Redistribution in the UK state pension system[1]

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Abstract

This paper examines intragenerational redistribution arising from the (pay-as-you-go financed) state pension system in the UK for the cohort born in the 1930s. Previous papers looking at the UK have relied on simulated contribution histories and focussed only on men. We remedy these deficiencies by making use of newly available administrative data on individuals' contribution histories and including both men and women in our analysis. We also add to the wider existing literature in this area by explicitly considering how measured redistribution is affected by the assumption of how couples share their income during working life and retirement. Furthermore, we shed light on the potential effect of scaling back the earnings-related second tier of a pension system, which many countries are currently doing or considering, by simulating the effect on intragenerational redistribution of recent reforms implemented in the UK that eliminate the second tier.

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1. Introduction

State pension systems redistribute income both across individuals' lives and between different individuals. Redistribution between individuals can occur either within cohorts or (as is often the case in pay-as-you-go systems) between cohorts.[2] In this paper we focus on intragenerational redistribution arising from lifetime contributions to and benefits from the state pension system in the UK for the cohort born in the 1930s, and abstract from intergenerational redistribution.[3] We add to previous work studying the UK (Creedy (1993) and Creedy, Disney and Whitehouse (1993)) by making use of newly available administrative data on individuals' lifetime contributions, rather than relying on simulated employment and earnings histories. These new data allow us to include women in our analysis, who were excluded from earlier work owing to the difficulty of accurately simulating their contribution histories. Adding women to the analysis changes significantly the overall patterns of redistribution as, particularly for the cohort we examine, women were very different to men in terms of their employment and contribution patterns over their lifetimes.

It is common for the literature to find that state pension systems redistribute from men to women and from rich to poor (see Borsch-Supan and Reid-Held (2001), Nelissen (1995) and Coronado et al. (2002)). It has been shown that differential mortality between high and low socioeconomic status individuals offsets the overall progressivity of a system (Nelissen (1995) and Creedy, Disney and Whitehouse (1993)), but can increase the inequality in returns to women and men, as women tend to live for longer than men (Falkingham and Johnson (1993)). Studies of redistribution done by the tax and benefit system have found that overall, most spending done by the state reflects redistribution across people's lifetimes, rather than redistribution between people (Falkingham and Harding (1996), O'Donoghue (2001) and Bovenberg, Hansen and Sorenson (2008)).

How much redistribution happens between people and which types of people are net contributors and which are net beneficiaries depends on what assumption one makes about how couples share their income in working life and in retirement. This is an issue that has not previously been examined in this literature. We show that there is much less inter-personal redistribution when we assume that couples pool their income than when we assume that they each benefit only from income their receive directly. In other words, some of the inter-

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[2] A number of studies have highlighted the fact that the first cohorts to receive a pension from a new pay-as-you-go system typically receive higher benefits than the contributions paid and this reverses for later cohorts. See, for example, Disney and Whitehouse (1993) for the UK and Leimer (1994) for the US.

[3] Using information on lifetime contributions and benefits allows us to capture more accurately than is possible using just one-year snapshots of income the redistribution achieved by the state. A number of papers have demonstrated that using one-year snapshots grossly overstates the amount of redistribution between people compared to using information on entire lifetimes (Bengtsson, Holmlund and Waldenstrom (2012), Bjorklund and Palme (2002), Bovenberg, Hansen and Sorenson (2008)).

personal redistribution apparently achieved by the state pension system may in any case be achieved by couples sharing their income.

How much intragenerational redistribution is achieved by a state pension system is important for understanding the role of the state pension system as a lever for redistribution, as well as the implications of fast-changing international state pensions policy. After the global recession and financial crisis there was a deterioration in the financial health of state pension systems around the world. One policy response has been to reduce the generosity of the second (earnings-related) tier of the state pension system and rely more heavily on the first, 'basic', tier (OECD, 2013). In this context the UK state pensions system provides an interesting case study; it began to reduce the generosity of its second tier, earnings-related state pension as early as 1985, and so is in some sense 'ahead' of state pensions undergoing reform elsewhere. In this paper we examine redistribution achieved by the existing state pension rules that apply to the 1930s cohort and compare this to the redistribution that would have been achieved had the 1930s cohort instead faced the rules that apply to younger cohorts. For younger cohorts the second tier has been entirely removed, leaving only a flat-rate first tier.

In this paper we use a rich dataset that links historical administrative records (from the National Insurance (NI) system) to household survey data (from the English Longitudinal Study of Ageing (ELSA)). The NI data provides information on employment since 1948 and earnings from 1975 onwards, allowing us to look at the same individuals over a 55-year period – a long time by the standards of the datasets used in the rest of the literature. The link to household data also means that we can link partners together and can observe a greater range of socio-demographic information about sample members. We investigate the relative importance of redistribution between individuals and across individuals' lifetimes. We focus on intragenerational redistribution (as opposed to intergenerational redistribution) by imposing revenue neutrality: that is, by construction the total contributions of our cohort are assumed to equal their total benefits. While intergenerational redistribution is both interesting and important, data constraints mean that it is beyond the scope of this paper.

We follow most closely the methodology of Creedy (1993), who studies intragenerational redistribution within a simulated cohort of men born in 1960. We repeat his calculation of the redistribution expected by the state pension, by comparing accrued entitlement to lifetime earnings and comparing inequality in lifetime earnings with inequality in earnings net of contributions and accrued pension benefits. We also consider the proportion of contributions made by the cohort that represent transfers between individuals rather than transfers across the lifecycle.

The rest of this paper proceeds as follows. Section 2 discusses the data used and the sample for which we conduct our analysis, and describes the distribution of gross lifetime earnings. Section 3 briefly describes our methodology (more detail

is provided in Appendix B). Section 4 describes how state pension entitlements vary across individuals under existing state pension legislation and how these benefits compare with the financial contributions made to the system for different groups of people. Section 5 then examines how these patterns might have been different had different state pension rules been in place; the alternative systems we consider approximate the steady-state version of some of the main reforms that have been enacted over the last 40 years. Having described how benefits received by individuals and their benefit–contribution ratios vary across different groups, Section 6 considers how this picture is altered if we assume that couples pool their income both during working life and in retirement. Section 7 discusses the implications of the results and concludes.

2. Data and sample

In this paper, we make use of survey responses to the English Longitudinal Study of Ageing (ELSA), linked to respondents' National Insurance (NI) records, to analyse the extent of redistribution provided by the UK state pension system to people in England who were born in the 1930s. This section describes the data used in more detail (Section 2.1), sets out the reasons for our choice of cohort and describes the implications of necessary sample restrictions for the representativeness of our sample (Section 2.2). Section 2.2 also describes the characteristics of our sample, including the distribution of gross lifetime earnings.

2.1 Data

ELSA is a biennial household panel survey that interviews a representative sample of the English household population aged 50 and over. It began in 2002–03 with a sample of around 12,000 individuals and, to date, five subsequent 'waves' of data have been collected. The ELSA survey collects a large amount of data on demographics, labour market behaviour, financial circumstances, subjective and objective measures of health, and individuals' expectations about various future events.

Respondents to the ELSA survey are also asked for permission to access their NI records held by HM Revenue and Customs. These are the administrative record of individuals' NI contributions, and are the same records used by the government to determine actual entitlement. For those individuals who gave permission in wave 1 (2002–03), their linked NI records are available up to the 2003–04 financial year. The analysis in this paper is therefore based on the first wave of ELSA. Further detail on the first wave of ELSA is provided in Marmot et al. (2003).

The information contained in these records varies over time. Between 1948 and 1974, the NI data record the number of weeks that an individual earned above the lower earnings limit (LEL) or received a NI credit. From 1975, the NI data record the level of earnings from employment, although before 1997 this is capped at the upper earnings limit (UEL)).

This restriction means that we have to estimate both earnings before 1975 and earnings above the UEL between 1975 and 1996. We estimate earnings profiles prior to 1975 on the basis of the number of NI contributions they made over the period, as well as their age, sex, education and average observed earnings post-

1975, as well as average economy-wide earnings growth. We estimate earnings above the UEL using a fixed effects tobit.[4]

In addition to information on earnings, the NI data contain information on past NI credits, 'home responsibilities protection' (time spent out of work caring for children) and periods of self-employment.

2.2 Sample

We have high quality data beyond 1975, but no data at all beyond 2003–04. Our choice of cohort therefore involves a trade-off between the quantity and quality of information we can observe over our cohort's working life. We choose to analyse the cohort of men and women born in the 1930s, as they all had reached the state pension age by 2004–05 and so their NI records were effectively complete by 2003–04.

The first wave of ELSA interviewed 3,627 people born in the 1930s (1,736 men and 1,891 women), of whom 2,494 (1,218 men and 1,276 women) were successfully linked to their NI records. For the purposes of our analysis, we must make two additional sample restrictions. First, we exclude individuals for whom we do not observe their (current or former) partner in both ELSA and the NI data. This is necessary because we need to observe both members of a couple to describe pooled outcomes. Second, we exclude the long-term self-employed (and their partners), where this is defined as spending 10 or more years in self-employment after 1975. We make this restriction because the NI data does not include the level of earnings for this group, and so we cannot accurately calculate lifetime earnings for those who spent a large proportion of their lives as self-employed.

These restrictions reduce the sample to 1,296 individuals: 709 men and 587 women. (The first sample restriction drops far more women than men, as women are much more likely to outlive their spouse than men.) Table A.2 in Appendix A examines the representativeness of our resulting sample. Unsurprisingly (given the sample restrictions described above), our sample is under-representative of single individuals, the self-employed and, probably as a result, those with the lowest levels of household wealth. However, in terms of other observable characteristics, our sample is broadly representative of individuals in ELSA born in the 1930s.

Finally, there is one further implicit restriction on our sample that should be acknowledged. Since ELSA interviews those who were alive in 2002–03, it excludes those members of the 1930s cohort who died before this date. Therefore, even without the additional restrictions described above, our sample would not be representative of the entire 1930s cohort who ever either received

[4] More detail on this technique is available in Crawford and O'Dea (2014).

a state pension or 'paid into' the state pension system. We estimate (from Office for National Statistics (ONS) life tables) that roughly 7% of this cohort died after reaching the SPA but before 2002–03, and an even higher fraction will have died before reaching the SPA. These people are implicitly excluded from our analysis.[5]

Some summary statistics of the resulting sample are described in Table 2.1. Slightly more than half of our sample members are men, and individuals are predominantly in couples and have had children. Virtually all individuals have done at least some paid work in the past, although around three-quarters report themselves to be retired by the time they are observed in 2002–03.

Table 2.1. Summary of sample characteristics

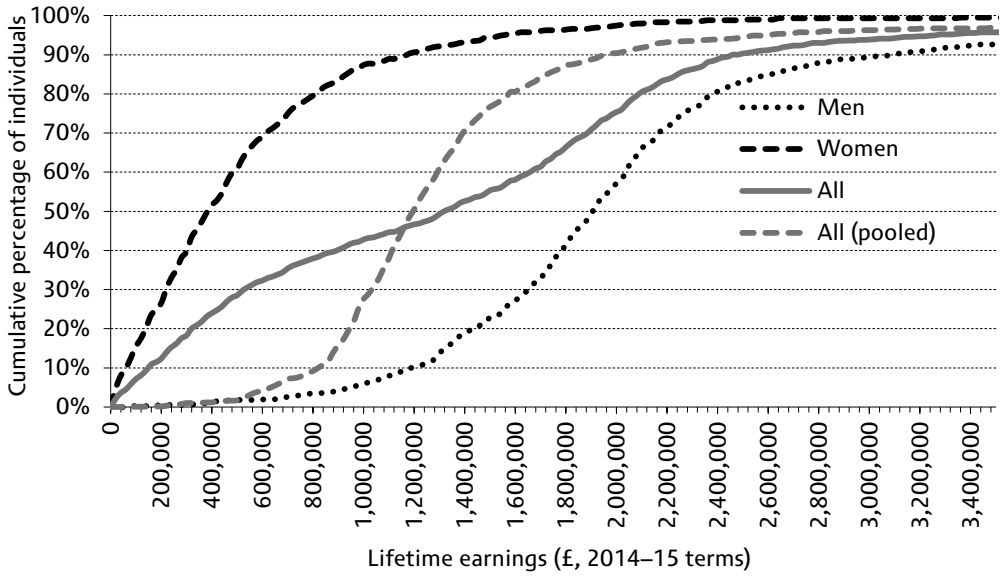
	Men	Women
Percentage:		
In a couple	92.2	92.7
With children	87.9	89.6
Low education	64.4	59.8
Medium education	25.3	30.4
High education	10.3	9.8
Ever worked	99.9	99.3
Homeowner	83.4	85.4
Currently: employee	12.1	7.5
self-employed	2.0	0.5
retired	76.6	72.7
other	9.3	19.3
Self-reported health: excellent	12.2	13.2
very good	27.8	27.2
good	29.5	36.8
fair	21.2	17.1
poor	9.3	5.8
Average year of birth	1935.0	1935.1
Median household wealth (£'000s)	207.3	203.7
Mean household wealth (£'000s)	138.0	143.0
Sample size	*709*	*587*

Note: 'Low' education defined as leaving school at or before the compulsory school-leaving age. 'Medium' education defined as leaving school between the compulsory school-leaving age and 18. 'High' education assigned to those who left education at the age of 19 or later. Wealth is total non-pension wealth of the benefit unit. Three respondents have missing education, three have missing self-reported health status and six have missing wealth information.

