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Pension Incentives and Labor Force Participation: Evidence from the Introduction of Universal Old-Age Assistance in the UK

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preliminary draft - comments welcome

Abstract

We estimate the labor force participation (LFP) response to the introduction of means-tested minimum pensions in the UK through the Old-Age Pension Act (OAP) of 1908. The OAP was a major social policy intervention and the first one to universally target older workers in a time of very limited social protection. The empirical framework is based on three decennial census waves (1891, 1901, 1911), covering the full UK population. We identify the LFP effects of the program based on variation at the age-based eligibility threshold between 69 and 70. Our results show a considerable and abrupt decline of 6.3 to 7.6 percentage points in the LFP rate when older men turn 70. This sudden drop only occurs at the age cutoff and only after the OAP was implemented. The unique historical setting allows us to study the full labor supply effects of an old-age assistance program and thus adds to understanding labor supply responses when labor earnings are taxed implicitly through government transfers.

Keywords: Old-Age Assistance, Labor Force Participation, Retirement, Regression Discontinuity Design

JEL-Classification: H24, H55, J14, J22, J26

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1 Introduction

Population aging requires changes in government old-age assistance programs, especially because these programs implicitly tax the labor of older workers relative to younger ones. A large body of literature has examined the labor supply effects of marginal changes in existing public pension systems. Little is known, however, on the full labor supply effects of introducing universal old-age assistance programs for the first time. Therefore, in this paper, we study the labor force participation (LFP) effects of the Old-Age Pension Act (OAP) of 1908 that initiated universal means-tested pensions in the UK. The unique historical setting allows us to estimate the full LFP effects from essentially no program to an old-age assistance scheme that covered a large share of the elderly population.

The expansion of old-age assistance coincides with a strong decline in LFP of older men in the U.S. (see e.g. Feldstein and Liebman, 2002; Krueger and Meyer, 2002; Coile, 2015). In contrast, aggregate statistics suggest that the downward trend in LFP rates among older men in the UK did not accelerate after the introduction of the OAP.¹ We provide striking evidence that, irrespective of the overall trend, LFP rates of older men did decline promptly and considerably as a direct consequence of the introduction of the OAP.

We make use of recently released full-count population data from three decennial UK census waves (1891, 1901, 1911). The census data includes detailed information on occupations and LFP of the entire workforce that allows us to precisely estimate the effects of old-age assistance on the LFP of older men. We isolate the causal effects of the program along the lines of two sources of identifying variation. First, we use variation over time across calendar years because the introduction of the OAP (effective in 1909) falls in between the available census waves. Second, the OAP introduces a sharp age-based eligibility threshold at age 70, inducing a discontinuity

¹Although LFP rates of older men did decline considerably over the entire 20th century in the UK, census data suggests that there is no acceleration in this trend between 1901 and 1911 and even a slight absolute increase in LFP between 1911 and 1921. The absence of a trend acceleration after the introduction of the OAP has also been noted by Johnson (1994) and Costa (1998).

in the retirement probability. To identify the LFP effects in the local environment of this age cutoff, we adopt a regression discontinuity design (RDD).²

Our main findings indicate an abrupt decline in male LFP at the age of 70 that is caused by the availability of old-age assistance. In absolute terms, the effect amounts to a 6.3 to 7.6 percentage point decline of LFP, measurable in the 1911 census just after the implementation of the OAP in 1909. Relative to a participation rate of 76.5% at age 69, the LFP rate declines by 8% to 10% when moving marginally above the age-based eligibility threshold. These estimates are strongly driven by older men who stop working and much less by older men who leave the labor force from unemployment. The estimated LFP effects are therefore dominated by reductions in labor supply and reflect a relevant reduction in work activity. Moreover, we show that the LFP decline is stronger for men without own children in the household, which is consistent with the hypothesis that children served as old-age insurance. Making use of the occupational information, we also demonstrate that the LFP decline is stronger for physically demanding occupations.

The dramatic decline in LFP as a reaction to the availability of pensions is consistent with theoretical expectations on labor supply responses when labor earnings are taxed implicitly through government transfers. Introducing old-age assistance induces an implicit tax of 100% on earnings that would be replaced by the availability of the pension. The introduction of the OAP thus induces a strong financial disincentive on continuing work after reaching the age-based eligibility threshold.

This paper makes three major contributions to the literature. First, it adds to earlier studies on the labor supply effects of pension incentives (Krueger and Pischke, 1992; Börsch-Supan, 2000; Mastrobuoni, 2009; Liebman et al., 2009; Atalay and Barrett, 2015; Manoli and Weber, 2016). We extend this strand of the literature by studying the full LFP effects of an old-age assistance program that was introduced at a time when social security systems did not exist, thus investigating the change from no program to universal coverage. In contrast to previous studies that rely

²The age threshold does not assign eligibility alone because further eligibility criteria, most notably a means test, existed. Thus, our RDD is a fuzzy one.

on marginal changes in existing pension schemes, our estimates quantify the entire LFP effects of the OAP starting from a benefit level of zero without having to rely on extrapolations.

Second, the institutional setting allows for highly credible and transparent identification. The reform introduced an age-based eligibility threshold at age 70, where every UK citizen became eligible conditional on having passed the means test. Based on a RDD, we quantify the abrupt decline in LFP in the local environment of this age cutoff. This type of research design builds on many recent studies that have used age-based eligibility thresholds to identify policy-relevant effects (see e.g. Card et al., 2008; Battistin et al., 2009; Card et al., 2009; Anderson et al., 2012, 2014; Fitzpatrick and Moore, 2018).

Finally, the historical background of this study is not only interesting in its own right but also involves many features that strengthen the empirical analysis. Enacted in 1908 and effectively implemented in 1909, the OAP was the largest means-tested old-age assistance program and one of the first of its kind at that time. It covered the entire UK, one of the largest and wealthiest economies (in terms of absolute GDP and GDP per capita) in the early 20th century. Private pension schemes or other government programs focusing on older workers were either small and uncommon or did not exist.³ Another historical feature of the OAP is that it marked the beginning of large-scale expansions of old-age assistance programs in many industrialized countries and served as an archetype for similar programs such as the U.S. Old Age Assistance program that was introduced in the 1930s. Studies that examine the introduction of old-age assistance in the U.S. (Friedberg, 1999; Fetter and Lockwood, 2018) are therefore a valuable benchmark to our results. Consistent with these studies, we document a considerable decline in LFP that is attributable to the disincentive to work when labor earnings are taxed implicitly through government transfers.

The remainder of this paper is structured as follows. Section 2 provides historical

³All empirical results in this paper are measured in 1911 or earlier. Unemployment and health insurance were only implemented after that in 1912.

and institutional details on the old-age assistance program in the UK and how its introduction creates exogenous variation that we use for identification. Section 3 outlines the research design. Section 4 describes the unique data source from the UK census and provides descriptive statistics. Section 5 presents results and section 6 concludes.

2 Historical Background and Institutional Details

The Old-Age Pension Act of 1908 (OAP) introduced means-tested, non-contributory minimum pensions for British citizens financed by the state government.⁴ The OAP was a major social policy intervention and the first one to specifically target the elderly in a time of very limited social protection. The law was debated in the British Parliament in May 1908, passed through in August 1908 and the first pensions were eventually paid out in January 1909. At that time, neither unemployment nor health insurance existed because both of these programs were only introduced in 1912.

Given that pensions were means-tested, the coverage rate of the OAP was astonishingly high. In 1911, almost 50% of males above the age limit in England and Wales were granted a pension (218,158 out of 445,340 according to the Department of Labour Statistics, 1915). The vast majority of pension recipients (about 93% in 1911) also received the maximum pension of 5 *shillings* per week. According to Feinstein (1990), this amounted to approximately 22% of average wages.

The OAP was a response to the perceived inadequacy of the the existing poor relief system that provided only very basic protection and involved considerable sanctions such as the loss of voting rights and the requirement of working in a workhouse unless the person could prove to be sufficiently unfit. The newly introduced pensions were not only less restrictive but also involved more generous benefits⁵, and thus considerably more older men applied for them (Thane, 2000). In contrast to the poor law, which was administered and financed at the local level giving lo-

⁴See Casson (1908) for details.

⁵At the time of the introduction of the OAP, poor relief was about 3 *shillings* per week and thus amounted to 60% of the new pensions that were legislated by the OAP (Casson, 1908).

cal authorities a lot of discretion in the assignment of financial aid, the OAP was enacted as a nation-wide right for older workers who met the specified eligibility criteria for receiving a pension.

Pension eligibility was mainly based on three criteria: age, citizenship and inadequate means.⁶ First of all, older workers only became eligible when reaching the age of 70. The original proposal for the reform, dating back to 1899, recommended a retirement age of 65, which would have been more in line with the retirement rules in the few pre-existing pension schemes that typically specified an age between 60 and 65.⁷ However, the original suggestion was considered too expensive. Given the low life expectancy at birth (below 50 for males in 1911), a retirement age of 70 seems high by today's standards. The low life expectancy, however, was mainly driven by high infant mortality. Once reaching the age of 70, men in 1911 could expect to live another 8.5 years on average (Human Mortality Database, 2018).

Second, eligibility required being a British subject⁸ as well as having resided in the UK within the last 20 years.

