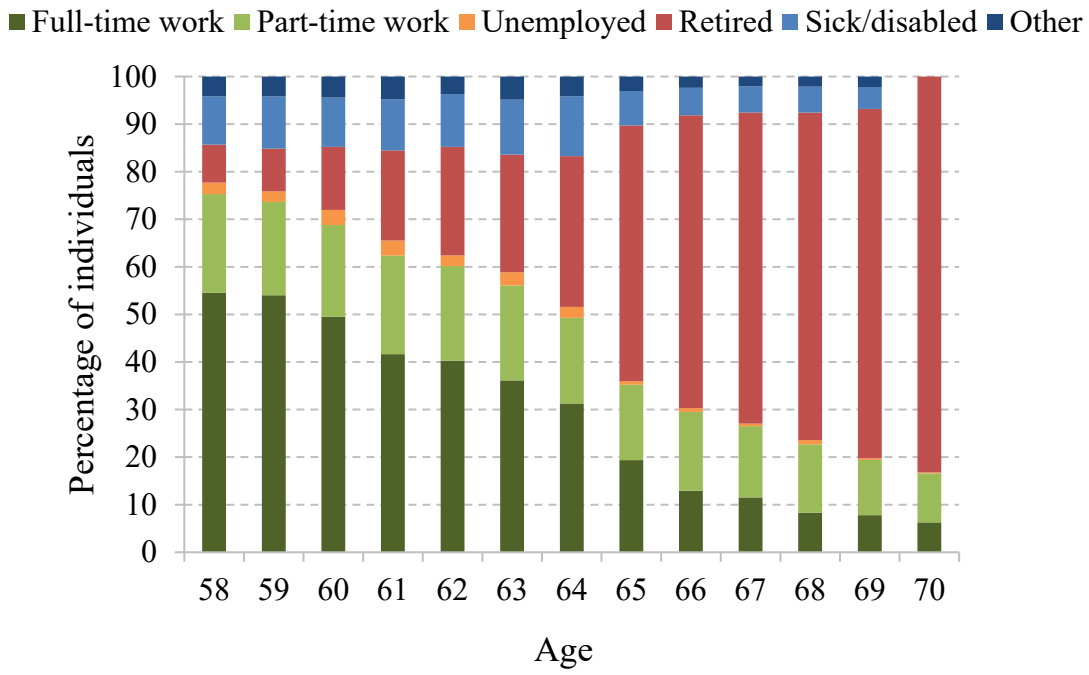
are temporarily away from paid work (for example due to illness or a holiday or – as we describe below – on furlough) or if they are on a government training scheme (although this last category is rare for older people). Individuals are considered as being in full-time work if they work 30 or more hours in a usual week. If individuals are not in paid 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), or "economically inactive". Of those who are economically inactive, they can give a number of reasons why they are not in (or actively seeking) paid work. These reasons are being 'retired', 'sick or disabled', or a residual category that includes looking after the family (these are all self-defined).

The data we use cover – in part – the Covid-19 pandemic in which many people have been unable to undertake their normal activity due to lockdowns or compulsory social distancing. In response to the pandemic, the UK government rapidly created a furlough scheme, by which the government would pay 80% of pre-pandemic salaries up to a cap of £2,500 per month for those employees that private sector employers chose to furlough. At its peak in Spring 2020, 8.9 million people (30% of employees) were furloughed (see Cribb and Salisbury 2021 for more details). However, as these people are counted as being temporarily away from their work, they are still counted as "employed" in our data. In later sections we show that our results are robust to considering instead these people as out of work.

The pattern of economic activity of older men and women by age is shown in Figures 2 and 3, respectively. This uses data between 2017Q4 and 2018Q3 (i.e. the year before the state pension age increased above 65 for men and women). The percentage of men and women in paid work (either full-time or part-time) declines with age. For men, there is a 14 percentage point drop in employment and a 22 percentage point increase in the share reporting themselves as retired between age 64 and age 65. Both of these changes are bigger than any