[5] Based on Government Actuary's Department (GAD) cohort estimates of life expectancy for England and Wales, 19.2% of men born in 1934 who reached the age of 16 did not survive to the SPA (65), compared with 8.9% of women (for whom the SPA is 60).

We calculate lifetime earnings for our sample as the sum of real discounted earnings between the age of 16 and the state pension age. We using the retail prices index[6] and a discount rate of 2% to approximate real growth over the period.[7] The resulting distribution of gross lifetime earnings is illustrated in Figure 2.1, with measures of inequality shown in Table 2.2.

Figure 2.1. Distribution of lifetime earnings



Note: Lifetime earnings are in 2014–15 prices, discounted to 2014–15. 'All (pooled)' illustrates the distribution of lifetime earnings assuming that husbands and wives share equally in the combined earnings that they both receive.

Men in this cohort typically earned much more than women, with median lifetime earnings of £1,907,000 compared to just £384,000 for women. Moreover, male earnings are more equal than those of women, which reflects the fact that women at the 10th percentile of lifetime earnings would have spent a lot of their working-age life with zero earnings and hence have very low lifetime earnings relative to those at the top of the distribution. In addition, both Figure 2.1 and Table 2.2 show that assuming that couples pool income reduces inequality in lifetime earnings; the Gini coefficient falls from 0.47 on an individual basis to 0.26 on a pooled basis.[8]

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[6] While there has been considerable debate about the appropriateness of this index of inflation (see, for example, Levell (2014)), it is the only index that is available for a sufficiently long period in the UK. Many of the concerns raised about the retail price index (RPI) have also only become acute in recent years and so this index may be a more reasonable estimate of inflation over the longer periods we consider here.

[7] The level of an individual's lifetime earnings expressed in this way is therefore sensitive to which year individuals earned the income in. Table B.1 in Appendix B shows how the ranking of individuals according to their lifetime earnings is affected by using a 0% discount rate instead.

[8] Inequality of *annual* income would be much higher than we observe within our lifetime measure. This is because the lifetime measure smoothes out variation associated with temporarily high/low income. See Roantree and Shaw (2014) for a detailed comparison of annual and lifetime measures of economic outcomes.

Table 2.2. Inequality in lifetime earnings

	90:10 ratio	**Gini coefficient**
All	16.2	0.47
Men	2.6	0.28
Women	19.6	0.49
All (pooled)	2.4	0.26

Note: 90:10 ratio is the ratio between the 90th percentile and the 10th percentile of the distribution of lifetime earnings, with higher numbers indicating greater inequality. The Gini coefficient ranges from 0 to 1, where 0 indicates perfect equality and 1 maximal inequality.

1. Methodology

In this paper, we examine how state pension benefits received differ across different types of people and also look at how these benefits compare with the financial contributions paid into the system. This section describes how we measure state pension benefits and financial contributions to the system and describes the three main measures of 'redistribution' that we look at.

3.1 Valuing state pension benefits

To construct our definition of the value of state pension benefits, we calculate entitlement according to the realised rules as well as the rules of the alternative stylised systems that we compare (more information on these systems is provided in Sections 4.1 and 5.1). As with lifetime earnings, we sum the real present value of state pension benefits, using the retail prices index and a discount rate of 2%.

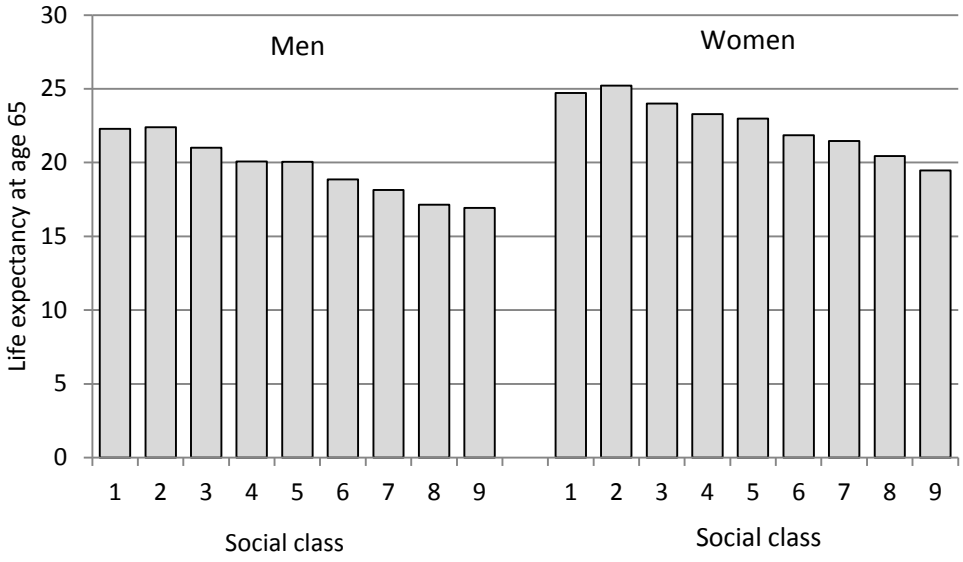
In our main results we assume that individuals die at the life expectancy of someone of the same age, sex and socio-economic status, though we also show outcomes based on life expectancy calibrated only by age.[9]

Figure 3.1 shows the average of assumed life expectancy at age 65 for men and women in different social classes.[10] These figures are based on cohort life expectancy estimates from the Office for National Statistics, adjusted for an estimate of how life expectancy differs across social classes. This shows that, while women in social class '1' (those who are 'large employers and higher managers') are expected to live for 24.7 years on average after age 65, men in social class '8'" (those in 'routine occupations') are expected to live for 17.1 years on average; therefore, even if both men and women start receiving their state pension at the same age, men in social class 8 will receive this income for eight fewer years than women in social class 1.

[9] The ONS life tables provide estimates of life expectancy at various ages, and separately calculate estimates of how life expectancy varies by socio-economic class. Taking life expectancies by socio-economic classification, we apply the ratio of life expectancies observed between a particular group and the average to the sex–cohort-specific life expectancy that we observe in the standard life tables.

[10] Life expectancies are cohort-specific and so the figures presented in Figure 3.1 are averages across the individuals in our sample.

Figure 3.1. Life expectancy at age 65, by sex and social class



Note: Social class is defined using the National Statistics Socio-Economic Classification. 1 is 'large employers and higher managers', 2 is 'higher professionals', 3 is 'lower managerial and professional occupations', 4 is 'intermediate occupations', 5 is 'small employers and own-account workers', 6 is 'lower supervisory and technical occupations', 7 is 'semi-routine occupations', 8 is 'routine occupations' and 9 is unclassified. For more information, see http://www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/soc2010/soc2010-volume-3-ns-sec--rebased-on-soc2010--user-manual/index.html#7.

3.2 Measuring financial contributions

Defining what is 'paid into' the state pension system is inherently difficult. Although national insurance (social security) contributions were originally intended to relate directly to state pension benefits, in reality, there is no direct link between the NI revenues the government receives and what it spends on state pensions. Since the distribution of NI contributions is very different from the distribution of the whole tax system, focusing on state pension benefits relative to NI contributions paid may give a misleading impression of the degree of redistribution in the state pension system.[11]

We therefore assume in our main results that there is a simple proportional tax on the earnings of this cohort, which raises sufficient money to fund the pension benefits of this cohort, for a given set of state pension rules. We calculate that a

[11] When we consider alternative state pension systems, there is a further problem that we do not know how the structure of NI payments might have changed had that system actually been in place.

tax of 13.4% would need to have been levied on all earnings to fund the realised pension benefits of this cohort.[12]

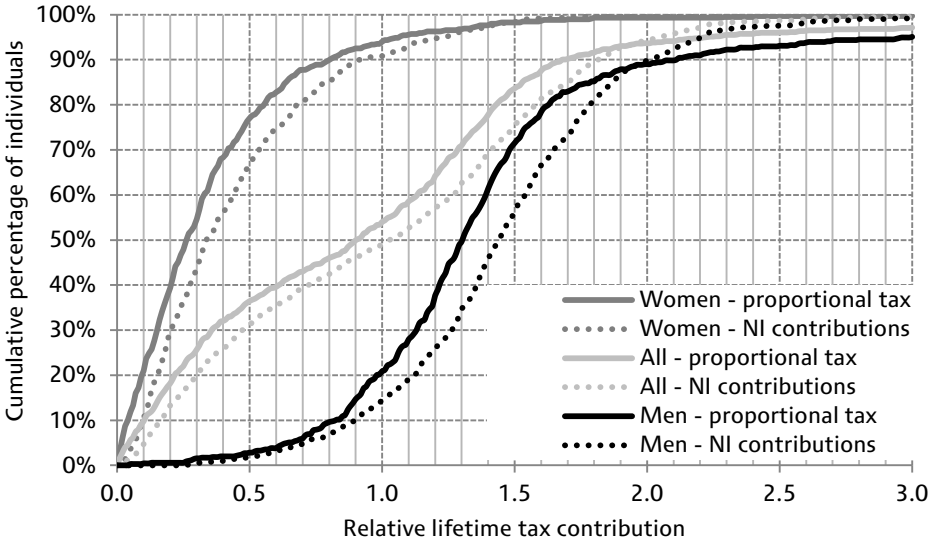
We calculate lifetime contributions in a similar way to how we measure the value of benefits from the state pension system: we calculate the tax contributions that each individual would have paid each year given their history of earnings, express this stream of contributions as a discounted present value (where contributions are revalued using RPI inflation and a 2% discount rate) and sum the stream of contributions from age 16 to the SPA.

Figure 3.2 compares the distribution of realised national insurance contributions with contributions from our hypothetical proportional tax. Contributions are expressed relative to the cohort average, though by construction this average is the same under both systems.

For both taxes men make on average much higher contributions than women, unsurprisingly given their higher average earnings. The simple proportional tax appears to be more progressive than the actual NI system. This is because the NI rate charged on earnings above the UEL is lower than the rate charged on earnings between the LEL and the UEL; indeed, for much of the lifetime of the 1930s cohort, no employee NI was due on earnings above the UEL. As a result, the average rate paid declines as earnings increase above the UEL under the NI system. In contrast, our simple proportional tax assumes that the same average tax rate is paid by everyone.

[12] While this is a hypothetical tax system, Office for National Statistics (2013) suggests that taking into account the whole tax system, including both direct and indirect taxes, people across the income distribution paid a roughly constant proportion of their income in taxes in 2011–12.

Figure 3.2. Distribution of contributions relative to the cohort average, according to 'existing' NI contribution system and proportional tax system



Note: Lifetime tax contributions are shown relative to the average for the cohort as a whole. Contributions under the two systems are normalised to have the same average.

3.3 Quantifying the extent of redistribution

We use three specific measures of intragenerational redistribution. The first involves calculating the ratio of lifetime benefits to lifetime contributions both for individuals and particular groups. By construction this is equal to one for the cohort as a whole. Therefore individuals with a benefit–contribution ratio greater than 1 are those who receive a greater share of the cohort's pension benefits than the share of contributions they pay, while individuals with a benefit–contribution ratio less than 1 are those who receive a smaller share of the cohort's pension benefits than the share of contributions that they make. If benefit–contribution ratios deviate from 1, this suggests that the state pension system is achieving some degree of redistribution: that is, there are some people who will have made higher contributions than the benefits they receive and vice versa.

The second decomposes contributions to the state pension system into 'intrapersonal' transfers (contributions by an individual up to the value of their own future state pension benefits) and 'interpersonal' transfers (contributions by an individual that are in excess of their own future state pension benefits and are transferred to other individuals). The proportion of contributions that represent 'interpersonal' transfers is defined as the sum of lifetime contributions less lifetime pension benefits among those individuals for whom contributions are greater than benefits, divided by total contributions of the cohort.

If all contributions and pension benefits simply represent transfers across each individual's lifetime, then this proportion would be 0. If, on the other hand, some individuals make all the contributions and a different set of individuals receive all the benefits (i.e. state pension spending is entirely comprised of transfers *between* people), then this proportion would be 100%.

Our final measure of redistribution is the Reynolds-Smolensky measure, which is the the difference between the Gini coefficient for 'net' lifetime earnings – where 'net' lifetime earnings is defined as gross lifetime earnings, less lifetime contributions, plus lifetime pension benefits – and the Gini coefficient for gross lifetime earnings.