Third, eligibility was conditional on a means test. Claimants had to prove to the pension authority that their annual means were below £31 and 10 *shillings* (54% of average annual wages at that time) to receive any pension. To become eligible for the maximum pension, an income of less than £21 (36% of average wages) was required. Annual income was calculated based on the actual income received in the previous year (including family transfers) and augmented, if applicable, by the rental value of living in one's own house as well as a hypothetical return on property that so far had not been used commercially even though it could have been. Income of

⁶Even if the claimant had satisfied all of the three eligibility criteria, he could still be disqualified due to the following reasons. First, receiving poor relief or having received poor relief any time between January 1908 and December 1910. Second, habitually failing to work according to her ability. And third, being detained in a lunatic asylum, or in any place as a recipient of poor relief or a criminal lunatic or being in jail (or ordered to be imprisoned) less than ten years ago.

⁷Small-sized pension schemes within the boundaries of the respective firm existed previous to the large-scale introduction of the OAP. However, these pensions were rather informal and discretionary. More formalized schemes only existed in very few larger firms, for example in the railway industry. By far, these pensions did not reach the universal coverage rate that was introduced through the OAP (see Thane, 2000, for details on pre-existing pensions in the UK).

⁸British subjects are defined to be individuals born within the British dominions, i.e. the British empire.

couples living together was added up and divided by two.⁹ The law also prescribed that if individuals intentionally deprived themselves of resources, the value of these resources would still be included in the calculation of the annual means.

Pensions were granted based on a gliding scale as depicted in table 1. However, the overwhelming majority received the maximum pension of 5 *shillings* per week. For simplicity, the pensions did not account for differences in the costs of living across regions, even though this has been considered during the legislation process.

Pension applications were typically made at the local post office. They were checked by a pension officer appointed by the treasury and a local pension committee. Most applications were approved with a rejection rate of only 10% (The Times, 1909; Old Age Pensions Committee, 1919). The main reasons for disapproval were the inability to prove the individual age, a failed means test or receiving poor relief. Proving age was easy for pension claimants in England and Wales because birth registers (and thus birth certificates) existed at least since 1837. Verification was more difficult in Scotland and especially challenging in Ireland, making rejections based on the age criterion far more frequent in Ireland (Old Age Pensions Committee, 1919).

Despite the relatively high retirement age, the costs of the newly introduced pension payments were considerable. In the budget year 1911, 6.3 million £ were spent on old-age pensions in England and Wales. For the entire UK, old-age pension expenditures amounted to £9.8 million, making pensions one of the largest single spending item (5.7% of overall expenditures in the budget of 1911,(House of Commons, 1911)).

⁹An example provided in Casson (1908) clarifies this rule: imagine a married couple. The man earns £40 and the woman £10. In this case, the woman had to claim an income of at least £25 $((40+10)/2)$. The man, however, had to report his entire income of £40. Thus, only the wife would have been eligible for a pension.

3 Empirical Strategy

3.1 Exogenous Variation and Research Design

The identifying variation that we use to estimate the causal effect of pension availability on LFP is based on the age cutoff that was introduced by the OAP. Pension eligibility at age 70 creates a discontinuity in the local environment between age 69 and 70. Along the lines of this age threshold, we adopt a RDD with the age as assignment variable. The identifying assumption is that the outcome of interest, LFP, would evolve smoothly between age 69 and 70 if the OAP had not been introduced. Any discontinuous jump of the outcome at the eligibility cutoff can be attributed to the availability of the pension if other programs did not affect LFP at the respective age.

Reaching eligibility does not necessarily mean that individuals instantaneously retire and claim pensions. At the eligibility threshold, however, the probability of retiring exhibits a discontinuous jump due to the fact that a substantial share of older men become eligible for the OAP while claiming the pension was not possible below the age cutoff.¹⁰ Since pension eligibility also depends on other criteria such as the means test, there is imperfect compliance and hence the retirement probability does not jump from zero to one. This setting can be referred to as a *fuzzy* RDD¹¹, where treatment is not fully determined by the age cutoff.

3.2 Estimation

The observable outcome y_a is an indicator of LFP that takes the value one if the individual is in the labor force at age a and zero otherwise. We thus estimate the equation

¹⁰For a similar setting where an age-based eligibility threshold of retirement is used to study consumption outcomes, see Battistin et al. (2009).

¹¹See Lee and Lemieux (2010) for an overview on RDDs.

$$y_a = \beta_0 + \beta_1 \mathbf{1}(a \geq 70) + \beta_2 f(a) + \varepsilon_a \quad (1)$$

where the coefficient of primary interest, β_1 , measures the percentage point difference in LFP, comparing the share of men in the labor force marginally above the age cutoff (age 70) to the respective share marginally below the age cutoff (age 69). To account for the possibility of a functional relationship between the outcome *LFP* and the assignment variable *age*, the function $f(a)$, which is allowed to vary on either side of the age cutoff, not only includes age linearly but also as a second order polynomial. However, graphical evidence suggests that the age-LFP relationship is essentially linear especially close to the age-cutoff.

We implement several estimation procedures to show that our results are largely robust against changes in the specification. Moving from the baseline parametric estimation framework with uniform weighting to the more flexible local non-parametric estimates that put more weight on observations close to the cutoff (triangular kernel weighting) does not change our findings. This also holds for bias-corrected point estimates with robust standard errors as suggested by Calonico et al. (2014a,b). Finally, we provide detailed results on how the estimates differ by bandwidth choice, the order of the polynomial, and several sources of heterogeneity.

4 Data and Descriptive Evidence

The analysis relies on full-count individual level census data for three decennial UK census waves collected in the spring of 1891, 1901 and 1911. The dataset is a recent release by the Integrated Census Microdata (I-CeM) project (Schurer and Higgs, 2014), distributed by Integrated Public Use Microdata Series International (IPUMS International, Minnesota Population Center, 2018). We use information for England and Wales, thus excluding Scotland, Ireland and the Channel Islands because data is not available for the other regions at all points in time. Moreover, birth certificates,

which substantially reduce age-misreporting, only existed in England and Wales for a sufficiently long period. Finally, we exclude persons with unknown gender (less than 0.1 % of the population) or age (0.2 % of the population).

Our definition of labor force status is based on the gainful employment concept which was used before the UK adopted the current labor force definition in 1961. In contrast to the current definition, which categorizes people based on their activity status (working or seeking work) in a specific reference week, the gainful employment concept derives the labor market status from the occupation of the respondents. In particular, we include people in the labor force ($LFP = 1$) if they report an occupation (working) or are either unemployed or formerly employed (not working). Individuals are considered out of the labor force ($LFP = 0$) if they report no occupation or that they have retired from a specific occupation.¹² Both the current definition of LFP and the gainful employment concept are closely related. Costa (1998) constructs participation rates based on the gainful employment concept for the U.S. until the 1990s, showing that the patterns of both series match. Similarly, Johnson (1994) argues that the change of the definition in 1961 did “appear to have had little effect on the enumeration of older workers” (Johnson, 1994, p. 109). Based on this evidence, the two concepts arguably yield very similar patterns of LFP over time. For our empirical analysis, potential differences between the two concepts are of little relevance because the gainful employment concept did not change throughout the time under study (1891 - 1911). Differences only need to be kept in mind when comparing the results to the current understanding of LFP.

Throughout this study, we focus on men only because the documentation of participation rates of women has been subject to some concerns (see Hill, 1993, for a discussion). Additionally, the participation rates of women were generally low. Over the three census waves, only 21% of women aged 50 or older were still

¹²Following the census in 1891, retirement was explicitly recognized as a separate category and retirees were not considered economically active anymore (Johnson, 1994), which is arguably consistent with being out of the labor force. We adjust the labor force variable constructed by IPUMS International by defining individuals to be out of the labor force if they state an occupation but add that they have retired already.

economically active. Participation rates of older men, in contrast, were relatively high amounting to 86% for the same age group (table 2). Moreover, the decline of male LFP rates over age evolved less steep than today. At age 80, participation rates still exceeded 40%. We will argue in this paper that one major explanation for this phenomenon was the low coverage by social security and old-age pensions.

The majority of older workers was active in sectors such as crafts or related trades (more than one third). The second largest sector included skilled agricultural and fishery work, followed by service workers and elementary occupations (table 3). In contrast, only few older men earned a living as senior officials or managers, technicians or other professionals. Occupation information is available for all men that are still in the work force, but only for a subset of retirees that chose to report their former occupations. Thus, comparing the occupational distribution of active and non-active men is biased from missing information. The available information nevertheless allows us to examine effect heterogeneity by occupation in section 5.2. Since the census data does not specifically report old-age pension receipt, we do not directly observe how many people receive a pension both inside and outside the labor force. However, this is not a major drawback because we are able to document the abrupt decline in LFP precisely at the age-based eligibility threshold just after the introduction of the OAP.

Using full-count census data enables us to zoom in directly at the age cutoff. Figure 1 shows the distribution of observations over age for the 1911 census, including 68,330 men at age 69 and 61,767 men at age 70. The drop in sample size from age 69 to 70 is natural as sample size declines steadily with age. While the census counts almost 200,000 males at age 50, the number of individuals drops to below 2,000 for males aged 90.