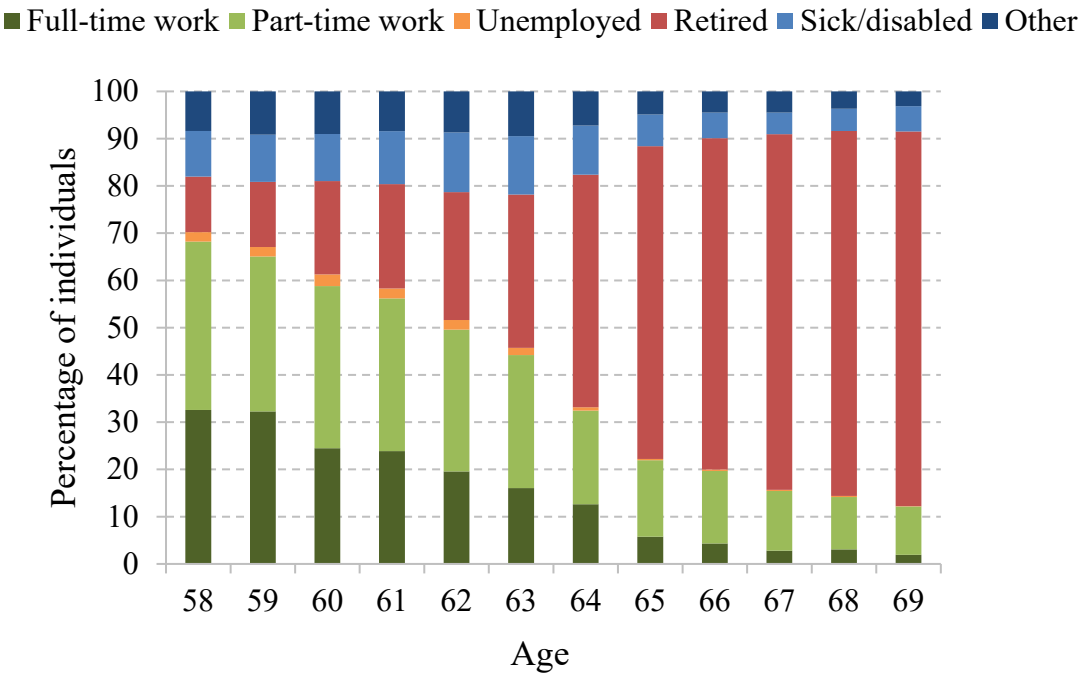
of the changes observed between other consecutive ages. This discontinuity is not quite so clear for women, since during this period some women aged 64 were above the state pension age and some were below it. However, we can see a similarly large fall in the employment rate between age 63 and age 65, by 22 percentage points, together with a large increase in the reported retirement rate by 34 percentage points. Our empirical analysis is able to separate out the effect of reaching state pension age on employment independently from any impact of reaching age 65.

Figure 2. Economic activity of men prior to state pension age being increased from 65 to 66, by age



Note: Average over the period 2017Q4 to 2018Q3. Data come from Labour Force Survey and Annual Population Survey. Based on 30,296 observations.

Figure 3. Economic activity of women prior to state pension age being increased from 65 to 66, by age



Note: Average over the period 2017Q4 to 2018Q3. Data come from Labour Force Survey and Annual Population Survey. Based on 32,440 observations.

Our analysis samples contain men and women between the ages of 65 and 67 for the sample period 2017Q4 – one year before the state pension age started to rise – to 2021Q2 (the latest available data at the time of analysis). Table 1 shows the background characteristics of these men and women. Over two thirds are in a couple, with men tending to have a younger partner and women tending to have an older partner. Over 80% of our sample are homeowners, the vast majority of whom have already paid off their mortgage. Slightly over a third of these men and women have a higher education qualification (such as a university degree), while less than one fifth have no formal educational qualifications. Finally, we see that the majority report having a longstanding health problem, that is, a health problem that has lasted, or is expected to last, for at least one year.

Table 1. Sample summary statistics

Characteristic	Men (%)	Women (%)
Single	23	31
In a couple	77	69
Younger partner	53	14
Older partner	15	47
Homeowner	83	83
Renter	17	17
Higher education	35	34
Secondary education	50	46
No formal qualifications	15	20
Longstanding health problem	58	55
Number of observations	29,554	32,695

Notes: Sample includes men and women between the ages of 65 and 67 for the sample period 2017Q4 to 2021Q2. Data come from Labour Force Survey and Annual Population Survey. 'Single' refers to people who are not currently in a couple, that is, it includes those who are divorced, separated or widowed.

IV. Empirical Methodology

Using data on the labour market behaviour of men and women who face different state pension ages, we can estimate what impact increasing the state pension age from 65 to 66 has had on employment. To do this, we employ a difference-in-differences methodology. The 'treatment' (being under the SPA) is administered to everyone, but, since the state pension age has risen, the treatment is administered for longer to those born more recently. Equation (1) below sets out the specification we use to estimate the impact of increasing the state pension age.

$$(1) \quad y_{it} = \alpha(underSPA)_{it} + \gamma_t + \sum_{a=1}^{A} \delta_a [age_{it} = a] + X_{it}\beta + \varepsilon_{it}$$

Our aim is to estimate the effect on an outcome, y, such as employment, for individual *i*, of being below (rather than above) the SPA *(underSPA)* in time *t*. Our key coefficient of interest is therefore α. Whether someone is under or over the state pension age is a deterministic function of their age and when they are interviewed. We therefore control flexibly for age and calendar time: fixed effects are used to control for age (age_{it} in years and quarters, with 11 dummies included in the model), and time period (γ_t in year and quarter, with 14 dummies). We cannot control for cohort using fixed effects for year and quarter of birth, as that would be perfectly collinear with the age and time fixed effects – this is the well-known age-period-cohort problem. We test the robustness of our results to controlling linearly for year of birth in Table 2.

We also control for a vector of individual characteristics, *X*. These include education, relationship status, housing tenure, ethnicity, and geography, as well as partner's age and partner's education for those with a partner.[3] The exact specification is shown in Appendix Table 1.