If the difference in the Gini coefficients is positive (i.e. the Gini for net lifetime earnings is lower than the Gini for gross lifetime earnings), then the inequality in net earnings is lower than the inequality in gross earnings. In other words, the state pension system is acting to redistribute from those with higher lifetime earnings to those with lower lifetime earnings.

2. The existing state pension system

The UK state pension system has been reformed many times since the basic state pension was introduced in 1948. Often when new systems and rules were introduced, entitlements under the previous systems were preserved. The result is that pension entitlement for individuals retiring today depends on a complicated mixture of rules from different vintages of the state pension system, and therefore not just on what individuals have earned over their lifetimes but also on whether and when they have done any other 'creditable activities' and on their date of birth.

In this section, we examine how state pension entitlements vary across members of the 1930s cohort, taking into account the activities they have done over their lifetimes, the rules of the existing state pension system, and differences in life expectancy between men and women and between those in different social classes. We then describe the degree of redistribution between individuals within this cohort that is achieved by the existing state pension system.

In Section 4.1, we describe the main features of the UK state pension rules that determine the pension entitlements of those born in the 1930s. Section 4.2 sets out our estimates of individual state pension entitlements under the existing rules and discusses why these vary between groups of individuals. Finally, in Section 4.3, we examine the extent of redistribution that is achieved between individuals through the existing state pension system. Section 5 presents similar analysis for alternative sets of state pension rules, while Section 6 considers how the distribution of entitlements and measures of redistribution are affected when we consider state pension entitlements and financial contributions at the household level rather than at an individual level.

4.1 What is the existing state pension system?

There have been a large number of reforms to the UK state pension system since 1948. The key reforms to the state pension that we account for in our calculation of individuals' entitlements under the existing state pension system are described in this section.[13] This description is a simplification of all the pension rules that affect the entitlements of the 1930s cohort, although we incorporate all important features of the system in our calculations. Readers interested in a comprehensive description of the UK state pension rules over the last 60 years can refer to Bozio, Crawford and Tetlow (2010).

[13] In addition to the reforms described here, the government also introduced the 'graduated retirement benefit' (GRB) in 1961. This was an earnings-related pension that existed between 1961 and 1975, but the value of benefits has not been uprated over time and therefore maximum entitlements are small (£11.30 per week in 2014–15). The GRB is excluded from all state pension entitlement calculations in this paper.

From 1948, individuals accrued entitlement to the basic state pension. The basic state pension is a flat-rate benefit, where the proportion of the benefit to which an individual is entitled depends on their years of contributions. Initially, only years of employment, self-employment, unemployment or incapacity for work counted as contributions, but from 1978 the introduction of 'home responsibilities protection' gave women recognition for years spent caring for children. The level of the basic state pension was initially uprated on an ad hoc basis, then uprated by the greater of earnings or prices (from 1975) and then (formally, at least) uprated by prices (from 1981).

In 1978, the second-tier, State Earnings-Related Pension Scheme (SERPS) was introduced, which aimed to ensure that all individuals had access to a pension scheme that offered earnings replacement in retirement.[14] Initially, SERPS was designed to give full contributors around 25% replacement of average earnings (between the LEL and the UEL) over their best 20 years of earnings. However, as the costs of financing these entitlements became apparent, the rules of SERPS were altered to reduce the generosity of entitlements.[15] For those reaching SPA from 1999 onwards, SERPS entitlement was calculated using an individual's earnings over the whole of their working life (rather than the best 20 years), and over time the replacement rate was reduced from 25% to 20%. In addition, for those reaching SPA from 2000 onwards, SERPS entitlements were subsequently made even less generous through a subtle change in the formula for calculating entitlement and a reduction (from 100% to 50%) in the fraction of SERPS that could be received by a surviving spouse.

In 2002, accrual to SERPS was ended and replaced by accrual to the state second pension (S2P). One important difference between SERPS and S2P is that S2P credited individuals with a minimum level of earnings if they were looking after pre-school children, unable to work due to disability, or on low earnings, whereas SERPS gave no (or limited) entitlement to people in these situations. In addition, S2P was more generous to low earners, and less generous to high earners, than SERPS. The cohort we consider here were largely unaffected by the introduction of S2P, as they were aged at least 62 when S2P was introduced.

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[14] This replaced the graduated pension. It has always been possible to choose to 'contract out' of the earnings-related element of the state pension, i.e. effectively to pay lower NI contributions in return for not receiving the earnings-related component from the state but instead receiving an equal amount from a private pension. We abstract from contracting out in this paper by assuming that all individuals were contracted in and calculating their pension benefits and financial contributions on this basis. This will be an accurate reflection of the pension income received by individuals (and the redistribution achieved by the system) if the NI adjustments for those who contracted out in the past were actuarially fair.

[15] From an early stage, commentators had pointed out that the original SERPS seemed unaffordable – see, for example, Hemming and Kay (1981).

Table 4.1. Distribution of annual state pension income at age 65, by sex

	Men	Women	All
Mean	£10,700	£4,300	£7,800
25th percentile	£9,100	£3,200	£3,400
Median	£10,800	£3,400	£8,300
75th percentile	£12,400	£5,000	£11,200
90:10 ratio	1.9	4.4	4.1
Gini coefficient	0.13	0.30	0.30

Table 4.2. Distribution of annual state pension income at age 65, by quintile of gross lifetime earnings

	Lowest earners	2nd	3rd	4th	Highest earners
Mean	£3,000	£4,400	£8,000	£10,700	£13,000
25th percentile	£3,100	£3,200	£7,000	£9,900	£11,900
Median	£3,200	£4,000	£8,400	£10,700	£12,900
75th percentile	£3,500	£5,700	£9,500	£11,600	£14,200
90:10 ratio	2.9	2.5	3.0	1.3	1.3
Gini coefficient	0.20	0.22	0.15	0.07	0.07

Note: Earnings quintiles are defined on the basis of individual earnings.

Table 4.1 shows the distribution of the annual state pension income that we calculate the 1930s cohort will have received at age 65, including income from both the first-tier 'basic state pension' and the second-tier earnings-related pension This shows that men have substantially higher average state pension income at age 65 than women, with mean annual state pension income among men being £10,700 compared with £4,300 for women. However, among both men and women, there is variation in annual state pension entitlements. Table 4.2 shows that some of this is driven by differences in lifetime earnings, as those in the highest quintile of lifetime earners have average annual state pension income at 65 of £13,000 compared to £3,000 in the lowest quintile of lifetime earners.

4.2 The distribution of individual state pension entitlements

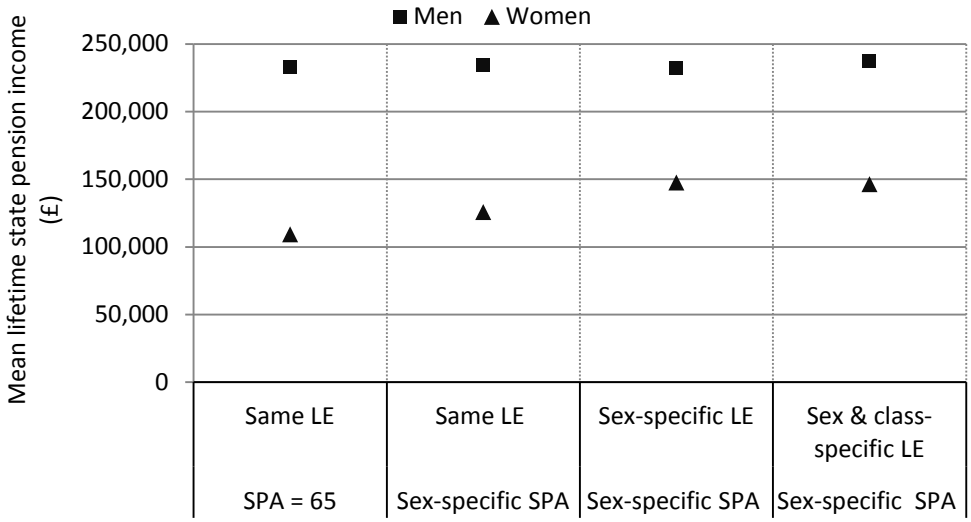
Creedy et al. (1993) showed that accounting for differences in life expectancy by socioeconomic status exacerbated inequality in lifetime state pension benefits. We extend their analysis by incorporating women, which introduces three other factors that either reduce or increase inequality in lifetime state pension income.

First, women in this cohort started to receive their state pension income at age 60, while men started to receive theirs at age 65: this means that the snapshot of

income in one year will overstate the differences between the state pension income received by women and men over their entire lifetimes. Second, women on average live longer than men and would therefore be expected to receive a state pension income for longer, even if they start receiving their pension at the same age. This again means that a snapshot of income in one year could overstate the difference between lifetime entitlements of men and women. Third, the ability of women in this cohort to 'derive' rights to the state pension based on their partner's contributions means that the state pension income stream that some women receive will vary over time. Figures 4.1 and 4.2 and Table 4.3 show how some of the factors just mentioned affect measures of the distribution of lifetime state pension income and the inequality thereof. First, the left-most panel of Figure 4.1 shows the mean value of lifetime state pension income among men and women, under the assumption that both men and women started receiving their state pension income at the age of 65 and live to the average male (age-specific) life expectancy. Under these assumptions, mean state pension entitlement among men is £233,000 and among women is £109,000. (Figure 4.2 shows similar figures for those in the different quintiles of lifetime earnings.)

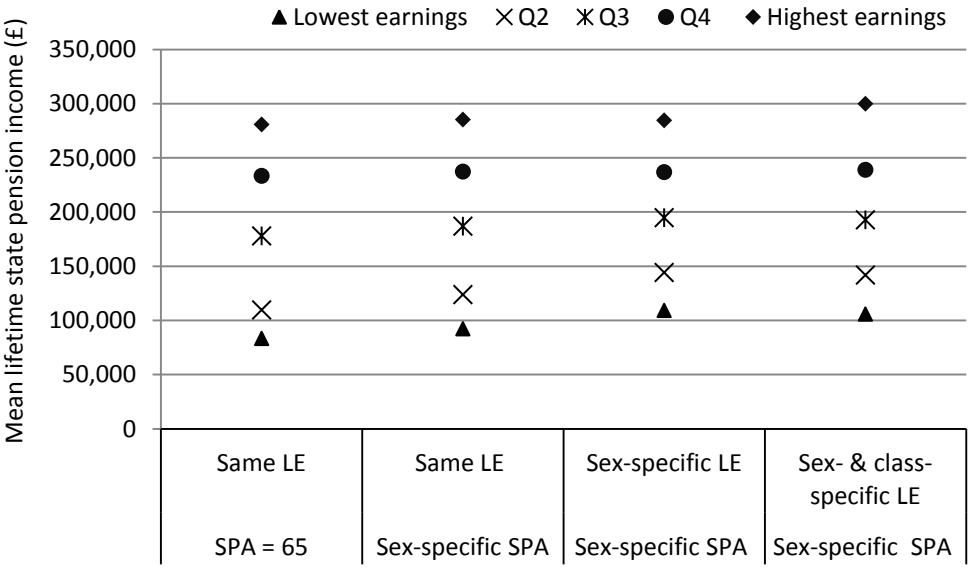
However, if we instead allow for the fact that women started receiving their state pension income at age 60 rather than age 65 (as the second panel in Figure 4.1 shows), this narrows the gap between male and female state pension entitlements, with the mean among women increasing to £125,500. Further allowing for higher average life expectancy among women than men (the third panel of Figure 4.1) narrows the gap again: mean entitlement among women increases to £147,500, while mean entitlement among men falls slightly to £232,500 as their wives living longer means that they receive the inheritable components of the state pension later. The final panel of Figure 4.1 shows the effect of allowing for differences in life expectancy across social classes; this has little effect on the mean but does affect the distribution of state pension entitlements.

Figure 4.1. Average state pension income, by sex



Note: 'Same LE' means that both men and women are assumed to have male cohort-specific life expectancies. 'Sex-specific SPA' means that men have a SPA of 65 and women a SPA of 60. Where we assume that both men and women have a SPA of 65, we assume that no extra state pension entitlements are accrued by women between the ages of 60 and 65 since the purpose of this figure is simply to illustrate the impact of different life expectancies and state pension ages on the distribution of lifetime pension entitlements.

Figure 4.2. Average state pension income, by lifetime earnings



Note: As for Figure 4.1. Earnings quintiles are defined on the basis of individual gross lifetime earnings.