Summary statistics in table 4 report a considerable decline in LFP between age 69 and 70. The drop totals to 8 percentage points (from 76% to 68%), while differences in other observable characteristics are fairly small. At age 70, men have fewer own children in the household, are less often married and exhibit higher disability rates. The increasing household size from age 69 to 70 can be explained by an increasing

likelihood of moving to a nursing home when people grow older.¹³

5 Results

5.1 Baseline Results

We start presenting graphical evidence on LFP rates for the entire period spanning over the census waves from 1891 to 1901 and 1911 (figure 2). For the two age groups at the eligibility threshold set by the OAP, the graph indicates a common trend in the pre-treatment period until 1901.¹⁴ After that, between 1901 and 1911, the two age groups diverge in terms of LFP. In what follows, we will present evidence that this divergence is due to the introduction of the OAP in 1908.

The point estimate that quantifies the LFP differential between 1901 and 1911, as apparent in figure 2, is a precise 6.1 percentage point difference between older men aged 69 and 70 (table 5). This is essentially a difference-in-differences (DiD) estimate that eliminates any time-constant unobservables that would confound estimating the impact of the introduction of the OAP on LFP. The DiD is robust against including any available observable characteristics such as number of own children in the household, household size, and indicator variables for being married, foreign born, disabled, and for each region covering the 53 counties in England and Wales.

Turning to our baseline research design, table 6 reports estimates of the LFP differential at the age threshold. When moving from age 69 to 70, our benchmark RDD estimates¹⁵ indicate a precisely measured drop in male LFP of 6.3 percentage

¹³Note that the average household size is so large only by the definition of some households as “group quarters” that can potentially comprise inhabitants of large buildings such as entire nursing homes. More than 90% of men live in households with less than 12 persons while the median household size is only 4.

¹⁴We cannot reject the null hypothesis of a common pre-trend, supporting the graphical evidence that LFP rates of the two groups move in tandem between 1891 and 1901.

¹⁵The benchmark is defined as an RDD estimate with a bandwidth of 4 age-years to the left and to the right of the age cutoff and uniform kernel weighting (same weight on all observations). Since graphical evidence in figure 4 suggests that linear and quadratic polynomials reproduce the LFP-age relationship very similarly, we present benchmark estimates for both. For simplicity, we use a linear polynomial for the placebo and robustness checks. Results are similar if we use a

points (quadratic polynomial) and 7.6 percentage points (linear polynomial). This closely resembles the DiD estimate reported above and is robust against several sensitivity tests that we discuss later on. Contrasting the male LFP distribution across age separately for the 1901 and the 1911 censuses, figure 3 reveals the striking difference in age-specific LFP patterns before and after the OAP became effective in 1909. Without universal coverage by old-age assistance, participation rates decline gradually over age (figure 3, panel a). In contrast, we observe an abrupt drop in male LFP in 1911 (figure 3, panel b) just at the age cutoff between 69 and 70. Running placebo tests on the 1901 census (table A.1, appendix) indeed confirms that the drop measured after the introduction of the OAP in 1911 was not there in 1901. Moreover, the abrupt decline only appears at the eligibility age after the introduction of OAP, and hence, there is no reason to believe that the abrupt LFP decline could be caused by anything but the availability of the OAP.

We further present several adjustments to the baseline specification. The results provided in table 7 show that the baseline estimates are robust when estimating local non-parametric and bias-corrected point estimates with robust standard errors as suggested by Calonico et al. (2014a,b). Changes in the magnitude of specific estimates are moderate when taking into account relatively strong changes in bandwidth, weighting scheme (uniform vs. triangular kernel) or the specified polynomial.

The estimated decline is sizable both in absolute and relative terms. Departing from a participation rate of 76.5% at age 69, the estimated absolute decline of 6.3 to 7.6 percentage points translates into a relative decline of 8% to 10%. Given the scale of the program and the absence of other social security programs such as unemployment insurance at the time, the substantial decline in participation rates is not surprising. The considerable impact of the 1908 OAP on LFP rates of older men, however, can easily be missed when looking at aggregated labor market trends only (see Johnson, 1994; Costa, 1998). Overall LFP rates of men aged 70 or older have declined by 6.9 percentage points between 1901 and 1911 and thus only slightly faster compared to the period between 1891 and 1901 (6.7 percentage

quadratic polynomial).

points). However, in contrast to the period from 1891 to 1901, when participation rates of men below 70 fell sharply, they remained almost constant between 1901 and 1911. This pattern is also visible from figure 2, showing the LFP patterns of men at age 69 who are marginally below the eligibility age. We thus assume that, without the OAP, LFP of the elderly would have declined more slowly among eligible men. Although this assumption is not testable, it is a plausible one when taking into account the common pre-trend in LFP rates of the age groups 69 and 70.

Our main findings are consistent to the ones of Fetter and Lockwood (2018), who study the effects of the introduction of an old-age assistance program in the US. They find that the labor supply of men aged 65 to 74 declined by 8.5 percentage points between 1930 and 1940 as a consequence of the introduction of old-age assistance in 1935. Our estimated LFP decline of 6.3 to 7.6 percentage points is thus very similar in magnitude. Since pension coverage in the respective age group was larger in the UK (49% of men 70+ in England and Wales compared to 22% of males 65+ in the US), one may expect the effects to be larger in the UK compared to the U.S. In contrast to the U.S. case, where almost half of the decline was explained by exits from work relief programs and unemployment, direct transitions from work to retirement were much more prevalent in the UK as we document in section 5.2.1.

5.2 Effect Heterogeneity

5.2.1 Labor Supply Response

To examine the labor supply response of the population that retires directly from active work, we now disregard the unemployed and the formerly employed and define a sample only for those who are actually working. To encounter the data limitation that we cannot observe whether older men actively work, we assume that those who report an occupation are actively working and that those who report to be unemployed or formerly employed are not working.¹⁶

This exercise shows that almost the entire decline in LFP is driven by people

¹⁶For details on the concept of labor force participation, see section 4.

who stop working (figure 5). The share of active workers declines by 7.1 percentage points at the age-based eligibility threshold (table 8). Thus, more than 93% of the LFP decline (baseline: 7.6 percentage points) can be attributed to people who directly retire from active work. Table 9 also suggests that transitions from both unemployment or former employment explain only little of the large-scale retirement. Once again, this result is very similar to the DiD estimate showing that 98% (6.0 divided by 6.1) of the LFP decline can be explained by exits from working (Table 10).

5.2.2 Inter-Generational Old-Age Support

The effects of a newly established pension system on LFP rates differs between men with and without children because children also serve as a type of old-age insurance (Cain, 1983; Caldwell, 1982; Boldrin and Jones, 2002; Leibenstein, 1957). This mechanism was also recognized during the legislation process of the OAP. After some debates, it was finally decided that voluntary family transfers must be included in the calculation of the annual means of a pension claimant (Casson, 1908). Men with support from their children should react less to the introduction of the OAP simply because they had alternative sources of old-age income and were less likely to pass the means test. Given that we do not have information on actual cash flows between generations, we proxy the availability of children support by cohabitation and distinguish between men with and without own children in the household.

Men without own children in the household do show a stronger decline in LFP rates at the age-based eligibility threshold (table 11). The difference amounts to 0.9 percentage points (RDD) and to 2.0 percentage points (DiD). Interestingly, participation rates of men with own children in the household generally decline faster over age (figure 6), which is consistent with the hypothesis that childrens' support enables the elderly to retire. Although the decision to procreate and cohabit is highly endogenous, we can show that selection on observables does not drive the differential responses. The estimated LFP differentials remain stable when including control variables such as marital status, disability status, being foreign born and

the county of residence in the DiD model.

5.2.3 Occupational Heterogeneity

Empirical evidence on retirement behavior suggests that retirement patterns also differ by physical demands of occupations (Giesecke, 2018). In connection to this finding, we test the hypothesis whether the LFP decline is the strongest for physically demanding jobs because they become more burdensome as people grow older. To analyze the differential impact by occupation, we rely on the International Standard Classification of Occupations (ISCO) at the highest aggregation level (1-digit level, 10 major groups) which is directly provided by IPUMS International. A summary of occupational shares for the two age groups at the age-based eligibility threshold is shown in table 12.

Not all retired men provided information about their original occupation. Thus, we use two different approaches to investigate occupational heterogeneity. First, we focus on the subset of men with known occupational status only and estimate the effects of the OAP on LFP status separately by occupational group. Again, we estimate both a RDD model based on the 1911 census and a DiD model based on all three decennial census waves to account for varying time trends among occupations. To test the difference across occupations within the DiD framework, we also add interactions of the occupational dummy (“Legislators and Managers” is the reference category) with calendar time (census 1911 = 1) and age (age \geq 70 = 1) and thus obtain the triple difference (census 1911 X age dummy X occupational group) as the occupation-specific change in LFP. The estimates in table 13 show considerable differences in the effects of the OAP on LFP by occupational groups.¹⁷ Among men who report their occupation, we find no significant decline in LFP for occupations such as “Legislators and Managers” and “Professionals”. Similarly, army servants that typically retired much earlier also show no abrupt reduction in LFP. However, those occupational groups that tend to be physically demanding, such as agriculture,

¹⁷This is also supported by graphical evidence in figure 7 that shows LFP patterns across age for each occupational group.

crafts workers and operators, do show sizable declines that differ significantly from zero. The measured drops in LFP are somewhat smaller compared to the baseline estimates for the whole sample because they omit the retirees that do not report their occupations.