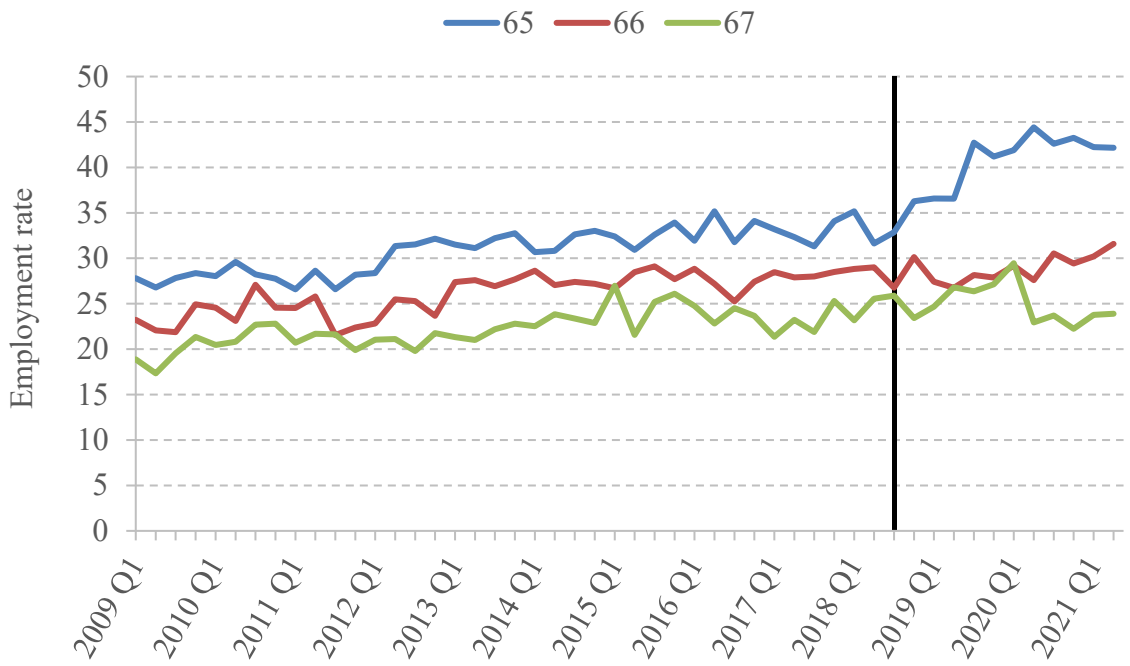
The primary outcome of interest is the effect of being under the state pension age on employment, although Tables 3 and 4 show the estimated effect of being under the state pension age on other labour market outcomes. We estimate all our models using ordinary least squares.

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 allow for this by clustering standard errors at the individual level.

[3] Specifically, we include 4 dummies for relationship status, 5 dummies for education level, a dummy for whether the respondent is white or not, a dummy for whether the respondent rents their home or not, 17 geographical area dummies, a dummy for the dataset (LFS or APS), 5 dummies for the respondent's partner's education level, a dummy for whether the respondent's partner is under the SPA and partner's age in years and quarters, (linear and quadratic), as well as the 14 dummies for quarter and 11 dummies for age in quarters mentioned earlier in the paragraph. The exact specification for this is shown in Appendix Table 1.

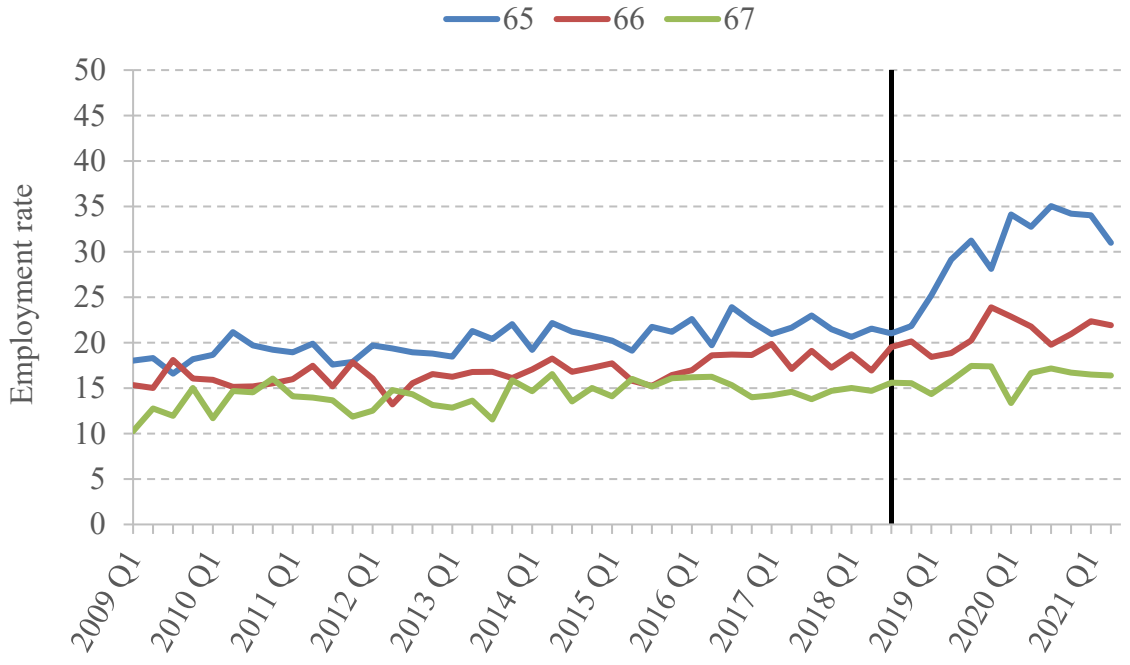
The key assumption that allows us to identify α as the causal effect of being under the state pension age in this difference-in-differences model is the 'common trends' assumption: that the employment rate of different age groups in our data would have evolved similarly over time in absence of the state pension age increase. By including 66 and 67 year olds in our analysis, (as well as 65 year olds, who are all over the state pension age at the start of the sample data and all under the state pension age by the end of the sample data), we have *control groups* that do not see changes in whether they are over or under state pension age. Figures 4 and 5 provide evidence that our common trends assumption is plausible. They show the employment rates of 65-, 66-, and 67-year old men and women from 2009Q1 to 2021Q2, with the vertical black line denoting the last quarter in which all 65-year-olds were over the state pension age, 2018Q3. Before 2018Q4, the employment rate of 65-year-olds increased gradually over time in a fairly smooth manner, similar to that of 66- and 67-year-olds. These parallel pre-trends suggest it is likely that the employment rate of 65-year-olds would have followed a similar pattern to that of 66- and 67-year-olds if the state pension age had not increased above 65. We show more formally in Appendix Table 2 that the common trends assumption held in earlier periods using placebo tests where the reform is assumed to have occurred earlier in time or at a different age.