Table 4.3. Decomposing the sources of inequality in state pension entitlements

	Men		Women		All	
	90:10 ratio	Gini	90:10 ratio	Gini	90:10 ratio	Gini
Annual income at age 65	1.9	0.13	4.4	0.30	4.1	0.30
Lifetime state pension income, assuming:						
SPA=65, same life expectancies	1.8	0.13	2.6	0.24	3.7	0.26
Sex-specific SPA, same life expectancies	1.8	0.13	3.2	0.27	3.7	0.25
Sex-specific SPA, sex-specific life expectancies	1.8	0.12	3.0	0.26	3.0	0.23
Sex-specific SPA, sex- and social-class-specific life expectancies	2.0	0.15	3.2	0.26	3.2	0.24

Note: As for Figure 4.1.

How the distribution of state pension entitlements is affected by allowing for differences in SPA and life expectancy is examined in Table 4.3. Both the 90:10 ratios and the Gini coefficients show that allowing for the earlier female SPA and higher life expectancy among women reduces the inequality in the distribution of state pension entitlements across this cohort as a whole. For example, if we look just at state pension income received at age 65, the 90:10 ratio for state pension income across the cohort is 4.1 and the Gini coefficient is 0.30. Allowing for the fact that people receive this state pension income for different periods of time – in particular, allowing for sex differences in SPA and sex differences in life expectancy – reduces these figures to 3.0 and 0.23, respectively.

On the other hand, allowing for differences in life expectancy by social class increases inequality slightly: the 90:10 ratio increases to 3.2 and the Gini coefficient increases to 0.24. This is consistent with the findings of Creedy, Disney and Whitehouse (1993), who concluded that differential mortality (across different socio-economic groups) exacerbated inequality in male state pension outcomes because higher-earning men lived longer on average than lower-earning men. However, overall inequality in state pension entitlements is lower when we take account of all pension income throughout the lifetime rather than focusing on a snapshot of income at a particular age. This is because, across the cohort as a whole, the equalising effect of differential mortality between men and women is greater than the disequalising effect of differential mortality across different social groups.

Finally, it is interesting to note that the inequality in both annual state pension income at age 65 and lifetime state pension income is lower than the inequality in gross lifetime earnings for this cohort. Recall that the Gini coefficient for gross individual lifetime earnings is 0.47 – discussed in Section 2.2 – which is higher than the Gini coefficients for state pension income at age 65 (0.30) and for lifetime state pension entitlements (0.24). In other words, even though state

pension entitlements are unevenly distributed, they are not as unevenly distributed as earnings.

Our preferred measure of state pension entitlements, which we focus on in the rest of our analysis, is therefore lifetime state pension income allowing for sex and social class differences in life expectancy (as described in Section 3.1). We use this measure (rather than, say, annual state pension income) because it provides a far more complete picture of differences in what individuals receive from the state pension system. Figure 4.3 shows the entire distribution of estimated lifetime state pension income calculated on this basis. The median entitlement across all individuals is just under £200,000 (in 2014–15 terms). However, as was apparent from the inequality measures presented in Table 4.3, there is considerable variation in the value of lifetime state pension benefits. One-in-five individuals have lifetime state pension benefits worth less than £112,000, while one-in-five are entitled to more than £272,000.

An alternative way of expressing figures for lifetime state pension entitlements, which we use when we examine alternative systems in Section 5, is to express values relative to the mean across the whole cohort. The mean value across all individuals under the existing state pension rules is £196,000. Among men, the mean is £237,000 – or 1.2 times the mean for the cohort – while among women the mean is £146,000 – or 0.7 times the cohort mean. Figure 4.4 shows some summary statistics on the distribution of state pension entitlements across men and women and across those with different levels of lifetime earnings, with figures expressed in this way.

Figure 4.3. Distribution of lifetime state pension income

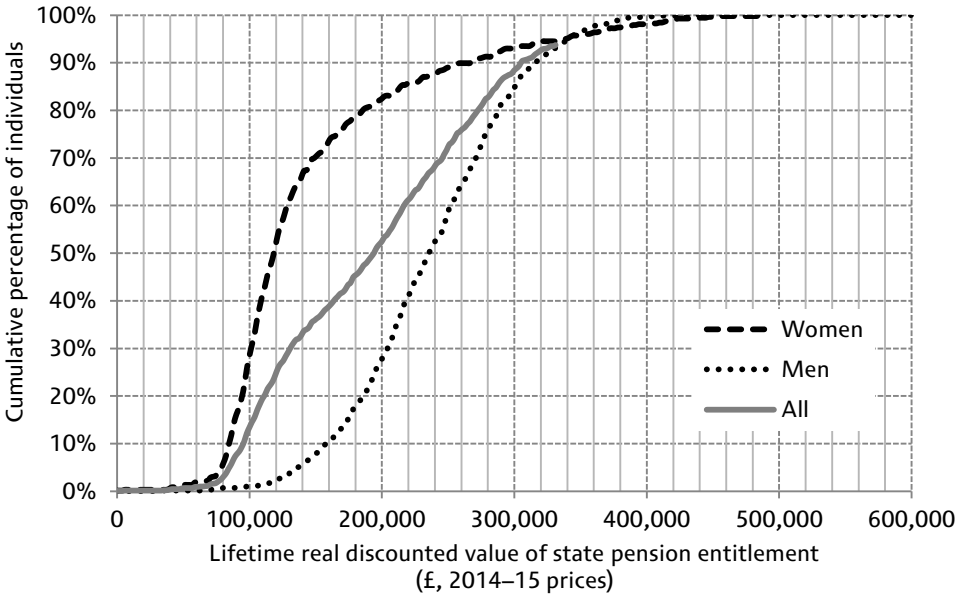
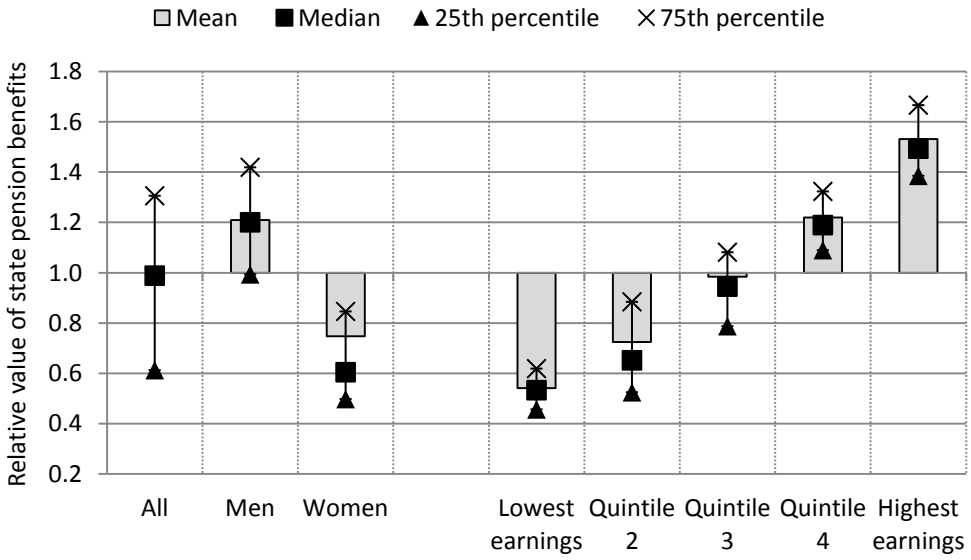


Figure 4.4. Distribution of lifetime state pension income, by characteristics



Note: Earnings quintiles are defined on the basis of individual gross lifetime earnings.

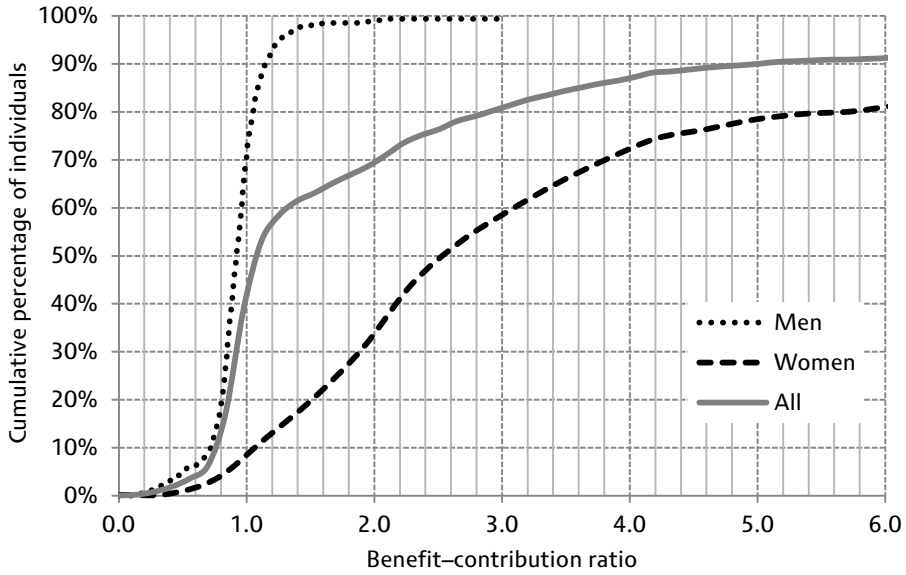
4.3 Redistribution under the existing state pension system

The first measure of redistribution we take is the 'benefit–contribution ratio' – the ratio between each individual's lifetime state pension entitlements and their lifetime financial contributions to the state pension system. Figure 4.5 illustrates the distribution of benefit–contribution ratios among men, women and all individuals assuming that financial contributions are made according to our hypothetical proportional tax system. There is considerable variation in benefit–contribution ratios. Many individuals are clustered around a benefit–contribution ratio of 1: 25% of individuals have a benefit–contribution ratio of between 0.9 and 1.1, while 44% of individuals have a benefit–contribution ratio of between 0.8 and 1.2. The state pension system therefore does little to redistribute either from or to these individuals. One-fifth of individuals, however, have a benefit–contribution ratio in excess of 3 – indicating that their share of the cohort's benefits is at least three times their share of the cohort's financial contributions – and these individuals clearly benefit from redistribution through the state pension system.

Over 90% of women have a benefit–contribution ratio greater than 1. In other words, most women receive a greater proportion of the cohort's state pension benefits than they themselves pay in tax. (This is largely driven by the fact that under the 'existing' state pension system, women can accrue state pension entitlement on the basis of their partner's earnings history if that would give them a greater entitlement than on their own.) In contrast, only 30% of men have a benefit–contribution ratio greater than 1. The median benefit–contribution

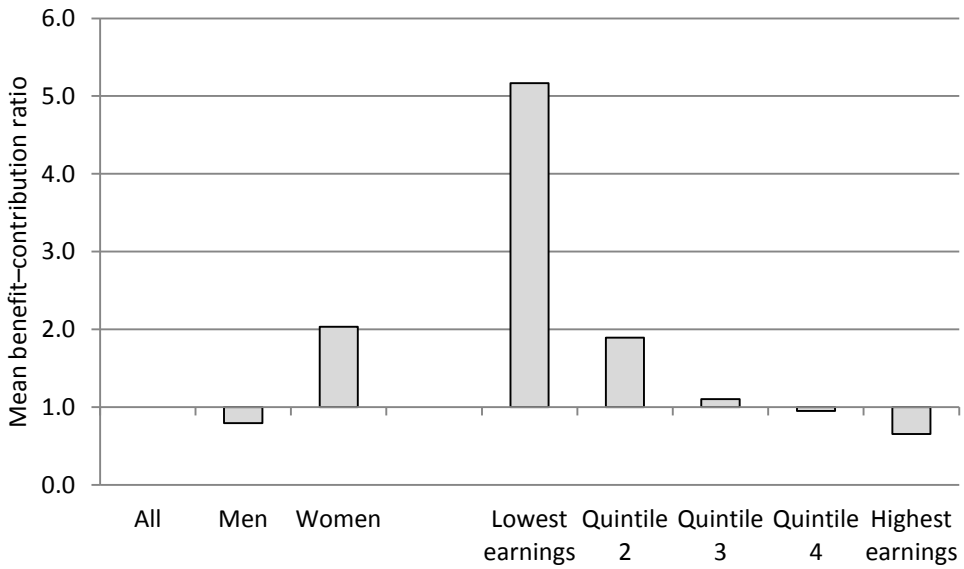
ratio among women is 2.6, compared with 0.9 among men. Therefore, while women on average receive a lower value of state pension benefits than men (shown in Figure 4.3), they pay an even lower proportion of financial contributions.

Figure 4.5. Distribution of benefit–contribution ratios under existing state pension system: contributions through a proportional tax



This is also illustrated in Figure 4.6, which shows the mean benefit–contribution ratios for groups of individuals with different characteristics. The benefit–contribution ratio is on average much higher among those with lower earnings (5.2 for those in the lowest earnings quintile under the existing state pension system compared with 0.7 among those in the highest earnings quintile). In other words, if the realised state pension system were fully funded through a proportional tax on this cohort's earnings, it would be redistributing from men to women, and from high lifetime earners to low lifetime earners (despite these groups who 'benefit' appearing to have a lower value of state pension benefits).