Restricting the sample to those who reported their occupation may provide flawed results due to selectivity.¹⁸ Our second approach circumvents this problem by repeating the analysis based on the full sample. For this purpose, we construct a dependent variable for each occupational group, indicating whether the individual is active in the specific occupational group ($= 1$) or not ($= 0$). The estimates obtained from this exercise represent the overall activity decline in a specific occupational group relative to the total size of the age group and not only to the members of the occupational group (as previously). The advantage of this approach is that we can include all retired men irrespective of their reporting status because we only need occupational data for men that are still active. Since the interpretation of the estimates changes, table 13 reports the relative activity decline for each occupational group, dividing the estimate by the size of the occupational group at age 69. The estimates including all men show larger differences across occupational groups, pointing at occupation-specific selection in reporting.¹⁹ Physically demanding jobs such as elementary occupations (including mostly common labourers) as well as agriculture and fishery work show the largest declines in LFP. This holds especially when occupation-specific trends over time are accounted for in the DiD framework. Declines are also substantial in other physically demanding occupations such as crafts and related trades as well as machine operators and assemblers. Physically less demanding jobs and army members show only little or no abrupt declines in LFP. Differences between the results from the first approach (only reporting men) and the second approach (all men) are most pronounced for less prestigious or un-

¹⁸Consider the extreme case where only individuals with prestigious occupations report their original occupation. In this case, we would observe no decline in LFP by age for non-prestigious occupations because men who retire from these occupations simply drop from the universe.

¹⁹Again, graphical evidence in figure 8 shows LFP patterns across age for each occupational group but now for the full sample that defines the share of individuals active in the respective occupation.

specific occupations including elementary occupations, indicating that these men in fact report their occupation very rarely once they retired.

5.3 Further Sensitivity Checks

To verify the validity of our results, we first conduct a placebo test by repeating the analysis for different hypothetical retirement ages. The results presented in table 14 show that we do not observe a similar decline in LFP rates at any hypothetical age cutoff other than the true age-based eligibility threshold at age 70.²⁰ Table 14 also shows that there is no substantial drop in LFP at age 60 in the 1901 census. The identifying variation in our baseline specification is based on the birth cohort that reached age 60 in 1901 (and thus age 70 in 1911). This robustness check therefore rules out that the birth cohorts under study already showed a LFP jump at the relevant age cutoff before the introduction of the OAP.

We also test whether observable characteristics, other than the outcome of interest (LFP), show a discontinuity at the threshold. As in the previous analysis, these observables include the number of own children in the household, household size, the share of individuals living in urban areas, and the share of married, foreign born and disabled persons. The estimates in table 15 and figure B.1 suggest that there are discontinuities in the share of foreign born men and in the household size. For the share of foreign born, however, the discontinuity is too small to have any relevance for the results. Moreover, the discontinuity in household size is almost entirely driven by the few very big households (> 12 persons). To further examine whether groups that exhibit discontinuities drive the results, we exclude them interchangeably from the estimation sample. Table 16 and figure B.2 show that dropping the foreign born does not change the conclusions. The results are also robust against dropping large households and we thus conclude that measurable discontinuities in observables at the age-based eligibility threshold are not only small but also uncorrelated to LFP and thus unproblematic for the identification.

²⁰This result holds for any other hypothetical age cutoff. Additional placebo tests are available from the authors upon request.

One final check that we undertake is excluding all men who are married to women aged 70 or older because these men may be affected by the pension of their wife. Once again, however, the results (bottom part of table 16) indicate that excluding men who may indirectly benefit from the pension of their wife does not change the conclusions.

6 Conclusions

This paper adopts a regression discontinuity design to estimate the effects of universal old-age assistance on labor force participation of older men in the UK. The Old-Age Pension Act introduced means-tested minimum pensions in 1909 and created an age-based eligibility threshold at age 70. The identifying variation is based on individuals who decide to retire at first eligibility, when turning 70. We use full-count census data, covering the entire male population between 1891 and 1911. Our outcome is a measure of labor force participation that we derive from detailed information about occupations and labor force withdrawal. We also construct a direct measure of labor supply which requires additional assumptions about available information but allows for economically meaningful insights.

The main finding of this paper is a considerable reduction of male labor force participation in the local environment of the eligibility threshold. When turning 70, labor force participation among men abruptly declines by more than 7 percentage points according to our main specification, thereby reducing the absolute size of the workforce by about 10%. The results are very similar when using a measure of labor supply that considers only those older men who directly retire from active work. Further heterogeneity analysis also suggests that both older men without children and in physically demanding occupations react more strongly to pension incentives, thus showing larger declines in labor force participation.

The historical background of the policy under study provides unique insights on the relationship between pension incentives and labor supply. The introduction of old-age assistance in the early 20th century in the UK was one of the largest

programs of its kind at that time. It was also the only government program that specifically targeted the elderly in the UK. This setting allows us to identify the full labor force participation effects of the program which stands in contrast to large parts of the literature that typically quantifies the incentive effects of marginal changes regarding the parameters of existing pension programs.

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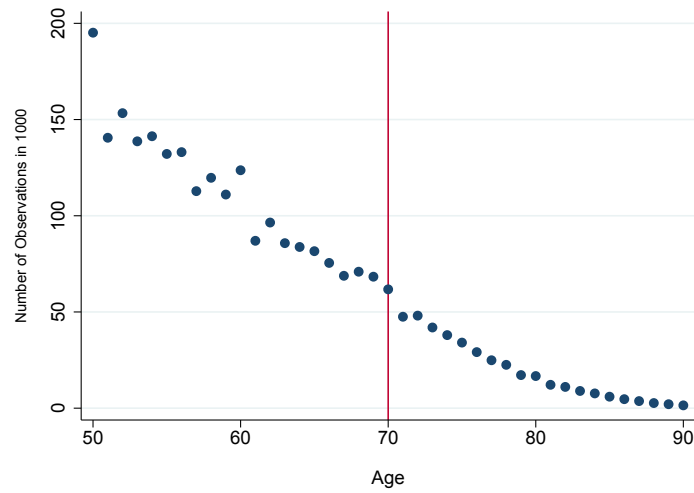
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Appendix

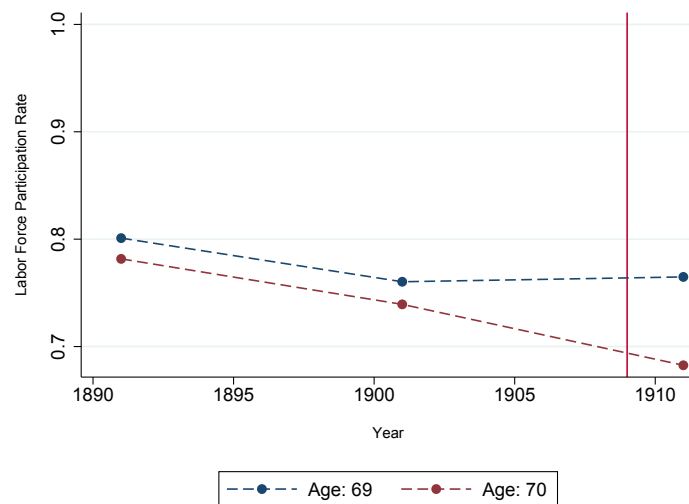
Figures

Figure 1: Number of Observations by Age (Census 1911)



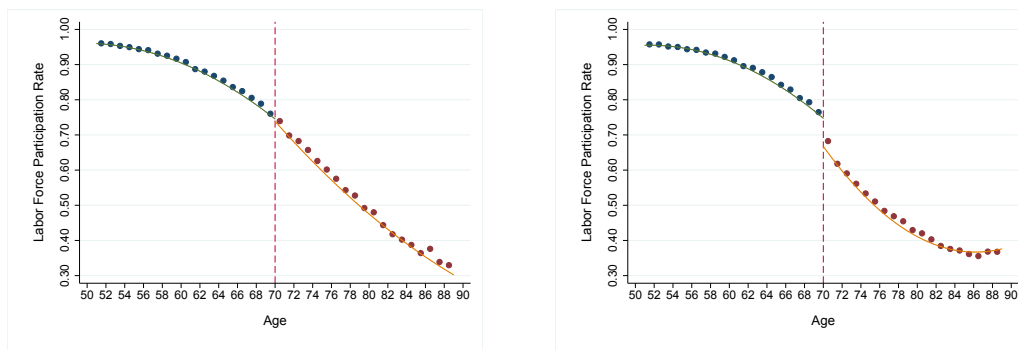
Source: Own calculations based on UK Census (wave 1911) and IPUMS. *Note:* The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.

Figure 2: Labor Force Participation by Calendar Time and Age-Based Eligibility



Source: Own calculations based on UK Census (waves 1891, 1901 and 1911) and IPUMS. *Note:* The vertical line indicates the introduction of old-age assistance by the OAP in 1909.