Figure 4. Employment rates of men over time, by single year of age



Note: The solid vertical line represents the last quarter in which all 65-year-olds were over the SPA. Data come from the Labour Force Survey and Annual Population Survey.

Figure 5. Employment rates of women over time, by single year of age



Note: The solid vertical line represents the last quarter in which all 65-year-olds were over the SPA. Data come from the Labour Force Survey and Annual Population Survey.

These figures also offer an initial indication of the impact of increasing the state pension age on employment. The employment rate of 65-year-old men increased from 33% in 2018Q3 (when every 65-year-old man was over the SPA) to 42% in 2021Q2 (when every 65-year-old man was under the SPA). Compared to this 9 percentage point increase, the employment rate of 66- and 67-year-old men changed by much less over the same time period: a 5 percentage-point increase for 66-year-old men and a 2 percentage-point decrease for 67-year-old men.

Figure 5 offers a similar picture for women. The employment rate of 65-year-old women increased by 10 percentage points, from 21% in 2018Q3 to 31% in 2021Q2. Meanwhile, the employment rate of 66-year-old women increased by only 2 percentage points and the employment rate of 67-year-old women increased by less than 1 percentage point. This provides initial indicative evidence that the increase in the state pension age substantially boosted the employment rates of 65-year old men and women.

V. Results

A. Effect of increasing the state pension age on employment

Table 2 reports the results from estimating Equation (1) using a variety of econometric specifications. The results in row (1) show the results of estimating Equation (1) for the sample of 65- to 67-year-olds in the LFS and APS from 2017Q4 to 2021Q2, controlling for year and quarter fixed effects, age fixed effects in year and quarter, and all the other controls listed in Section IV. The full results of the estimating the specification shown in Row (1) are provided in Appendix Table 1. The other rows check the robustness of the results to various changes.

Specification (1) indicates that being under the state pension age increases the probability of being in work by 7.4 and 8.5 percentage points for men and women, respectively. These estimates are statistically significantly different from zero at the 1% level, though while the

point estimate is larger for women, the estimated effect on employment of being under the SPA is not significantly different for men and women This indicates that the increase in the SPA from 65 to 66 led to a large increase in employment – if anything the point estimates are bigger than those in Cribb, Emmerson and Tetlow (2016), who found that the increase in the SPA for women in the UK from 60 to 62 that took place in the early 2010s raised female employment rates by around 7 percentage points.

This is perhaps surprising given that the employment impact of increasing the SPA may be expected to fall as it rises further because the pool of people still working at the year before the state pension age is lower (as shown in Figures 2 and 3)

Table 2. Effect of increasing state pension age from 65 to 66 on employment

		Men		Women	
	Specification	Effect of being under state pension age	Standard error	Effect of being under state pension age	Standard error
(1)	Main	0.074***	[0.015]	0.085***	[0.013]
(2)	Including linear cohort control	0.075***	[0.015]	0.084***	[0.013]
(3)	Excluding data after February 2020	0.077***	[0.022]	0.086***	[0.019]
(4)	Classifying furloughed workers as not in employment	0.067***	[0.014]	0.077***	[0.012]
(5)	Including 64-year-olds in control group	0.074***	[0.014]	N/A	N/A

Note: ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at the individual level.

The Table shows that our results are robust to a variety of specifications. Specification (2) includes a linear control for year of birth, which allows for linear underlying differences in

employment patterns between different birth cohorts of men or women.[4] Including this has essentially no impact on our estimates.

Specifications (3) and (4) assess the extent to which our estimates are affected by the changes to the labour market brought about by the Covid-19 pandemic. Specification (3) estimates Equation (1) for the sample period 2017Q4 to February 2020 (i.e. before the start of the pandemic in the UK), with again a similar point estimate to our main specification (although the standard errors are slightly larger due to the reduced sample size). In Specification (4), we examine the extent to which our results in row (1) are driven by workers below the SPA being more likely to be "furloughed". To do this, we reclassify workers in our data who we identify as furloughed as being out of work[5], and then re-estimate Equation (1). This slightly reduces the point estimate for both men and women. However, the estimated employment effect remains of a similar magnitude and significantly different from zero. Finally, Specification (5) shows that including 64-year-old men in our sample again has little effect on the estimated employment effect of being under the SPA. 64-year-old men were under the SPA throughout our sample period, so are potentially a good additional control group for 65-year-old men. We do not repeat this robustness check for women, since between 2017Q4 and 2018Q4 the SPA for women was rising from 64 to 65. Therefore, some 64-year-old women would be under the SPA, and some would be over, meaning that our estimate would become a weighted average of the impact of increasing the SPA from 64 to 65 and the impact from increasing it from 65 to 66.