Figure 4.6. Mean benefit–contribution ratios, by characteristics: contributions through a proportional tax



Note: Earnings quintiles are defined on the basis of individual gross lifetime earnings. 'Mean' benefit–contribution ratio is the 'group mean', i.e. calculated by dividing total benefits for the group by total contributions for the group.

Figure 4.7. Distribution of benefit–contribution ratios under existing state pension system: contributions are National Insurance contributions

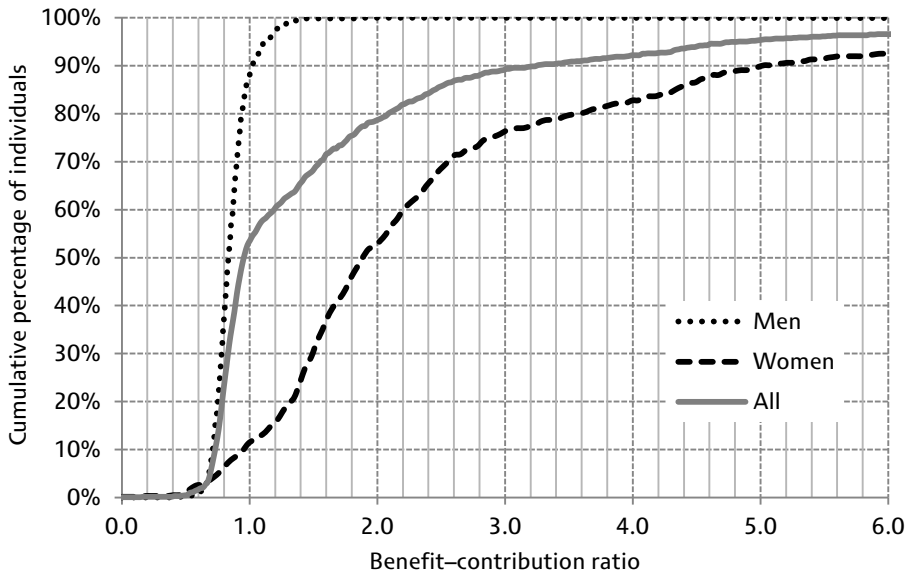


Figure 4.7 illustrates the distribution of benefit–contribution ratios when financial contributions are measured as individuals' (and their employers') actual NI contributions. Comparing Figures 4.5 and 4.7 shows that the benefit–contribution ratios are much more dispersed when we assume that financial contributions are made through a proportional tax than when we assume they are made simply through NI contributions. This reflects the fact that a

proportional tax is more progressive than the NI system (as was described in Section 3.2) and so benefit–contribution ratios are lower (higher) for high (low) earners when we assume a proportional tax than when we use NI contributions. The equivalent to Figure 4.6 but with financial contributions measured as NI contributions is provided as Figure A.2 in Appendix A.

Taking our second measure of redistribution, we calculate that, when contributions are measured assuming a proportional tax on earnings, 20% of state pension spending on this cohort represents a transfer between different individuals or, conversely, that 80% of the spending simply reflects a transfer from earlier in individuals' lives to later in their own lives. When contributions are measured as NI contributions, our calculations suggest that 14% of state pension spending on this cohort represents a transfer between different individuals or, conversely, that 86% of the spending simply reflects a transfer from earlier in individuals' lives to later in their own lives.

Our final indicator of redistribution is the reduction in the Gini coefficient implied by contributions and benefits to and from the state pension system. We estimate that the Gini coefficient for net lifetime earnings is 0.43 when contributions are assumed to be made through a proportional tax, which is lower than the Gini coefficient for gross lifetime earnings of 0.47. In other words, interpersonal redistribution through the state pension reduces the inequality present in gross lifetime earnings. When we measure contributions as NI payments, the Gini coefficient for net lifetime earnings is 0.45. Our calculations therefore suggest a smaller reduction in lifetime earnings inequality through the state pension system when financial contributions are measured as NI contributions rather than assumed to be made through a proportional tax on earnings.

3. Alternative state pension systems

There have been a number of significant reforms to the UK state pension system over the last 40 years and it is interesting to ask how these different pension systems affected individuals' entitlements and the extent of redistribution. This is analysed in this section, under the assumption that each different system was in place throughout the lifetime of the 1930s cohort and under the assumption that these individuals would not have changed their behaviour in response to different state pension rules.[16] We start in Section 5.1 by describing the systems we model. Section 5.2 sets out our estimates of individual entitlements under the different systems and discusses why these differ. Finally, in Section 5.3, we compare the extent of redistribution that is achieved through the alternative state pension systems.

5.1 The alternative systems modelled

We consider six hypothetical state pension systems. These are chosen to approximate some of the major reforms that have been implemented in the UK over the past 40 years, as well as the one that will be implemented from April 2016.

Reforms implemented in 1978 changed the shape of the state pension system considerably. On the one hand, the system became more explicitly redistributive between people. In particular, for the first time, the state pension system explicitly acknowledged periods spent out of work caring for children, which increased the state pension entitlements of many women, thus redistributing (broadly speaking) from higher-lifetime-earning men to lower-lifetime-earning women. On the other hand, the introduction of a more generous earnings-related element to the state pension increased the extent to which the state pension transferred resources across the life cycle for a given individual.

Since then, various reforms to the components of the state pension system have all acted in the same direction. First, the extent to which the pension transfers resources across an individual's lifetime has been reduced – for example, by reducing the generosity of the earnings-related component of the state pension. Second, the amount of redistribution between individuals has been increased – for example, by introducing more extensive crediting of non-work activities.

The main features of each of the pension schemes we model in this paper are described in Table 5.1. In summary:

[16] This is a fairly strong assumption, not least as it assumes, for example, no labour supply response following an increase in the SPA under one of the systems we consider, despite strong evidence that women and their husbands have responded to such reforms recently (see, for example, Cribb, Emmerson and Tetlow (2013)).

- *Original basic state pension ('Original BSP')*
  This system approximates the basic state pension as it was originally introduced: a flat-rate benefit, where full entitlement depends on years of contributions (employment, self-employment, unemployment or incapacity), that is indexed in line with the greater of growth in earnings or prices.[17]

- *Single-tier pension ('STP')*
  This system approximates the single-tier pension system that is due to be introduced from 2016. It differs from the 'original BSP' system in that it credits childcare activities and has no option for pension rights to be derived from a partner's entitlement. Unlike under the other systems, the SPA for women and men is equalised at age 65.

- *Original State Earnings-Related Pension Scheme ('Original SERPS')*
  This system approximates the UK state pension system at the time SERPS was first introduced. There are two components: a flat-rate component, similar to 'original BSP' but with the addition of crediting for childcare activities, and an earnings-related component where entitlement is calculated according to the original SERPS rules.

- *SERPS with price-indexed BSP ('SERPS with p.i.')*
  This system approximates the system in place in 1981. The only difference between this system and the original SERPS system is that here the flat-rate component is increased by inflation, rather than the greater of inflation and average earnings growth.

- *Final SERPS*
  This system approximates a long-run version of the UK state pension system that existed at the start of the 2000s. There is a flat-rate component (the same as in 'SERPS with price-indexed BSP') and an earnings-related component where entitlement is calculated using the final (least-generous) SERPS formula.

- *State second pension ('S2P')*
  This system approximates a long-run version of the original S2P system. There is the same flat-rate component as in 'SERPS with p.i.' and 'final SERPS', but an earnings-related component where entitlement is calculated using the initial S2P formula. Compared with the final SERPS system, S2P credits unemployment, disability and childcare more generously, and gives a more generous entitlement to lower earners.

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[17] This reflects legislated policy set by the National Insurance Act 1974, which provided for the basic state pension to be increased by the greater of prices and earnings. See House of Commons Library (2010).

Table 5.1. Main features of the hypothetical state pensions considered

	Original BSP	Single-tier pension	Original SERPS	SERPS with price indexation	Final SERPS	State second pension
Flat-rate element:						
Qualifying years required for full entitlement	All years 16–SPA	35 years	All years 16–SPA, reduced for years of childcare	All years 16–SPA, reduced for years of childcare	All years 16–SPA, reduced for years of childcare	All years 16–SPA, reduced for years of childcare
Credits for:						
Employment	✓	✓	✓	✓	✓	✓
Self-employment	✓	✓	✓	✓	✓	✓
Unemployment	✓	✓	✓	✓	✓	✓
Disability	✓	✓	✓	✓	✓	✓
Childcare	×	✓	✓	✓	✓	✓
Derived rights	60% of spouse's pension (if alive); 100% of spouse's pension (if dead)	None	60% of spouse's pension (if alive); 100% of spouse's pension (if dead)	60% of spouse's pension (if alive); 100% of spouse's pension (if dead)	60% of spouse's pension (if alive); 100% of spouse's pension (if dead)	60% of spouse's pension (if alive); 100% of spouse's pension (if dead)
Indexation	Greater of prices and earnings	Greater of prices and earnings	Greater of prices and earnings	Prices	Prices	Prices
Earnings-related element:						
Credits for:						
Employment			✓	✓	✓	✓
Self-employment			×	×	×	×
Unemployment			×	×	×	✓
Disability			×	×	×	✓
Childcare			×	×	×	✓
Full entitlement			~ 25% of average earnings between LEL and UEL over best 20 years	~ 25% of average earnings between LEL and UEL over best 20 years	~ 20% of average earnings between LEL and UEL over working life	~ 20% of average earnings between LEL and UEL over working life for high earners; higher replacement for lower earners as their income is topped up from the LEL to the LET (approx. 2.8 times the LEL)
SPA (women/men)	60/65	65	60/65	60/65	60/65	60/65

Note: LET is the lower earnings threshold.

This set of systems is chosen to highlight the impact of changes to some of the main components and parameters of the state pension system that have happened in the past and that are proposed for the future.

Each of the systems we consider would have implied a different overall level of spending on pensions. Table 5.2 illustrates the level of spending implied by each of the systems relative to spending under the existing pension system, where the latter is normalised to be equal to 100. The original SERPS system is the most expensive by a considerable distance, implying total state pension benefits across the cohort two-thirds higher than under the existing system. In our comparison of the systems, we abstract from these differences in the overall level of spending required by focusing on the *relative* benefit enjoyed by different individuals/groups – this is described in more detail at the start of Section 5.2.

Table 5.2. Spending on each system (index, existing system = 100)

State pension system	Total spending	Total spending on BSP	Total spending on SERPS/S2P
Existing system	100	60.5	39.5
Original BSP	99.4	99.4	–
Original SERPS	166.3	103.6	62.8
SERPS with price-indexed BSP	125.4	62.6	62.8
Final SERPS	98.8	66.2	32.6
State second pension	109.1	66.2	43.0
Single-tier pension	93.6	93.6	–

5.2 Individual state pension entitlements under the alternative pension systems

In this section, we discuss how and why the distribution of individual state pension entitlements would differ under the alternative pension systems. Since we want to compare how the distribution of benefits differs while abstracting from the fact that the overall level of state pension spending would also be very different under each system, we focus on an individual's *relative state pension entitlement* rather than their *level of lifetime state pension income*. This relative entitlement is defined as an individual's lifetime state pension income divided by the mean lifetime state pension income of the whole cohort. (This is the same metric as was described in Figure 4.4.)

Figure 5.1 illustrates how the distributions of state pension entitlements compare under the alternative state pension systems[18] and Table 5.3 presents overall summary statistics for the inequality of relative state pension

[18] Figures A.1(a) and A.1(b) in Appendix A illustrate the equivalent pictures for men and women separately.

entitlements under each of our alternative systems. The largest difference is between those systems that contain an earnings-related element (shown in the bottom four rows of Table 5.3) and those that do not (shown in the top two rows). As would be expected, there is less inequality in the value of pension benefits under the systems without an earnings-related component than under those with an earnings-related component. For example, the ratio of the value at the 90th percentile to the value at the 10th percentile is around 1.5 for the original BSP system, compared with 3.5 for the original SERPS system with a price-indexed BSP.