Figure 3: Labor Force Participation by Age

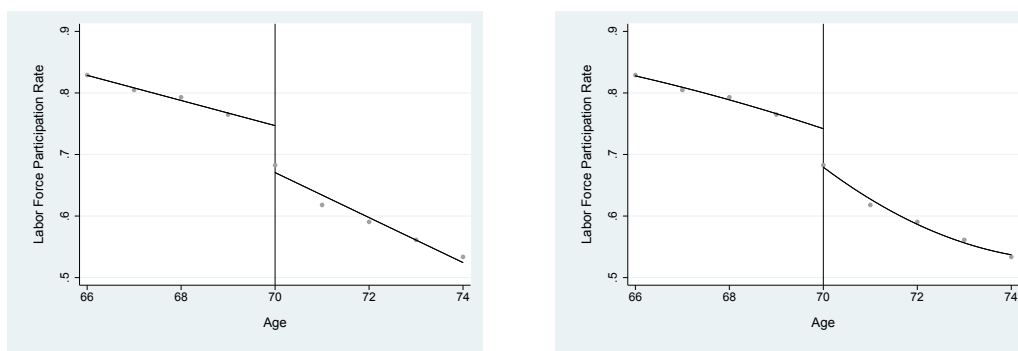


(a) Census 1901

(b) Census 1911

Source: Own calculations based on UK Census (waves 1901 and 1911) and IPUMS. Note: The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.

Figure 4: Functional Form of Labor Force Participation and Age Around the Cutoff

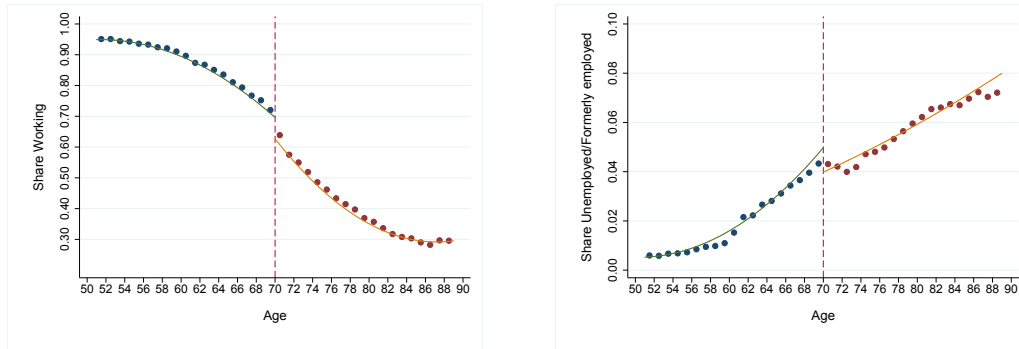


(a) Linear

(b) Quadratic

Source: Own calculations based on UK Census (wave 1911) and IPUMS. Note: The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.

Figure 5: Work Status (1911)

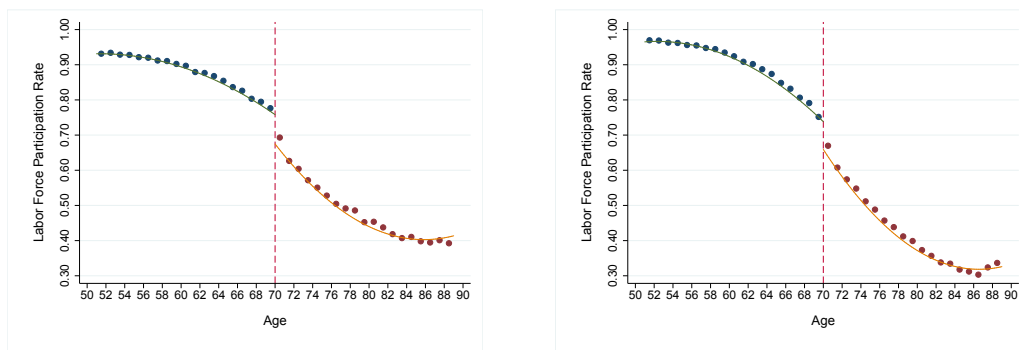


(a) Actively Working

(b) Unemployed/Formerly Working

Source: Own calculations based on UK Census (wave 1911) and IPUMS. Note: The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.

Figure 6: Heterogeneity by Own Children in the Household (1911)

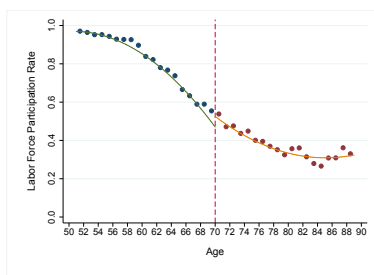


(a) No Own Children

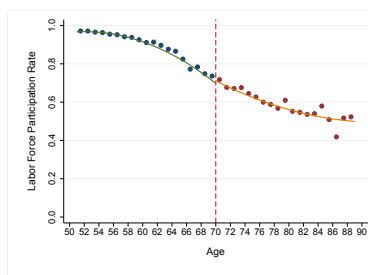
(b) Own Children

Source: Own calculations based on UK Census (wave 1911) and IPUMS. Note: The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.

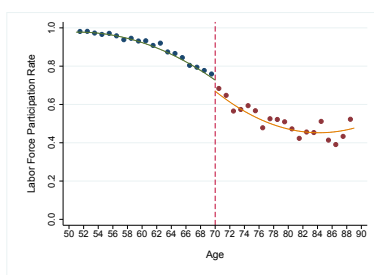
Figure 7: Heterogeneity by Occupation (1911)



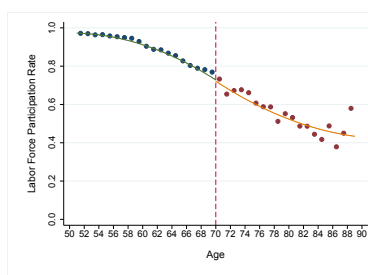
(a) Legislators and Managers



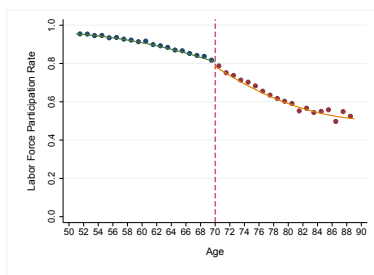
(b) Professionals



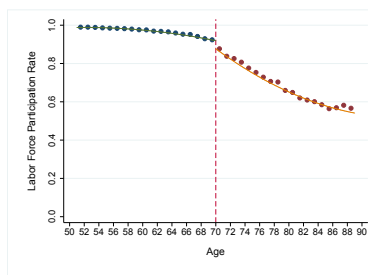
(c) Technicians



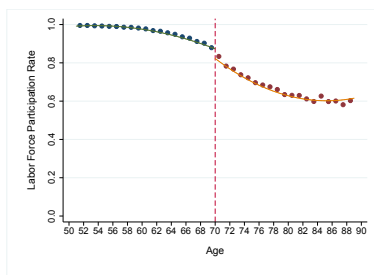
(d) Clerks



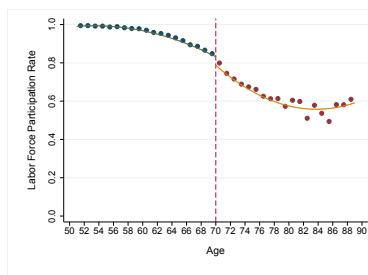
(e) Services



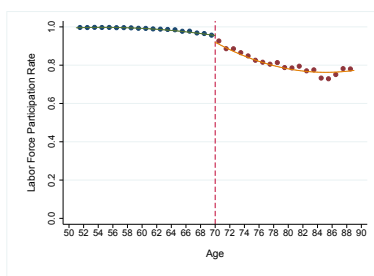
(f) Agriculture and Fishery



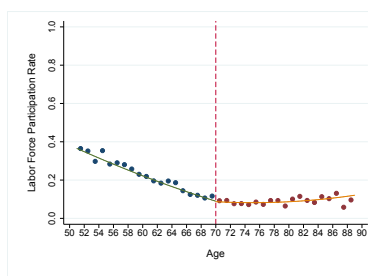
(g) Crafts and Related Trades



(h) Operators and Assemblers



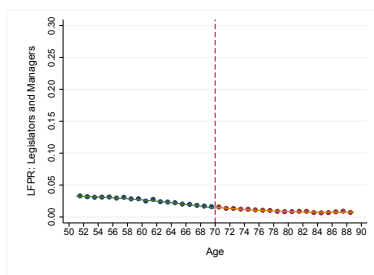
(i) Elementary Occupations



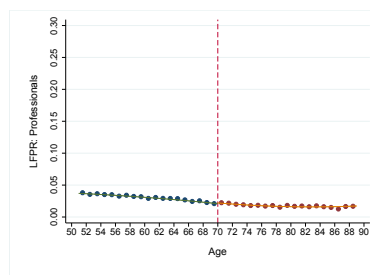
(j) Armed Forces

Source: Own calculations based on UK Census (wave 1911) and IPUMS. Note: The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.