[4] Morris (2021) shows that in some scenarios controlling for cohort differences can be important for evaluating pension reforms, specifically in looking at the effect on employment of raising the eligibility age for the Australian Age Pension.

[5] We follow the UK's Office for National Statistics and measure furloughed employees as employees who are working fewer than usual hours due to "laid off/short time/work interrupted by economic or other causes", "Other personal/family reasons" or "Other reasons" and report that this was caused by the coronavirus pandemic.

A further test of the validity of our results, implicitly testing for common trends in employment prior to the reform, is to conduct "placebo tests". Appendix Table 2 presents "placebo tests" which imagine that the reform had occurred 2, 4, or 6 years earlier than they actually did, and tests whether there was an impact on employment of this "placebo reform". In all cases, we find no effects on employment of these placebos, suggesting that there were indeed common trends in employment between 65-, 66-, and 67-year olds prior to the reform.

B. Effect of increasing the SPA on different types of employment

In Table 3, we decompose this employment effect into different types of employment by re-estimating the specification from row (1) of Table 2 with different outcome variables. Specification (1) of Table 2 reports the overall employment effect again for comparison.

In Specification (2), we estimate the effect of being under the SPA on the share of workers who have joined their job in the last year. For both men and women, the estimated effects are small and insignificantly different from zero at conventional significant levels. This implies that increasing the SPA does not induce those who are not in paid work to return to employment (or those in paid work at age 65 to move to a new job); rather, workers simply stay in their original job for longer, consistent with the findings of Staubli and Zweimüller (2013).

Specifications (3) and (4) report the estimated effect of being under the SPA on full-time and part-time work, respectively. For men, we estimate that being under the SPA is associated with a 6.1 percentage point increase in the share of 65-year olds working full-time, while the estimated increase in part-time work is only 1.2 percentage points and not statistically significant from zero at conventional significance levels. Given that 26% of working men aged 64 work part-time, the fact that only 16% of the employment response comes from part-time work suggests that the response comes disproportionately from full-

time workers for men. For women, we estimate that being under the SPA increases the share in full-time and part-time work, by 4.5 and 4.0 percentage points, respectively. The share of the response for women coming from full-time work (56%) is higher than the share of working women aged 64 in full-time work (48%), again indicating that a higher-than-expected share of the employment response for women comes from full-time workers.

In Appendix Table 3 we show in more detail the impact on hours of work. The increases in part-time work for women are not driven by people working a very small number of hours per week (the higher SPA did not cause any rise in the share working 0-16 hours per week for women). Instead the increase in part-time work for women came amongst those working 16-30 hours. The increases in full-time work for men and women are clearly driven by the distribution of hours pre-reform. The increase in full-time work for women came entirely amongst those working 30-39 hours (and not at all from those working 40+ hours a week), which is consistent with very few 64-year old women actually working 40+ hours per week pre-reform (5%). In comparison, there was a more even split for full-time work for men, with 2.4 percentage point increase in the probability of working 30-39 hours and 3.8 percentage point increase in the probability working 40+ hours, consistent with around 58% of full-time working men working 40+ hours at these ages.

Specifications (5) and (6) decompose the estimated employment effect in Specification (1) into the effects of being under the state pension age on the share of employees and self-employed workers. For men, we estimate that being under the SPA leads to an increase in the share of employees and self-employed workers by 4.2 and 3.2 percentage points, respectively. Therefore, we estimate that around 43% of the employment effect for men comes from the self-employed, which is markedly higher than the share of 64-year-old working men who are self-employed (28%). For women, we find that essentially all of the

employment effect of being under the SPA comes from employees. This is consistent with the fact that a very low share of women of these ages are self-employed.

Table 3. Effect of increasing state pension age from 65 to 66 on different types of employment

		Men		Women	
	Outcome	Effect of being under state pension age	Mean for 64-year-olds pre-reform	Effect of being under state pension age	Mean for 64-year-olds pre-reform
(1)	In work	0.074*** [0.015]	48.3%	0.085*** [0.013]	38.1%
(2)	Job tenure < 1 year	0.004 [0.004]	2.8%	0.000 [0.003]	2.6%
(3)	Full-time work	0.061*** [0.013]	35.9%	0.045*** [0.008]	18.2%
(4)	Part-time work	0.012 [0.010]	12.4%	0.040*** [0.011]	19.9%
(5)	Employees	0.042*** [0.013]	34.7%	0.089*** [0.012]	31.4%
(6)	Self-employed	0.032*** [0.010]	13.6%	-0.004 [0.007]	6.7%
(7)	Public sector	0.007 [0.007]	6.8%	0.042*** [0.008]	12.8%
(8)	Private sector	0.067*** [0.014]	41.5%	0.041*** [0.011]	25.3%

Note: ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at the individual level in parentheses. Pre-reform mean calculated on 64-year-olds that are under the SPA during the period 2017Q4 to 2018Q3.