Figure 5.1. Distribution of state pension entitlements

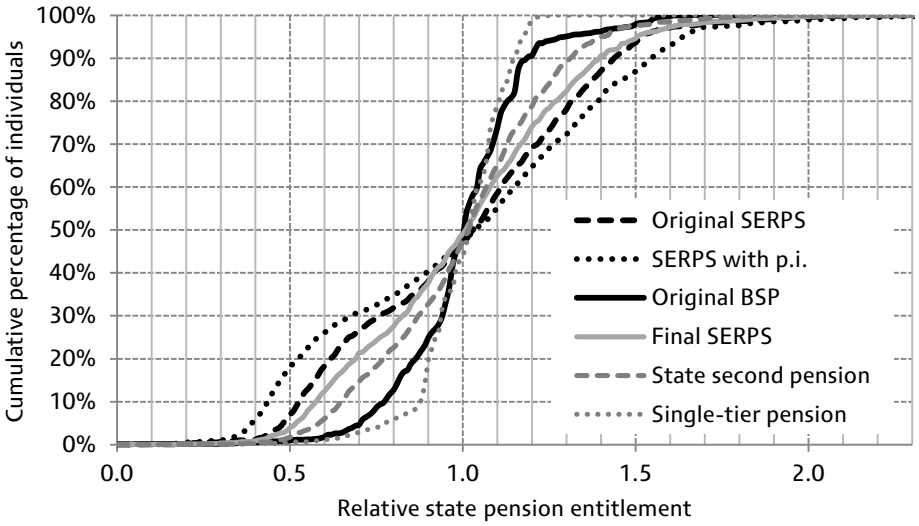


Table 5.3. Inequality in relative state pension entitlements, by state pension system

	90:10 ratio	Gini
Original BSP	1.5	0.10
Single-tier pension	1.3	0.07
Original SERPS	2.7	0.20
Original SERPS with price-indexed BSP	3.5	0.24
Final SERPS	2.4	0.18
State second pension	2.0	0.14

Comparing the original SERPS system with the original SERPS system with price-indexed BSP illustrates the effect of price indexing the basic state pension (rather than indexing it in line with the greater of earnings growth and price inflation). The lower indexation of the flat-rate component under the original SERPS system with price-indexed BSP has the effect of reducing the value of lifetime state pension benefits arising from the flat-rate component. This not only reduces overall state pension spending (which was shown in Table 5.2), but also means

state pension spending is less focused on those with only entitlement to the flat-rate component and more focused on those with greater earnings-related entitlement. This exhibits itself as an increase in the relative value of pension benefits among men and a reduction among women: this is illustrated by comparing the first two panels of Figure 5.2. It also leads to an increase in the relative value of pension benefits among higher earners and a reduction among lower earners, which is illustrated by the first two panels of Figure 5.3. This leads to an increase in the overall inequality of state pension entitlements, as shown in Table 5.3.

Figure 5.2. Average relative value of state pension benefits under alternative systems, by sex

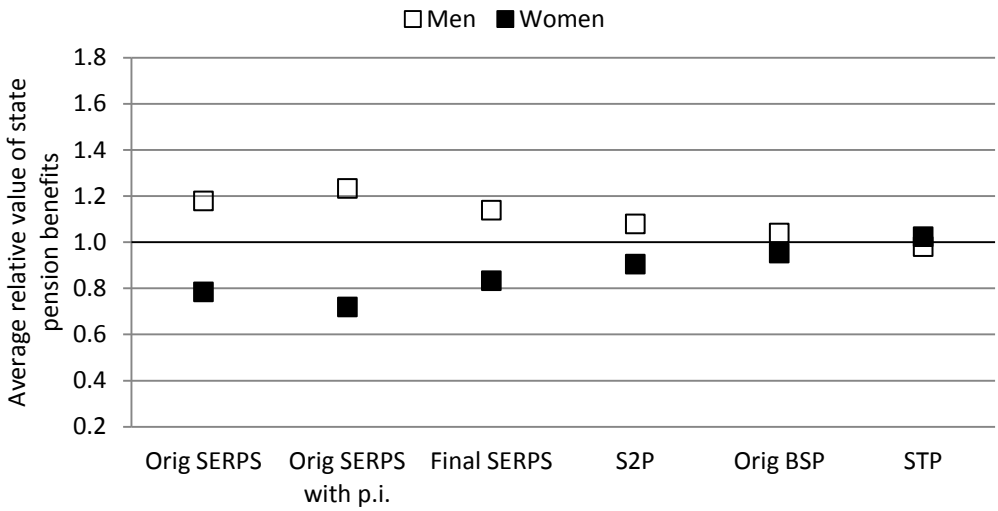
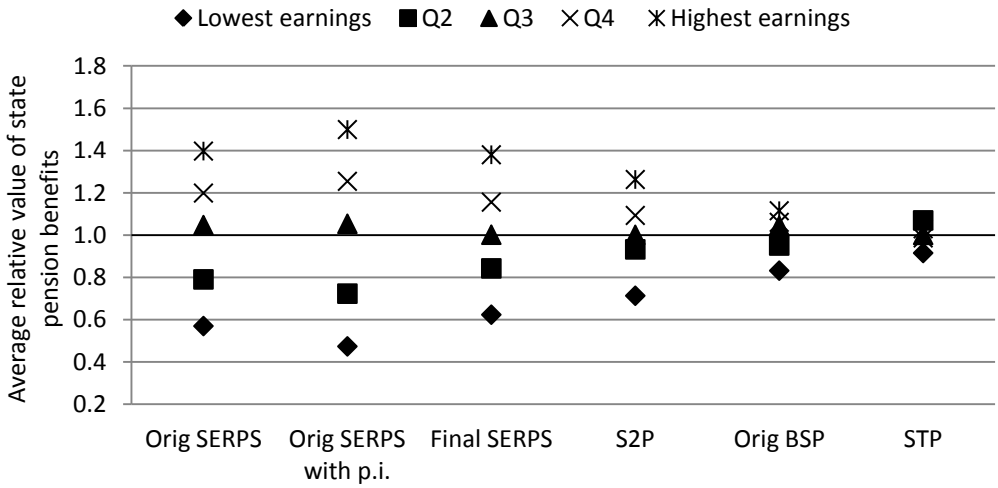


Figure 5.3. Average relative value of state pension benefits under alternative systems, by lifetime earnings quintile



Note: Earnings quintiles are defined on the basis of individual gross lifetime earnings.

We can see the reverse by comparing the original SERPS system with price-indexed BSP and the final SERPS system, as the only difference between the two is that the latter has a less generous earnings-related component. This reduction in generosity both reduces overall state pension spending (shown in Table 5.2) and increases the proportion of state pension spending that goes on the flat-rate component. The final SERPS system therefore increases the focus of state pension spending on those in lower earnings quintiles and reduces the focus on those in higher earnings quintiles and, as a consequence, has lower inequality in state pension entitlements.

The distinction between the final SERPS and S2P systems is that under the S2P system there is crediting to the earnings-related component for individuals who have undertaken certain non-paid work activities or who have lower earnings, which dilutes the earnings-related component. This again results in a reduction in the inequality of pension benefits, and a greater focus of state pension benefits on those with lower earnings and groups such as women who are more likely to have undertaken non-paid work activities.

The single-tier pension system exhibits greater equality of state pension entitlements than the original BSP system and exhibits less difference in the average value of state pension benefits between women and men (seen by comparing the final two panels in Figure 5.2). In fact, under the single-tier pension system, the average relative value of state pension benefits is slightly higher for women than for men. The difference between the original BSP and single-tier pension systems shown in Figures 5.2 and 5.3 is the net effect of opposing factors. The single-tier system provides greater crediting for non-paid work activities and requires a lower number of years of contributions for a full pension: these factors tend to benefit women more than men on average (women also tend to live for longer). This is sufficient to more than offset the reduction in lifetime state pension value for women that arises from the higher female SPA under the single-tier pension system than under the original BSP system.[19] The single-tier pension system also reduces the difference between entitlements for those with different levels of earnings. This is again due to the greater crediting of non-paid work activities and the reduction in the number of years required for a full pension, which benefit those at the lower end of the earnings distribution more than those at the higher end of the earnings distribution.

[19] The more generous indexation would (all else equal) result in a greater proportion of benefits going to women than men since women on average have longer life expectancies.

5.3 Redistribution under the alternative state pension systems

Benefit–contribution ratios

The average ratios of benefits to financial contributions for men and women, and for individuals in each earnings quintile, are shown for each of the systems in Figures A.3 and A.4 in Appendix A. As before, ratios greater than 1 imply that individuals receive a greater share of the cohort's state pension benefits than the share of financial contributions that they paid, while ratios less than 1 indicate the reverse. The financial contributions made by each individual are assumed to be the same under all the pension systems, since spending under each of the systems is normalised to be the same and contributions are assumed to exactly equal spending on pension benefits. As a result, the differences in the benefit–contribution ratios across the alternative pension systems shown in this section are driven by the differences in entitlements discussed in Section 5.2.

The degree of inequality in the benefit–contribution ratios under each of the different pension systems is summarised in Table 5.4. The systems with an earnings-related element (shown in the bottom four rows of the table) exhibit less inequality in the benefit–contribution ratios than do the first two systems, which contain only a flat-rate component. This is because under an earnings-related system, both benefits and contributions are increasing with earnings, whereas under a flat-rate system, increasing earnings increases contributions but not necessarily benefits, which results in greater differences in benefit–contribution ratios.

Table 5.4. Inequality in benefit–contribution ratios, by state pension system

	90:10 ratio	Gini
Original BSP	12.1	0.95
Single-tier pension	15.2	0.94
Original SERPS	6.9	0.92
Original SERPS with price-indexed BSP	5.4	0.91
Final SERPS	7.9	0.92
State second pension	9.9	0.93

Interpersonal transfers and comparing gross and net lifetime earnings

The extent of redistribution, as quantified by the proportion of contributions that represent interpersonal redistribution, and the difference between inequality in gross and net lifetime earnings are set out in Table 5.5 for each of the systems.

Table 5.5. Redistribution, by state pension system

	Percentage *interpersonal* redistribution	Gini coefficient		
		Gross lifetime earnings	Net lifetime earnings	Difference (net – gross)
Original BSP	29.6%	0.47	0.41	–0.05
Single-tier pension	32.8%	0.47	0.40	–0.07
Original SERPS	21.9%	0.47	0.43	–0.04
Original SERPS with price-indexed BSP	19.5%	0.47	0.43	–0.03
Final SERPS	23.0%	0.47	0.42	–0.04
State second pension	26.4%	0.47	0.42	–0.05

Taking the proportion of interpersonal redistribution first, the results illustrate that the systems that contain only a flat-rate element are more redistributive than those with an earnings-related component, but it is interesting to note that even under the most redistributive system we consider (the single-tier pension system) over two-thirds of contributions to the pension system represent transfers over individuals' own lifetimes rather than transfers between people.

Comparing the two flat-rate pension systems, the more generous crediting arrangements and lower number of years required for maximum pension entitlement under the single-tier pension system result in more redistribution: 33% of pension contributions (through a hypothetical proportional tax on earnings) are transfers between individuals under the single-tier pension system, compared with 30% under the original BSP system.

Comparing the systems with an earnings-related component, the change in indexation of the flat-rate component between the original SERPS system and the original SERPS system with price-indexed BSP results in less redistribution. This is because it is the flat-rate component that is largely responsible for the redistribution, and reducing the indexation makes that component less generous and thus a larger share of state pension spending goes on the earnings-related component instead. The reduction in the value of the earnings-related component (particularly to higher earners) under the final SERPS and S2P systems increases the extent of redistribution inherent in the system, as a greater fraction of state pension spending happens through the flat-rate component rather than the earnings-related component.

The same story is told by the comparison of inequality (as measured by the Gini coefficient) in gross and net lifetime earnings. The single-tier pension system results in the lowest Gini coefficient for net lifetime earnings (0.40), indicating that it is the most redistributive system. In fact, such a system would reduce lifetime earnings inequality by nearly twice as much as if the same amount of money were redistributed in the way implied by the original SERPS system with a price-indexed BSP.

4. The impact of household pooling

The results presented in Sections 4 and 5 focused on state pension entitlements at the individual level (albeit with entitlement sometimes based on the contribution history of a spouse). However, we generally tend to think that couples share financial resources, and so we might want to take into account this *within-household* redistribution when thinking about the distribution of state pension entitlements. The advantage of the data source we use here, which is based on household survey data, compared with the data used in previous similar studies is that we can examine the incomes and pension entitlements of both members of each couple. In this section, we therefore illustrate how our main results would differ were we to assume that households shared all resources equally, rather than focusing on individual earnings and state pension entitlements.

6.1 Pooled entitlements under the existing state pension system

We define pooled state pension entitlements by assuming that couples share equally the lifetime value of state pension benefits. In other words, for single individuals 'pooled entitlement' is simply equal to their individual lifetime state pension benefit, while for individuals in couples 'pooled entitlement' is the sum of the individual lifetime state pension benefits of the couple divided by two.

We start in Figure 6.1 by illustrating the impact household pooling has on the value of each individual's state pension entitlement under the existing state pension rules. Each dot represents an individual: if the dot lies above the 45-degree line, an individual's pooled state pension entitlement is greater than their individual entitlement; if the dot lies below the 45-degree line, the value of their pooled entitlement is lower than the value of their individual entitlement. Some individuals are unaffected by household pooling (for example, all those who are single). However, for the most part, taking into account household pooling acts to increase the value of state pension entitlement among women (the black dots) and reduce it among men (the grey dots).