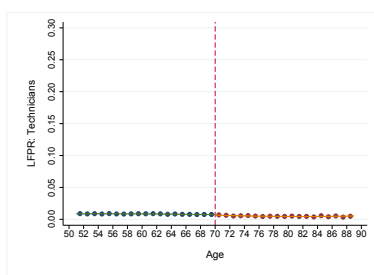
Figure 8: Heterogeneity by Occupation: Share of Active Men (1911)



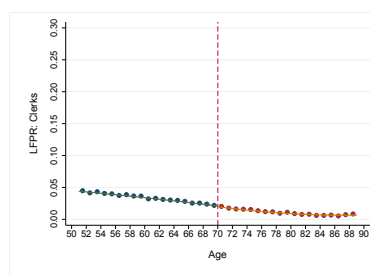
(a) Legislators and Managers



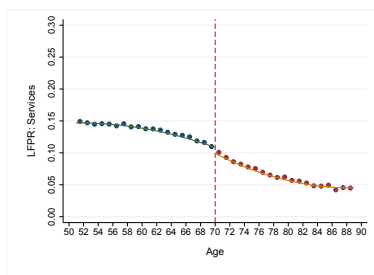
(b) Professionals



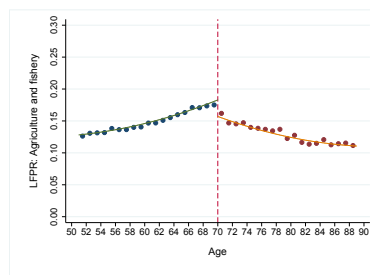
(c) Technicians



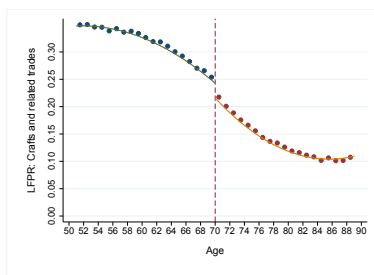
(d) Clerks



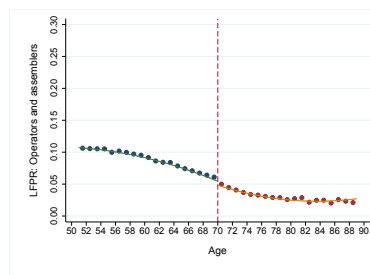
(e) Services



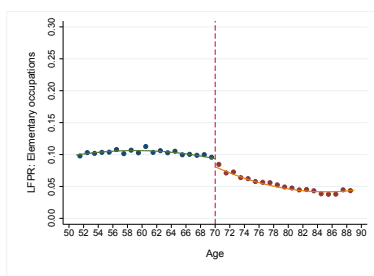
(f) Agriculture and Fishery



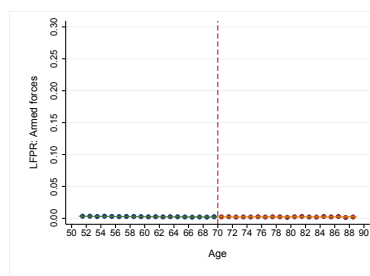
(g) Crafts and Related Trades



(h) Operators and Assemblers



(i) Elementary Occupations



(j) Armed Forces

Source: Own calculations based on UK Census (wave 1911) and IPUMS. Note: The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.

Tables

Table 1: Pension Schedule

Annual Means	Pension (per week)
less or equal £21	5s
more than £21 but less or equal £23 12 s and 6d	4s
more than £23 12s and 6d but less or equal £26 5s	3s
more than £26 5s but less or equal £28 17s and 6d	2s
more than £28 17s and 6d but less or equal £31 10s and 6d	1s
more than £31 and 10s	0s

Source: UK legislation (1908). *Note:* s denotes shillings and d pence. £1 corresponds to 20 s or 240 d.

Table 2: Summary Statistics by Census Wave

	1891		1901		1911	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Labor Force Participation Rate	0.87	0.33	0.86	0.35	0.85	0.36
Number of Own Children in the Household	1.53	1.89	1.57	1.88	1.46	1.80
Share Urban	0.11	0.31	.	.	0.10	0.30
Share Married	0.75	0.44	0.74	0.44	0.72	0.45
Share Foreign Born	0.05	0.22	0.05	0.21	0.04	0.21
Share Disabled	0.01	0.11	0.01	0.11	0.01	0.12
Number of Persons in the Household	21.18	122.53	31.85	180.29	47.46	254.91
<i>N</i>	1,858,233		2,116,780		2,661,979	

Source: UK Census waves 1891, 1901, 1911 and IPUMS. *Note:* Reported values for men aged 50 to 90.

Table 3: Occupational Composition by Census Wave

Occupation	Census 1891		Census 1901		Census 1911	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Legislators and Managers	35,578	2.2	45,685	2.83	65,583	2.9
Professionals	45,704	2.8	59,351	3.41	78,989	3.5
Technicians	16,443	1.0	18,177	1.1	21,248	0.9
Clerks	44,755	2.8	57,712	3.24	85,479	3.8
Service Workers	217,113	13.4	255,865	14.56	341,393	15.1
Agriculture and Fishery	387,366	23.8	352,871	19.08	380,535	16.9
Crafts and Related Trades	546,271	33.6	660,147	36.3	797,159	35.3
Machine Operators and Assemblers	137,737	8.5	172,030	9.28	222,543	9.9
Elementary Occupations	189,908	11.7	190,054	9.89	258,640	11.5
Armed Forces	4,144	0.3	4,881	1.2	7,275	0.3
Active	1,625,019	100	1,816,773	100	2,258,844	100
Inactive	233,214		300,007		403,135	
Total	1,858,233		2,116,780		2,661,979	

Source: UK Census waves 1891, 1901, 1911 and IPUMS.

Note: Reported values for men aged 50 to 90. Occupations based on ISCO classification at the 1-digit level.

Table 4: Summary Statistics by Age (Census 1911)

	69		70	
	Mean	S.D.	Mean	S.D.
Labor force participation rate	0.76	0.42	0.68	0.47
Number of own children in the household	0.85	1.20	0.79	1.15
Share Urban	0.09	0.29	0.10	0.30
Share Married	0.63	0.48	0.61	0.49
Share Foreign born	0.05	0.21	0.06	0.24
Share Disabled	0.02	0.13	0.02	0.13
Number of Persons in the Household	73.23	314.93	70.19	303.97
<i>N</i>	68,330		61,767	

Source: UK Census wave 1911 and IPUMS. Note: Reported values for men aged 69 and 70.

Table 5: Estimates of Labor Force Participation (DiD)

	(1)	(2)	(3)
DiD Estimate	-0.061** (0.004)	-0.060** (0.004)	-0.061** (0.004)
Controls	–	✓	✓
Controls X Census Year	–	–	✓
<i>N</i>	315,764	308,735	308,735

Source: UK Census wave 1891, 1901, 1911 and IPUMS. Note: Estimates for men aged 69 and 70. **, * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses.

The dependent variable is the labor force participation rate.

Table 6: Baseline Estimates of Labor Force Participation at the Age Cutoff (RDD)

	Linear	Quadratic
	-0.076** (0.003)	-0.063** (0.005)
<i>N</i>	520,865	

Source: UK Census wave 1911 and IPUMS. Note: **, * denotes significance at the 1% and 5% level respectively. The bandwidth is 4 age-years to the left (N: 283,554) and to the right (N: 237,311) of the age cutoff with uniform weighting on all observations. Dependent variable: labor force participation rate.

Table 7: Alternative Estimates of Labor Force Participation (RDD)

Estimation Framework	Parametric	Parametric	Local Non-Parametric	Local Non-Parametric	Bias-Corrected	Bias-Corrected
Polynomial	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
<i>Bandwidth</i>						
20	-0.167** (0.001)	-0.083** (0.001)	-0.132** (0.001)	-0.076** (0.002)	-0.076** (0.002)	-0.067** (0.002)
10	-0.107** (0.001)	-0.070** (0.002)	-0.089** (0.002)	-0.067** (0.003)	-0.067** (0.003)	-0.065** (0.004)
9	-0.101** (0.002)	-0.067** (0.002)	-0.085** (0.002)	-0.067** (0.003)	-0.067** (0.003)	-0.061** (0.004)
8	-0.095** (0.002)	-0.069** (0.003)	-0.082** (0.002)	-0.067** (0.003)	-0.067** (0.003)	-0.056** (0.005)
7	-0.089** (0.002)	-0.069** (0.003)	-0.079** (0.002)	-0.065** (0.003)	-0.065** (0.003)	-0.049** (0.006)
6	-0.084** (0.002)	-0.069** (0.003)	-0.076** (0.002)	-0.060** (0.004)	-0.060** (0.004)	-0.045** (0.008)
5	-0.082** (0.002)	-0.063** (0.004)	-0.072** (0.003)	-0.057** (0.005)	-0.057** (0.005)	-0.009 (0.013)
4	-0.076** (0.003)	-0.063** (0.005)	-0.068** (0.003)	-0.039** (0.007)	-0.039** (0.007)	-0.038** (0.004)

Source: UK Census wave 1911 and IPUMS.

*Note:*** , * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. Parametric estimates are OLS estimates with uniform weighting of all observations. Local non-parametric estimates use triangular kernel weighting, putting more weight on observations close to the cutoff. Bias-corrected estimates use the bias correction proposed by Calonico et al. (2014a,b) including robust standard errors and triangular kernel weighting. Dependent variable: labor force participation rate.