Finally, in rows 7 and 8 of Table 3 we show whether the increase in employment comes from public or private sector workers (where private sector includes the self-employed). The increase in employment for men comes almost entirely from those working in private sector jobs, whereas the split for women is more even between public and private sector workers. If anything, it looks like female public sector workers are more likely to delay retirement as a result of the reform, as more than half the employment effect comes from

public sector workers, but only a third of working women were in the public sector prior to the reform.

C. Effect of increasing the SPA on broader measures of economic activity

Table 4 presents the estimated effect of being under the state pension on the share of 65-year olds who are retired, out of work for health reasons, unemployed, and the share out of work for other reasons, including caring. It is important to note that these are all self-reported states, but that you can only declare to be in one of these states if you are not in paid work

Table 4 shows that being under the SPA significantly decreases the probability of self-reported retirement by 12.2 percentage points for men and 15.4 percentage points for women. This more than accounts for the increase in employment associated with being under the SPA. Consistent with this, the results show that being under the SPA results in a significant increase in the probability of reporting being out of work for health reasons, by 3 to 4 percentage points. Of course, much of this could be labelling: those aged 65 who are in poor health, not in paid work and not receiving a state pension – but potentially receiving an incapacity benefit – might be less likely to label themselves as retired compared to similar non-working 65-year-olds who are receiving a state pension and not receiving an incapacity benefit.

The results also show that being under the SPA leads to a 0.7 (men) or 0.9 (women) percentage point increase in the share of 65-year olds who report being unemployed. Given that unemployment is fairly uncommon at this age, with only 1 to 2 percent of 64-year-olds unemployed pre-reform, this is a sizeable relative increase, and corresponds to over 5,000 extra 65-year-olds in unemployment. Finally, the Table shows that being under the SPA has a fairly small effect on the probability of reporting being out of work for other reasons, and this effect is not statistically significant from zero at the 5% level.

Table 4. Effect of increasing state pension age from 65 to 66 on economic activity

Outcome	Men		Women	
	Effect of being under state pension age	Mean for 64-year-olds pre-reform	Effect of being under state pension age	Mean for 64-year-olds pre-reform
In paid work	0.074*** [0.015]	48.3%	0.085*** [0.013]	38.1%
Retirement	–0.122*** [0.015]	33.9%	–0.154*** [0.014]	41.5%
Sick/disabled	0.030*** [0.008]	11.9%	0.044*** [0.007]	11.4%
Unemployed	0.009*** [0.003]	2.0%	0.007*** [0.002]	1.1%
Other out of work	0.008 [0.005]	3.9%	0.018*** [0.006]	7.9%

Note: ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at the individual level in parentheses. Pre-reform mean calculated on 64-year-olds that are under the SPA during the period 2017Q4 to 2018Q3.

D. Effect of increasing the SPA on employment for different subgroups

Table 5 shows the results from estimating equation (1), where the outcome is a binary variable for being in paid work, separately for different subgroups. The table also shows the employment rate for 64-year-olds in this subgroup in the period before the reform, in order to help gauge how large the estimated impact is.

The effect of being under the SPA on employment rates is 8.5 percentage points for men in a couple, compared to 2.9 percentage points for men who are not in a couple, consistent with single men of these ages being less likely to be in work at 64 to start with. However, particularly due to the small sample size of single men at these ages, these point estimates are not significantly different from one another at conventional significance levels. Conversely, the point estimate is actually larger for single women than for women with a partner – this

mirrors the fact that single women are more likely to be employed at age 64 than women in a couple. For both sexes, the estimated employment effect is slightly larger for people with younger partners compared to people with older partners; however, again these differences are not statistically significant from each other.

The point estimates are larger for renters than for people who own their home (either outright or with a mortgage); however, these differences are also not statistically significant. We do, however, find statistically significant differences in the employment effects between people with different education levels. The estimated effect of being under the SPA on employment is around 4 percentage points for both men and women with a degree or equivalent, compared to 9 to 10 percentage points for those with secondary education, and 12 to 13 percentage points for those without secondary school qualifications.

Finally, presented at the bottom of the table, we estimate the regressions separately for people with and without a self-reported health problem lasting at least one year. The point estimates are smaller for those reporting a health problem, which suggests that these people might be less able to work longer at older ages and therefore the state pension age is less relevant for their decisions. However, it is important to note here that health is a potentially endogenous variable, which could itself be affected by the increase in the state pension age.[6]

[6] Many papers have analysed the effects of retirement on health, including Atalay and Barrett (2014), Banks et al. (2019), Fitzpatrick and Moore (2018), Mazzonna and Perrachi (2012, 2016), though there is no clear consensus in exactly how retirement affects health, in part because while some jobs may improve (some forms of) health, others may cause it to worsen, and for some people retirement may be full of activities that boost health, but not for others.