The distribution of lifetime state pension benefits with and without household pooling is illustrated in Figure 6.2. As would be expected given the relationship between individual and pooled entitlements described above, there is much less inequality in the value of state pension benefits once pooling is taken into account. On an individual basis, the person at the 90th percentile receives approximately 3.2 times as much as the person at the 10th percentile (as was described in Table 4.3). When income is pooled within households, this measure of inequality falls to 1.8. The Gini coefficient for individual-level entitlement is 0.24, compared to 0.14 for pooled entitlement.

Figure 6.1. Comparing individual and pooled state pension entitlements, under the existing system

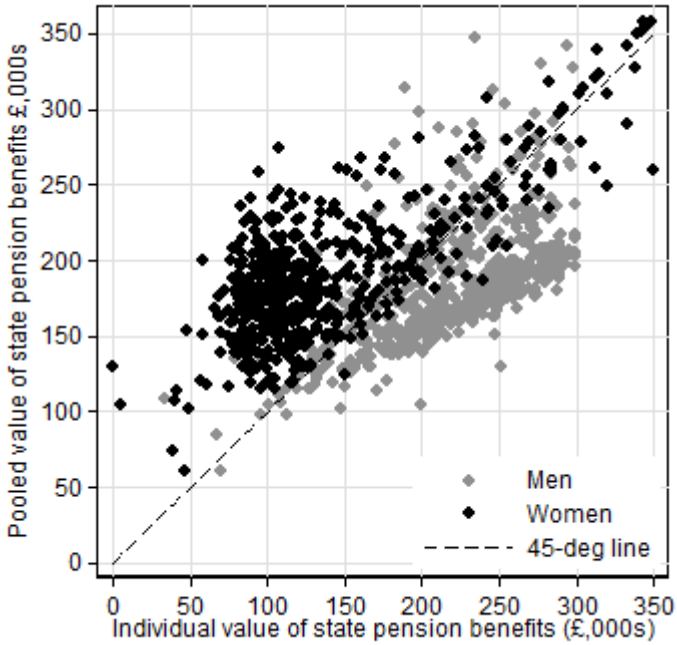
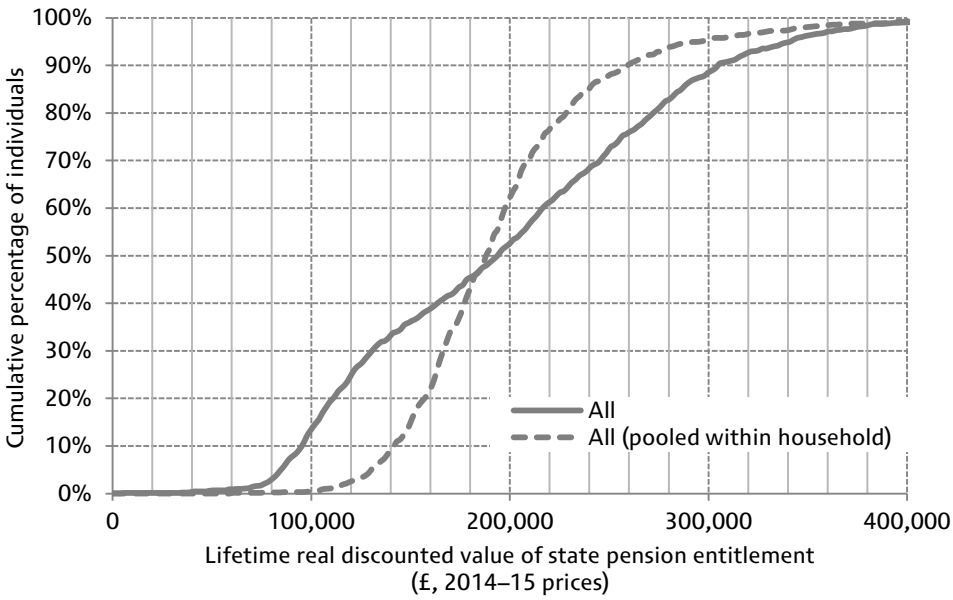


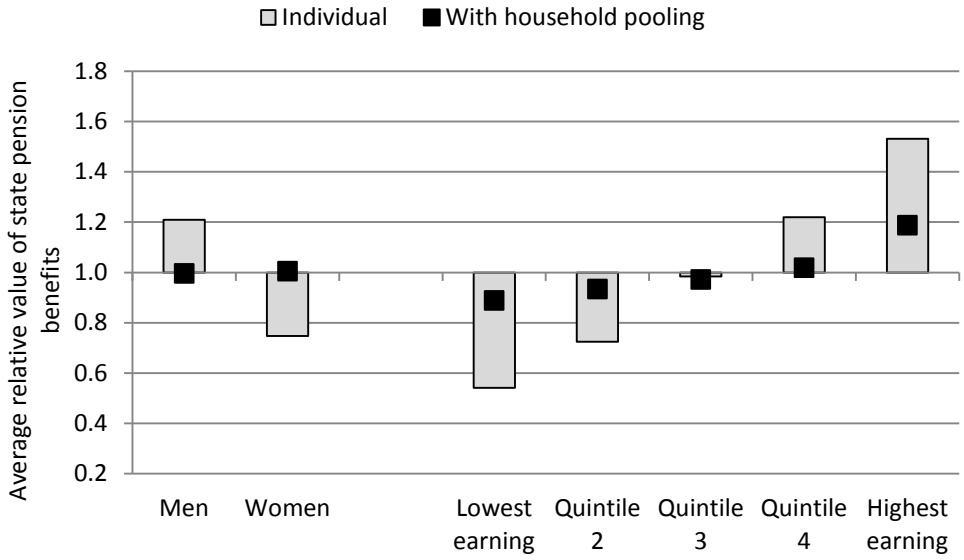
Figure 6.2. Distribution of lifetime state pension income, under the existing system



The impact of household pooling on the average relative value of state pension benefits among different groups is illustrated in Figure 6.3. Once household pooling is taken into account, there is virtually no difference between the average entitlement of men and women (the remaining difference is driven by single

individuals and couples where only one individual is in our sample). Household pooling also reduces the gradient in average pension entitlements by lifetime earnings quintiles – since those in the lower earnings quintiles are disproportionately women, who are partnered to men in higher earnings quintiles.

Figure 6.3. Average lifetime state pension income, with and without pooling



Note: Lifetime earnings quintiles are defined on an individual-level basis.

6.2 Redistribution by the existing state pension system given household pooling

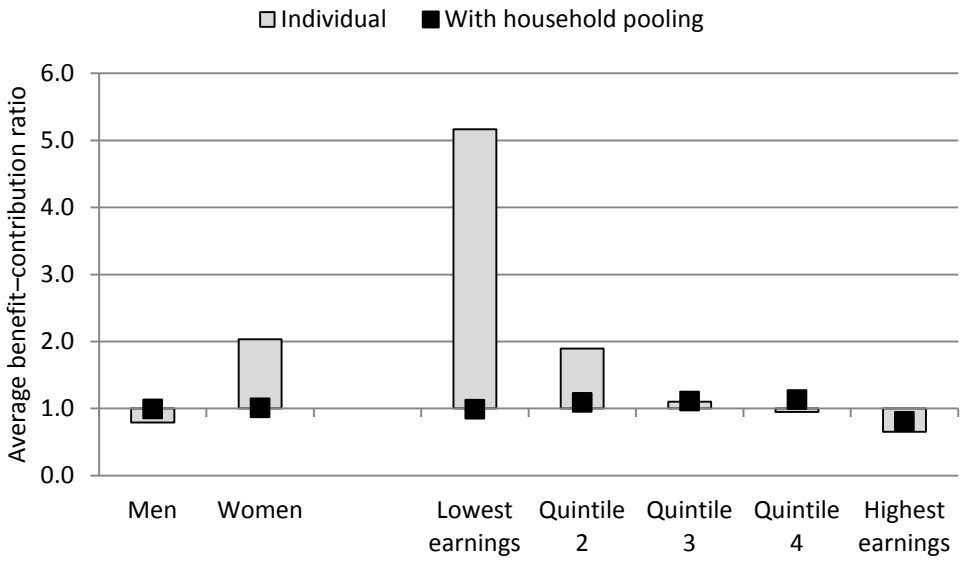
Pooled benefit–contribution ratios

We define 'pooled contributions' in an analogous way to 'pooled entitlements' – for individuals in couples, we sum the contributions of both individuals and then divide by two. A pooled benefit–contribution ratio can then be calculated as the ratio between pooled benefits and pooled contributions. A benefit–contribution ratio greater than 1 indicates that an individual and their partner (if applicable) together receive a greater share of the cohort's pension benefits than the share of financial contributions they pay between them. Conversely, a benefit–contribution ratio of less than 1 indicates that they receive a smaller share of the cohort's pension benefits than the share of financial contributions they pay.

Household pooling has a similar equalising impact on benefit–contribution ratios to its effect on lifetime state pension entitlements. This is illustrated in Figure 6.4. For example, when benefit–contribution ratios under the 'existing' pension system are calculated at the individual level, the mean for men is 0.8 and for

women is 2.0 (as was shown in Figure 4.6); on a pooled basis, the mean is 1.0 for both men and women. Furthermore, benefit–contribution ratios on a pooled basis average around 1 in all earnings quintiles (ranging from 0.8 for the highest earnings quintile to 1.1 among the middle three earnings quintiles).

Figure 6.4. Average benefit–contribution ratios, with and without pooling



Note: Lifetime earnings quintiles are defined on an individual-level basis.

This does not, however, suggest that there is no redistribution through the state pension from those with high lifetime incomes to those with low lifetime incomes once we account for household pooling. All the figures presented so far that compare benefits or benefit–contribution ratios between individuals in different earnings quintiles have continued to use earnings quintiles defined on the basis of *individual* earnings, as we did in Sections 4 and 5. However, these individual quintiles could give a misleading impression of an individual's lifetime access to resources if their spouse is at a very different position in the earnings distribution and they share financial resources.

Table 6.1 illustrates how individuals' positions in the individual earnings distribution compare with their positions in the distribution of 'pooled lifetime earnings' (i.e. household per-capita earnings). There is much re-ranking of individuals when we consider pooled lifetime earnings rather than individual lifetime earnings. For example, only 30% of individuals in the lowest earnings quintile are also in the lowest quintile of the pooled earnings distribution, while 13% are actually in the highest quintile of pooled earnings. Similarly, 20% of those who are in the highest quintile of individual earnings are actually only in the middle quintile of the pooled earnings distribution. Much of this re-ranking reflects the fact that virtually all individuals in the bottom two quintiles of the individual earnings distribution are women, who are often partnered to men higher up the earnings distribution.

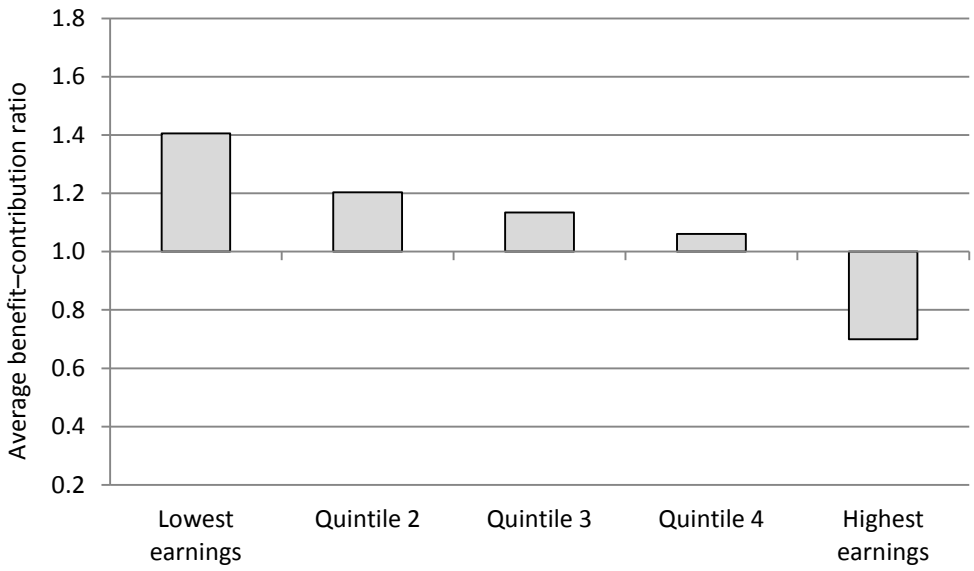
Table 6.1. Comparing positions in the individual earnings distribution and positions in the distribution of pooled lifetime earnings

	***Of which:* % in quintile of pooled earnings distribution:**					
	Lowest earnings	2	3	4	Highest earnings	N
All						
Lowest earnings	30	27	21	10	13	260
Quintile 2	26	19	22	22	10	259
Quintile 3	37	18	13	18	14	259
Quintile 4	7	34	24	21	14	259
Highest earnings	0	1	20	29	49	259
Women						
Lowest earnings	29	27	21	10	13	255
Quintile 2	18	21	24	25	11	233
Quintile 3	1	3	16	38	42	74
Quintile 4	–	–	–	–	–	13
Highest earnings	–	–	–	–	–	12
Men						
Lowest earnings	–	–	–	–	–	5
Quintile 2	–	–	–	–	–	26
Quintile 3	51	24	12	10	3	185
Quintile 4	7	36	25	21	10	246
Highest earnings	0	1	21	31	47	247

Note: Figures based on sample sizes of less than 30 are excluded. As a result, data for men in the lowest two quintiles of the individual earnings distribution, and for women in the top two quintiles of the individual earnings distribution, are not reported.