Table 8: Estimates of Labor Supply (RDD) for Retirement from Active Work

Estimation Framework	Parametric	Parametric	Local Non-Parametric	Local Non-Parametric	Bias-Corrected	Bias-Corrected
Polynomial	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
<i>Bandwidth</i>						
20	-0.166** (0.001)	-0.072** (0.001)	-0.127** (0.001)	-0.067** (0.002)	-0.067** (0.002)	-0.064** (0.003)
10	-0.100** (0.002)	-0.066** (0.002)	-0.084** (0.002)	-0.062** (0.003)	-0.062** (0.003)	-0.061** (0.004)
9	-0.095** (0.002)	-0.062** (0.002)	-0.080** (0.002)	-0.063** (0.003)	-0.063** (0.003)	-0.057** (0.005)
8	-0.089** (0.002)	-0.064** (0.003)	-0.077** (0.002)	-0.062** (0.003)	-0.062** (0.003)	-0.052** (0.005)
7	-0.083** (0.002)	-0.064** (0.003)	-0.074** (0.002)	-0.061** (0.004)	-0.061** (0.004)	-0.044** (0.006)
6	-0.079** (0.002)	-0.065** (0.003)	-0.071** (0.002)	-0.056** (0.004)	-0.056** (0.004)	-0.039** (0.008)
5	-0.077** (0.002)	-0.059** (0.004)	-0.067** (0.003)	-0.052** (0.005)	-0.052** (0.005)	-0.005 (0.014)
4	-0.071** (0.003)	-0.058** (0.005)	-0.064** (0.003)	-0.034** (0.008)	-0.034** (0.008)	-0.037** (0.004)

Source: UK Census wave 1911 and IPUMS.

*Note:*** , * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. Parametric estimates are OLS estimates with uniform weighting of all observations. Local non-parametric estimates use triangular kernel weighting, putting more weight on observations close to the cutoff. Bias-corrected estimates use the bias correction proposed by Calonico et al. (2014a,b) including robust standard errors and triangular kernel weighting. Dependent variable: labor force participation rate.

Table 9: Estimates of Retirement from Unemployment/Former Employment (RDD)

Estimation Framework	Parametric	Parametric	Local Non-Parametric	Local Non-Parametric	Bias-Corrected	Bias-Corrected
Polynomial	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
<i>Bandwidth</i>						
20	0.000 (0.000)	-0.010** (0.001)	-0.004** (0.001)	-0.007** (0.001)	-0.007** (0.001)	-0.002* (0.001)
10	-0.007** (0.001)	-0.003** (0.001)	-0.005** (0.001)	-0.004** (0.001)	-0.004** (0.001)	-0.004 (0.002)
9	-0.006** (0.001)	-0.004** (0.001)	-0.005** (0.001)	-0.004** (0.001)	-0.004** (0.001)	-0.004* (0.002)
8	-0.006** (0.001)	-0.004** (0.001)	-0.004** (0.001)	-0.004** (0.001)	-0.004** (0.001)	-0.004 (0.002)
7	-0.005** (0.001)	-0.004** (0.001)	-0.004** (0.001)	-0.004* (0.002)	-0.004* (0.002)	-0.005 (0.003)
6	-0.005** (0.001)	-0.004* (0.001)	-0.004** (0.001)	-0.004* (0.002)	-0.004* (0.002)	-0.006 (0.004)
5	-0.005** (0.001)	-0.004* (0.002)	-0.004** (0.001)	-0.004 (0.002)	-0.004 (0.002)	-0.004 (0.006)
4	-0.004** (0.001)	-0.004 (0.002)	-0.004* (0.001)	-0.005 (0.003)	-0.005 (0.003)	-0.001 (0.002)

Source: UK Census wave 1911 and IPUMS.

*Note:*** , * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. Parametric estimates are OLS estimates with uniform weighting of all observations. Local non-parametric estimates use triangular kernel weighting, putting more weight on observations close to the cutoff. Bias-corrected estimates use the bias correction proposed by Calonico et al. (2014a,b) including robust standard errors and triangular kernel weighting. Dependent variable: labor force participation rate.

Table 10: Labor Supply Response (DiD)

	(1)	(2)	(3)
<i>Employed</i>			
DiD Estimate	-0.060** (0.004)	-0.060** (0.004)	-0.059** (0.004)
Controls	–	✓	✓
Controls X Census Year	–	–	✓
<i>Unemployed/Formerly Employed</i>			
DiD Estimate	-0.001 (0.001)	0.000 (0.001)	-0.001 (0.001)
Controls	–	✓	✓
Controls X Census Year	–	–	✓
N	315,764	308,735	308,735

Source: UK Census (waves 1891, 1901, 1911) and IPUMS. Note: Estimates for men aged 69 and 70. **, * denotes significance at the 1% and 5% level respectively. RDD estimates use a linear polynomial, bandwidth of 4 age-years to the left and to the right of the age cutoff and uniform weighting on all observations. Standard errors in parentheses. Dependent variable is the labor force participation rate.

Table 11: Estimates Stratified by Own Children (RDD and DiD)

	RDD: No Own children	RDD: Own children	DiD
Estimate	-0.081** (0.003)	-0.072** (0.004)	
Difference			-0.020** (0.007)
N	218,771	188,623	315,764

Source: UK Census (waves 1891, 1901 and 1911) and IPUMS. Note: **, * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. RDD estimates use linear polynomial, bandwidth of 4 age-years to the left and to the right of the age cutoff and uniform weighting on all observations. DiD estimates augmented by all possible interactions between census dummy, age 70 dummy and no children dummy. Difference: Estimate of the triple interaction: census 1911 X age dummy X no child. Dependent variable: labor force participation rate.

Table 12: Occupation by Age (Census 1911)

Occupation	69		70	
	Frequency	Percent	Frequency	Percent
Legislators and Managers	1,106	1.6	975	1.6
Professionals	1,434	2.1	1,383	2.2
Technicians	523	0.8	430	0.7
Clerks	1,499	2.2	1,256	2.0
Service Workers	7,510	11.0	6,230	10.1
Agriculture and Fishery	11,961	17.5	9,999	16.2
Crafts and Related Trades	17,346	25.4	13,434	21.7
Machine Operators and Assemblers	4,168	6.1	3,087	5.0
Elementary Occupations	6,547	9.6	5,225	8.5
Armed Forces	169	0.2	142	0.2
Inactive	16,067	23.5	19,606	31.7
<i>N</i>	68,330		61,767	

Source: UK Census wave 1911 and IPUMS.

Note: Occupations based on ISCO classification at the 1-digit level.

Table 13: Estimates of Labor Force Participation under Heterogeneity by Occupation

	Legislators Managers	Professionals	Technicians	Clerks	Services	Agriculture Fishery	Crafts	Operators Assemblers	Elementary	Military
	Model 1: Estimates only including retirees that reported an occupation									
RDD	-0.011 (0.016)	-0.017 (0.015)	-0.077** (0.025)	-0.049** (0.014)	-0.029** (0.006)	-0.040** (0.004)	-0.041** (0.004)	-0.045** (0.008)	-0.031** (0.004)	-0.014 (0.012)
N	11,918	12,410	3,995	11,486	52,984	74,523	111,111	27,099	37,693	9,389
DiD	0.003 (0.026)	-0.012 (0.021)	-0.017 (0.038)	-0.044* (0.022)	-0.030** (0.009)	-0.034** (0.005)	-0.037** (0.005)	-0.042** (0.012)	-0.021** (0.006)	-0.014 (0.021)
N	7,818	8,942	3,211	7,801	39,535	69,555	85,955	20,380	30,352	5,378
DiD	Reference group	-0.015 (0.024)	-0.020 (0.034)	-0.047 (0.025)	-0.033 (0.020)	-0.037 (0.019)	-0.040* (0.019)	-0.044* (0.021)	-0.024 (0.020)	-0.017 (0.028)
N	278,927	278,927	278,927	278,927	278,927	278,927	278,927	278,927	278,927	278,927
	Model 2: Estimates including all retirees									
RDD	0.000 (0.001)	0.002 (0.001)	-0.001(0.000)	-0.002(0.001)	-0.006**(0.002)	-0.019**(0.002)	-0.030**(0.002)	-0.008**(0.001)	-0.014**(0.002)	0.000(0.000)
Relative	2.3%	11.1%	-11.7%	-7.3%	-5.4%	-10.6%	-11.8%	-13.5%	-14.3%	-6.1%
N	407,394	407,394	407,394	407,394	407,394	407,394	407,394	407,394	407,394	407,394
DiD	0.002* (0.001)	0.003* (0.001)	0.000 (0.001)	0.000 (0.001)	-0.002 (0.003)	-0.023** (0.003)	-0.020** (0.004)	-0.006** (0.002)	-0.015** (0.002)	0.000 (0.000)
Relative	12.7%	13.2%	2.6%	-0.3%	-2.1%	-12.9%	-8.0%	-9.3%	-16.1%	1.3%
N	315,764	315,764	315,764	315,764	315,764	315,764	315,764	315,764	315,764	315,764

Source: UK Census waves 1891, 1901, 1911 and IPUMS.

Note: **, * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. RDD estimates use linear polynomial, bandwidth of 4 age-years to the left and to the right of the age cutoff and uniform weighting on all observations. Dependent variable: labor force participation rate.

Table 14: Placebo Tests

Age Cutoff	RDD	DiD
<i>Census 1911</i>		
69	-0.027** (0.002)	0.000 (0.003)
65	-0.011** (0.002)	-0.004 (0.003)
60	-0.005** (0.001)	0.000 (0.002)
<i>Census 1901</i>		
60	-0.004** (0.001)	

Source: UK Census wave 1891, 1901, 1911 and IPUMS. *Note:* **, * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. RDD estimates use linear polynomial, bandwidth of 4 age-years to the left and to the right of the age cutoff and uniform weighting on all observations. Dependent variable: labor force participation rate.