Table 5. Effect of increasing state pension age from 65 to 66 on employment for different subgroups

Subgroup	Men		Women	
	Effect of being under state pension age	Employment rate for 64-year-olds pre-reform	Effect of being under state pension age	Employment rate for 64-year-olds pre-reform
Single	0.029	29.0%	0.094*	38.1%
	[0.043]		[0.053]	
In a couple	0.085***	51.1%	0.072***	34.9%
	[0.017]		[0.015]	
Has younger partner	0.100***	52.0%	0.095**	44.0%
	[0.020]		[0.032]	
Has older partner	0.041	49.3%	0.063***	32.4%
	[0.034]		[0.017]	
Own house	0.070***	49.8%	0.076***	36.6%
	[0.016]		[0.014]	
Rent house	0.096***	42.6%	0.127***	44.4%
	[0.033]		[0.031]	
Degree	0.041	48.2%	0.039*	37.6%
	[0.025]		[0.022]	
Secondary education	0.086***	50.6%	0.096***	43.8%
	[0.021]		[0.019]	
No formal qualifications	0.131***	40.6%	0.126***	23.3%
	[0.036]		[0.027]	
Health problem	0.054**	41.8%	0.063***	33.2%
	[0.024]		[0.020]	
No health problem	0.073**	54.6%	0.113***	41.5%
	[0.030]		[0.025]	

Note: ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at individual level in parentheses. Pre-reform mean calculated on 64-year-olds that are under the SPA during the period 2017Q4 to 2018Q3.

Table 6 shows how the estimated employment response to the increase in the state pension age differs for people living in local areas on England with different levels of deprivation. We do not have perfectly comparably measures across the four nations of the UK, so we focus on the differences in England. We measure deprivation using the Index of Multiple Deprivation, the official measure of relative deprivation in England. Deprivation is measured at the Lower Layer Super Output Area (LSOA) level, with each area containing on average 650

households. Again we run separate regressions for each group. For completeness, at the bottom of the table, we show the estimated employment response to the increase in the state pension age across all areas of England, which is similar to the response found for the UK as a whole.

Table 6. Effect of increasing state pension age from 65 to 66 on employment, by deprivation quintile (England only)

Subgroup	Men		Women	
	Effect of being under state pension age	Employment rate for 64-year-olds pre-reform	Effect of being under state pension age	Employment rate for 64-year-olds pre-reform
Quintile 1 (most deprived)	0.099** [0.041]	40.0%	0.127*** [0.037]	43.7%
Quintile 2	0.084** [0.040]	43.6%	0.094** [0.037]	40.8%
Quintile 3	0.101*** [0.038]	57.4%	0.072** [0.034]	41.4%
Quintile 4	0.087** [0.035]	48.3%	0.072** [0.031]	36.0%
Quintile 5 (least deprived)	0.049 [0.037]	50.4%	0.036 [0.029]	34.1%
All England	0.081*** [0.017]	48.3%	0.075*** [0.015]	38.9%

Note: ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at individual level in parentheses. Pre-reform mean calculated on 64-year-olds that are over the SPA during the period 2017Q4 to 2018Q3.

For men, we can see that the increase in the state pension age led to an increase in the share of 65-year-olds in paid work by around 8 to 10 percentage points among those living in the most deprived 80% of areas, while the employment increase is only 5 percentage points for those living in the least deprived 20% of areas. This is despite the fact that the employment rate of 64-year-old men in the least deprived quintile is higher than in the most deprived 40% of areas. For women, we see a more monotonic relationship between deprivation and effect size. The employment effect of the increase in the state pension age is estimated to be almost

13 percentage points for women living in the most deprived quintile of areas, and the magnitude of the employment effect falls as we look at less deprived areas, before reaching just 4 percentage points for women in the least deprived quintile of areas.

E. Effect of increasing the state pension age to 66 on spouses' employment

Table 7 shows how men and women respond to their spouse reaching the state pension age. To estimate this, we restrict our sample to people with partners (i.e. husband/wife or cohabiting partners), and estimate equation (1) with the outcome being a binary variable for whether the individual's partner is in work or not. The estimates imply that husbands' employment does not respond when his wife reaches the state pension age. For wives, we estimate an employment response of 1.4 percentage points as a result of their husband reaching the state pension age; however, this is not statistically significant from zero at conventional significance levels. This suggests we do not see a large employment response of partners to the change in the SPA.

Table 7. Effect of increasing partner's state pension age from 65 to 66 on employment of their husbands and wives

	Effect of being under SPA on husbands	*Standard error*	*Effect of being under SPA on wives*	*Standard error*
In paid work	–0.001	[0.015]	0.014	[0.017]

Note: ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at individual level. Opposite sex couples only. "Husbands" include cohabiting male partners of women, and "Wives" include cohabiting female partners of men.

VI. Conclusion

In this paper, we analyse the increase in the UK state pension age for men and women from 65 to 66 that occurred between December 2018 and October 2020. For women, this was the latest part of a longer-term increase in their state pension age, which was 60 as recently as

2010. On the other hand, this was the first change in the state pension age for men since the Second World War (and the first increase ever).

Although 66 is a high age, internationally, for people to first be able to claim a state pension, we find that the employment rates of 65-year-olds increased markedly in response to the increase. Specifically, we estimate that the reform led to an increase in the employment rates of 65-year-old men and women by 7.4 and 8.5 percentage points, respectively. This is a little higher than the 6.3 percentage-point employment effect of the increase in the UK female SPA from 60 to 62 found in earlier work (Cribb, Emmerson and Tetlow, 2016).

Analysing this employment response in more detail, we find that a disproportionate share of the effect comes from full-time workers, and, for men, from the self-employed. However, we do not find evidence of "spillover" employment effects on the partners of individuals whose state pension age has been increased.