Table 15: Discontinuity of Observables at the Age Cutoff

Number of Children	0.004 (0.007)
Share Urban	0.000 (0.002)
Share Married	-0.003 (0.003)
Share Foreign Born	0.009** (0.001)
Share Disabled	0.001 (0.001)
Household Size	-5.378** (1.748)
Household Size (only below 12)	-0.027* (0.012)

Source: UK Census wave 1891, 1901, 1911 and IPUMS. *Note:* **, * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. RDD models use bandwidth of 4 age-years to the left and to the right of the age cutoff with uniform weighting on all observations. Dependent variable is the respective observable.

Table 16: Further Robustness Checks: Excluding Subgroups

Excluding Foreign Born	-0.078** (0.003)
Only Household Size Below 12	-0.080** (0.003)
Excluding Men With Spouses Age ≥ 70	-0.0077** (0.003)

Source: UK Census wave 1911 and IPUMS. *Note:* **, * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. RDD estimates use linear polynomial, bandwidth of 4 age-years to the left and to the right of the age cutoff and uniform weighting on all observations. Dependent variable: labor force participation rate.

A Additional Tables

Table A.1: Placebo Estimates of Labor Force Participation (RDD) – Census 1901

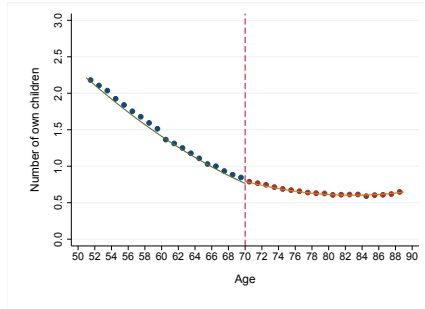
Estimation Framework	Parametric	Parametric	Local Non-Parametric	Local Non-Parametric	Bias-Corrected	Bias-Corrected
Polynomial	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
<i>Bandwidth</i>						
20	-0.067** (0.001)	-0.008** (0.001)	-0.042** (0.001)	-0.008** (0.002)	-0.008** (0.002)	-0.008** (0.003)
10	-0.025** (0.002)	-0.008** (0.003)	-0.018** (0.002)	-0.003 (0.003)	-0.003 (0.003)	0.003 (0.005)
9	-0.023** (0.002)	-0.004 (0.003)	-0.015** (0.002)	-0.003 (0.003)	-0.003 (0.003)	0.008 (0.005)
8	-0.019** (0.002)	-0.005 (0.003)	-0.013** (0.002)	-0.001 (0.004)	-0.001 (0.004)	0.012* (0.006)
7	-0.016** (0.002)	-0.004 (0.003)	-0.011** (0.002)	0.002 (0.004)	0.002 (0.004)	0.016* (0.007)
6	-0.015** (0.002)	-0.001 (0.004)	-0.009** (0.003)	0.007 (0.005)	0.007 (0.005)	0.016 (0.010)
5	-0.013** (0.003)	0.005 (0.005)	-0.005 (0.003)	0.009 (0.006)	0.009 (0.006)	0.033* (0.015)
4	-0.008** (0.003)	0.006 (0.006)	-0.002 (0.004)	0.019** (0.004)	0.019** (0.004)	0.033* (0.015) ^a

Source: UK Census wave 1901 and IPUMS.

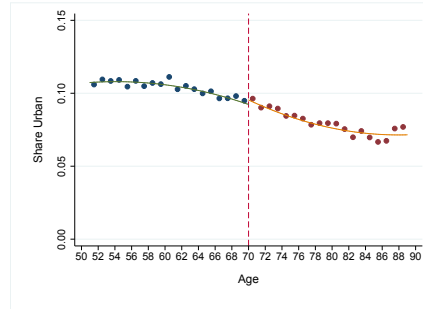
*Note:*** , * denotes significance at the 1% and 5% level respectively. Standard errors in parentheses. Parametric estimates are OLS estimates with uniform weighting of all observations. Local non-parametric estimates use triangular kernel weighting, putting more weight on observations close to the cutoff. Bias-corrected estimates use the bias correction proposed by Calonico et al. (2014a,b) including robust standard errors and triangular kernel weighting. Dependent variable: labor force participation rate.

B Additional Figures

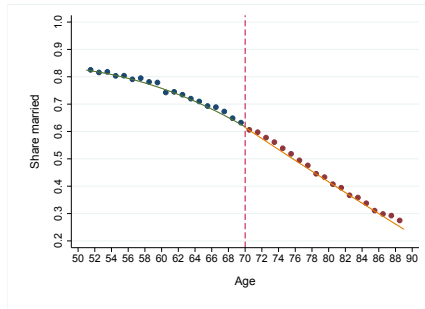
Figure B.1: Continuity of Observable Characteristics at Age Cutoff



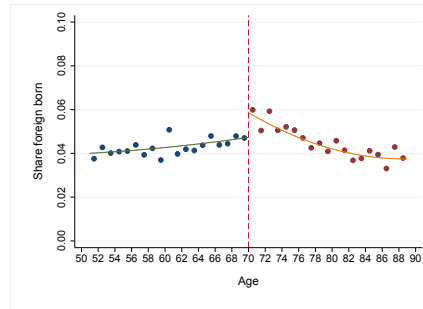
(a) Children in Household



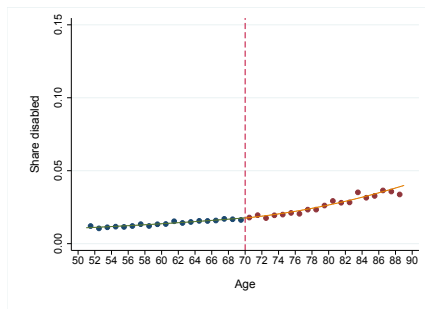
(b) Urban



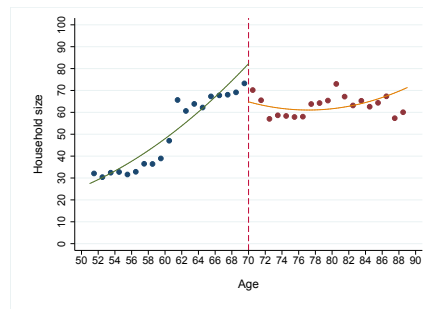
(c) Married



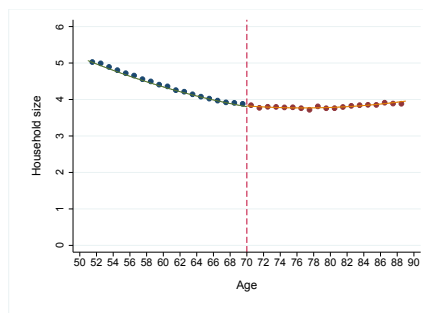
(d) Foreign born



(e) Disabled



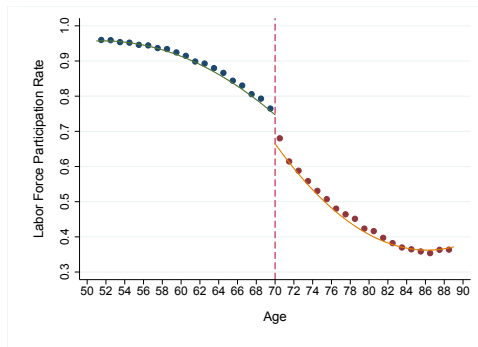
(f) Household Size



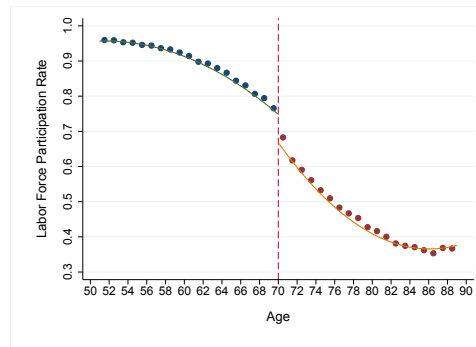
(g) Household Size (<12)

Source: Own calculations based on UK Census (wave 1911) and IPUMS. *Note:* The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.

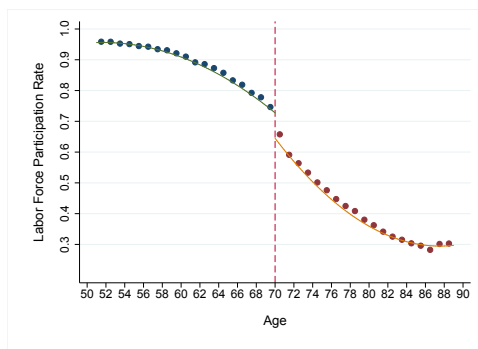
Figure B.2: Further Sensitivity Checks – Exclusion of Subgroups



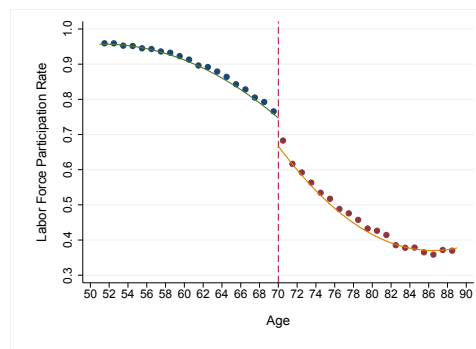
(a) Children in Household



(b) Urban



(c) Married



(d) Foreign born

Source: Own calculations based on UK Census (wave 1911) and IPUMS. *Note:* The vertical line indicates the age-based eligibility threshold at age 70 that was introduced by the OAP in 1909.