In addition to the impact on employment rates, we find that the policy led to a 3 to 5 percentage point increase in the share of individuals who reporting being out of work for health reasons, although much of this is likely to be labelling rather than an effect of the policy on health itself. Previous analysis has shown that a higher state pension age for women has increased some health problems, such as depressive symptoms (see Carrino et al 2020) but that the resulting increase in employment has reduced other health problems such as physical disability and has improved cognition (see Banks et al 2019). The share of workers who report themselves as being unemployed and actively seeking work increased by a little under 1 percentage point due to the policy change. This is large relative to rate of unemployment among 64-year olds above the SPA (1.6%). These increases in employment, unemployment, and economic inactivity due to health problems are offset by a large reduction in the proportion of 65-year-olds self-reporting themselves to be retired.

Finally, subgroup analysis demonstrates that the effect on the employment rate of the reform are (statistically and economically) significantly larger for individuals with lower levels of education, and for people that live in deprived areas. These results suggest that less advantaged people are more likely to continue to work as a result of the higher state pension age,

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Appendix

Appendix Table 1. Effect of increasing state pension age from 65 to 66 on employment – full results from main specification

	Men		Women	
	Coefficient	Std error	Coefficient	Std error
Under SPA	0.074***	[0.015]	0.085***	[0.013]
Cohabiting	0.026	[0.019]	0.066***	[0.019]
Single	–0.120***	[0.040]	0.028	[0.031]
Widowed	–0.076*	[0.042]	0.038	[0.029]
Divorced/Separated	–0.013	[0.040]	0.096***	[0.028]
Other HE	–0.051***	[0.015]	–0.050***	[0.012]
A level or equivalent	–0.055***	[0.014]	–0.009	[0.013]
O level or equivalent	–0.046***	[0.012]	–0.033***	[0.011]
Other qualifications	0.003	[0.019]	–0.042***	[0.016]
No qualifications	–0.080***	[0.014]	–0.100***	[0.011]
White	–0.026	[0.023]	–0.029	[0.020]
Rents house	–0.050***	[0.012]	–0.025**	[0.010]
APS dataset	–0.002	[0.008]	–0.004	[0.007]
Partner: under SPA	0.029*	[0.017]	0.061***	[0.023]
Partner's age (years and quarters)	–0.012	[0.011]	0.010	[0.016]
Partner's age squared	0.000	[0.000]	–0.000	[0.000]
Partner's age: 60-64	–0.057***	[0.020]	–0.070***	[0.035]
Partner's age: 65-69	–0.080***	[0.026]	–0.073*	[0.043]
Partner's age: 70+	–0.012	[0.045]	–0.027	[0.050]

Partner's education: non-degree higher ed	–0.022	[0.017]	–0.014	[0.017]
Partner's education: A-level	0.007	[0.017]	0.013	[0.016]
Partner's education: GCSEs	0.012	[0.015]	0.033**	[0.014]
Partner's education: Other qualifications	0.010	[0.024]	0.039*	[0.022]
Partner's education: No qualifications	–0.000	[0.017]	0.045***	[0.017]

Note: ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at the individual level. The regression results are from a regression that also include X dummy variables for age (in year and quarters), Y for time (in year and quarters) and Z regions. The coefficients are estimated compared to a baseline of: married, degree holder, non-white ethnicity, homeowner, the LFS dataset, partner being aged under 60 and partner having a degree.

Appendix Table 2 Placebo tests: "Effect" of increasing state pension age from 65 to 66 on employment had the reform between implemented 2, 4, or 6 years earlier

	Men	*Women*
Actual timing	0.074***	0.085***
	[0.015]	[0.013]
2 years early	–0.004	–0.012
	[0.016]	[0.013]
4 years early	0.005	–0.004
	[0.013]	[0.011]
6 years early	–0.007	–0.004
	[0.012]	[0.010]

Note: The effects for the placebo reforms i.e. "2 years early" use data from the before the increase, using the same model and control variables, but coding the variable "under State Pension Age" as if reform had been implemented 2, 4 or 6 years previously. ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at individual level.

Appendix Table 3. Effect of increasing state pension age from 65 to 66 on proportion of people undertaking different hours of work

	Men		Women	
Outcome	Effect of being under state pension age	Mean for 64-year-olds pre-reform	Effect of being under state pension age	Mean for 64-year-olds pre-reform
0-16 hours	0.008	4.1%	–0.004	7.9%
	[0.007]		[0.008]	
16-30 hours	0.004	8.%	0.044***	12.0%
	[0.005]		[0.008]	
30-40 hours	0.024***	15.1%	0.042***	12.8%
	[0.009]		[0.007]	
40+ hours	0.038***	20.8%	0.003	5.4%
	[0.010]		[0.005]	

Note: ***, ** and * denote that the effect is significantly different from zero at the 1%, 5% and 10% level respectively. Robust standard errors clustered at the individual level in parentheses. Pre-reform mean calculated on 64-year-olds that are under the SPA during the period 2017Q4 to 2018Q3. Throughout, all hours groups include individuals working the lowest number of hours and does not include individuals working exactly the highest number of hours (i.e. 16-30 includes people working 16 hours per week but does not include people working 30 hours per week).