These patterns are important because they affect the extent to which the redistribution achieved by the state pension system with respect to individual earnings feeds through into redistribution with respect to household earnings. Figure 6.5 illustrates how average pooled benefit–contribution ratios differ across quintiles of the pooled earnings distribution. In marked contrast to the picture across quintiles of the individual earnings distribution (shown by the black squares in Figure 6.4), there is variation in pooled benefit–contribution ratios across quintiles of the pooled earnings distribution. The average benefit–contribution ratio for the lowest-earning fifth of households is 1.4, compared with just 0.7 among the highest-earning fifth of households. This suggests that the state pension system does involve redistribution from households with high lifetime earnings towards households with lower lifetime earnings.

Figure 6.5. Average pooled benefit–contribution ratios, by pooled earnings quintiles



Note: Lifetime earnings quintiles are defined on the basis of household earnings per capita.

Interpersonal transfers and comparing gross and net lifetime earnings

We can also illustrate how household pooling affects our estimate of the proportion of interpersonal redistribution and our comparison of gross and net household lifetime earnings. This is illustrated in Table 6.2. Section 4, which looked just at individual-level benefits and contributions, concluded that 20% of spending on state pensions reflected a transfer of resources from one individual to another, with the remaining 80% simply reflecting a transfer between different points in the same individuals' lifetimes. Table 6.2 shows that a similar calculation based on pooled benefits and contributions suggests that a slightly smaller fraction of state pension spending actually reflects a transfer between different family units – 14% rather than 20%. This suggests that some of the 'redistribution' achieved (by the state) at the individual level actually reflects redistribution between people who are partnered with each other anyway. As a result, we conclude that the state pension system has less effect on reducing the inequality in the distribution of pooled household earnings than it does on reducing the inequality in individual earnings, as demonstrated by the Gini coefficients reported in Table 6.2.

Table 6.2. Redistribution before and after household pooling

	Individual	With household pooling
Percentage *interpersonal* redistribution	20.0%	13.7%
Gini coefficient		
Gross lifetime earnings	0.47	0.26
Net lifetime earnings	0.43	0.25
Difference	–0.03	–0.02

Summary

This analysis shows that, to the extent that households pool their resources, there is a considerable degree of *within-household* redistribution. In other words, in general those with low benefit–contribution ratios are often partnered with those with higher benefit–contribution ratios. This means that focusing only on the extent to which the state pension redistributes between certain types of individuals could overstate the extent of redistribution achieved by the pension system, if we think that individuals' living standards are better captured by the income of their household than by their own individual income.

6.3 Comparing alternative pension systems after taking into account household pooling

How then might household pooling affect our conclusions from Section 5 on how much different alternative pension systems focus resources on different groups? Figure 6.6 illustrates how the distribution of relative state pension entitlements compares under the alternative pension systems described in Section 5 once the value of lifetime state benefits is pooled within households. This can be compared with Figure 5.1, where entitlements were calculated on an individual basis. In contrast to Figure 5.1, once household pooling is taken into account there is considerably less difference in the distribution of state pension entitlements between the flat-rate systems and the earnings-related systems. Similarly, Table 6.3 illustrates both that inequality in state pension entitlements is much lower under any given pension system, and that the difference in inequality between the systems is much smaller, once we assume resources are pooled within households.

The notable exception to this general pattern is the single-tier pension system. For this system the 90:10 ratio and the Gini coefficient is nearly identical if we consider household pooling to the values obtained when we look only at individual level entitlements. This suggests that the state pension entitlements of members of a couple are much more similar to one another under the single-tier

system than under the other systems we consider, and therefore pooling has less effect on the distribution of entitlements.

Figure 6.6. Distribution of state pension entitlements, pooled within couples

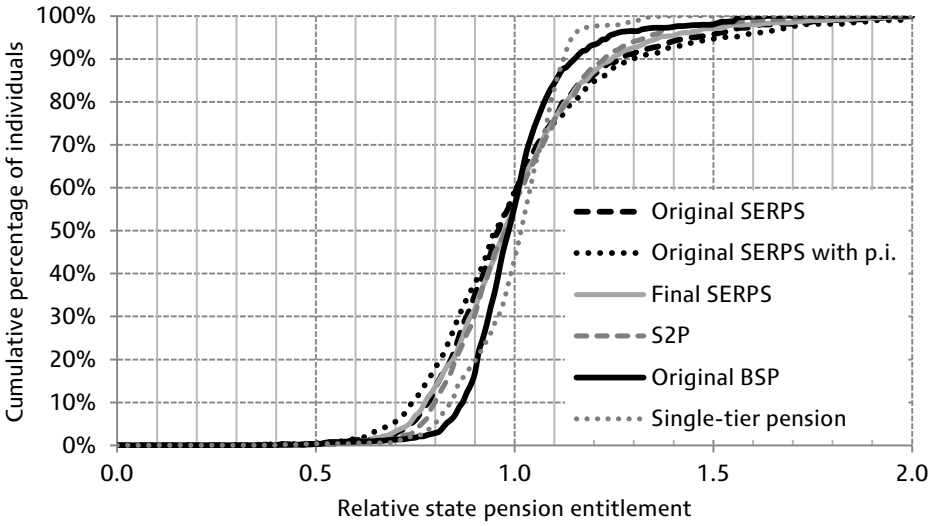


Table 6.3. Inequality in relative state pension entitlements, by state pension system

	Individual entitlement		Pooled entitlement	
	90:10 ratio	Gini	90:10 ratio	Gini
Original BSP	1.5	0.10	1.3	0.07
Single-tier pension	1.3	0.07	1.3	0.06
Original SERPS	2.7	0.20	1.6	0.11
Original SERPS with p.i.	3.5	0.24	1.7	0.13
Final SERPS	2.4	0.18	1.6	0.11
State second pension	2.0	0.14	1.5	0.10

Finally, Table 6.4 illustrates how the measures of redistribution that we discussed above are affected by allowing for the pooling of resources within households and how this affects our comparison of the alternative state pension systems.

Once we allow for household pooling, we find that all the state pension systems exhibit lower inequality in benefit–contribution ratios, entail less interpersonal redistribution and result in a smaller reduction in earnings inequality than when we look simply at individual benefits and contributions – just as we found for the existing system.

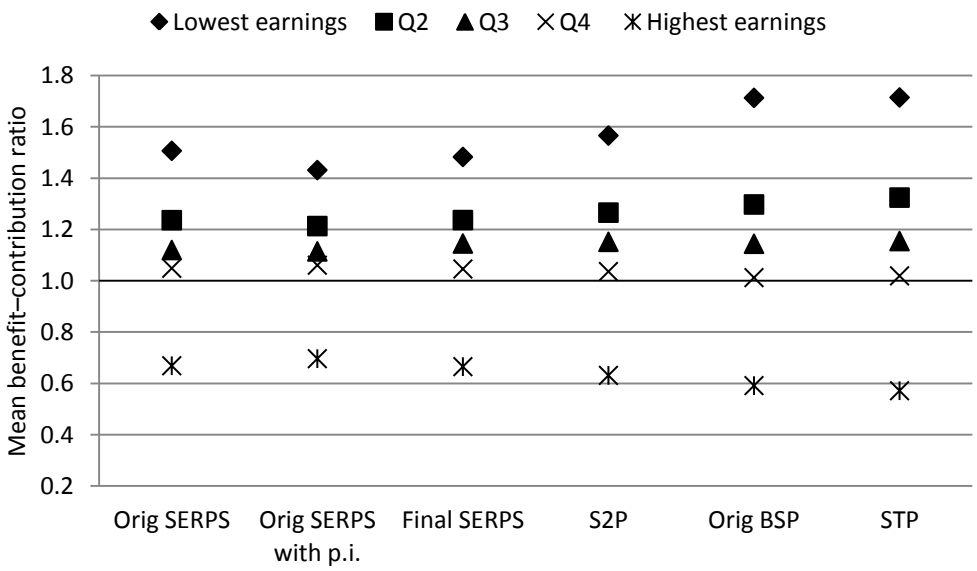
Table 6.4. Measures of redistribution, by state pension system

	Inequality in benefit–contribution ratios		Percentage *interpersonal* redistribution	Gini of net earnings minus Gini of gross earnings
	90:10 ratio	Gini		
		Individual level		
Original BSP	12.1	0.95	29.6%	–0.05
Single-tier pension	15.2	0.94	32.8%	–0.07
Original SERPS	6.9	0.92	21.9%	–0.04
Original SERPS with p.i.	5.4	0.91	19.5%	–0.03
Final SERPS	7.9	0.92	23.0%	–0.04
State second pension	9.9	0.93	26.4%	–0.05
		With household pooling		
Original BSP	2.2	0.20	16.1%	–0.03
Single-tier pension	2.3	0.21	16.5%	–0.03
Original SERPS	1.9	0.17	14.0%	–0.02
Original SERPS with p.i.	1.8	0.16	13.6%	–0.02
Final SERPS	1.8	0.16	13.8%	–0.02
State second pension	2.1	0.18	14.8%	–0.03

Furthermore, the differences between the systems, in terms of the share of interpersonal redistribution done, are smaller when we account for household pooling. For example, on an individual basis, the original BSP system involves over a third more interpersonal redistribution than the original SERPS system (29.6% of spending reflects interpersonal transfers compared with 21.9%), but taking into account household pooling the original BSP system involves only around one-seventh more interpersonal redistribution than the original SERPS system (interpersonal redistribution of 16.1% compared with 14.0%).

The single-tier system displays the largest fall in the proportion of interpersonal redistribution when we take household pooling into account (from 32.8% to 16.5%). It is unsurprising that the single-tier is most affected; one of the main differences of the single-tier system compared with the other systems is the greater relative entitlement it gives to women who have less complete work histories (particularly if this is due to childcare responsibilities), and these women are typically partnered to men who are net financial contributors to the state pension system. Therefore, when we take account of household pooling, the fall in the proportion of interpersonal redistribution is particularly marked for the single-tier system.

Figure 6.7. Average benefit–contribution ratio under alternative systems, by quintiles of pooled lifetime earnings



Note: Earnings quintiles are defined on the basis of pooled gross lifetime earnings. All figures shown are the ratio of group-level mean benefits to group-level mean contributions.

Figure 6.7 illustrates how the systems compare in terms of the average benefit-contribution ratios at different points in the distribution of pooled earnings. The original BSP system and the single-tier system redistribute from individuals in high-lifetime-earning households to individuals in low-lifetime-earning households to a much greater extent (that is, the divergence in the benefit–contribution ratios is greater) than the other earnings-related state pension systems.

6.4 Implications

The analysis above shows that conclusions on the extent of intragenerational redistribution provided by the existing or alternative state pension systems would differ were we to consider individuals as part of households as compared with individuals in isolation. In particular, to the extent that there is within-household redistribution (i.e. that, in general, those with lower state pension entitlements are often partnered to those with higher state pension entitlements and resources are pooled within the household), pension systems that redistribute from high lifetime earners to low lifetime earners make less difference to the inequality of pooled benefits than they do to the inequality of individual-level benefits.

However, whether or not one wants to focus on the impact of the state pension system, or reforms to it, on resources at the household level or the individual level will depend on the precise question being asked and the stance one takes on how resources are (or should be) shared within couples. Existing research

suggests that households do not pool resources completely and that *to whom* income is paid does affect behaviour (see, for example, Lundberg, Pollak and Wales (1997)).

The stance that one takes on this would affect what impact a switch between some of the alternative sets of state pension rules that we consider would have. As an example, consider a switch from the existing state pension rules to the single-tier pension rules. Section 4 showed that under the existing system, assuming couples do not pool their income, on average male state pension entitlements were 1.2 times the cohort average, while women's entitlements were on average 0.7 times the cohort average. Meanwhile, under the single-tier pension rules, the results presented in Section 5 showed that both men's and women's entitlements would on average be the same (and therefore equal to the cohort average). This suggests that, in the absence of household pooling, switching to the single-tier pension rules would have an equalising effect on men's and women's entitlements. On the other hand, if we allow for pooling of resources, the switch from the existing system to the single-tier system would be found to have little impact on men's and women's relative entitlements, since on average men and women have the same state pension entitlement under the existing state pension rules once we assume household pooling (as shown in Figure 6.3). In other words, the effect of this policy change on the resources available to men and women – and, therefore, the likely effect on behaviour – would be expected to be much smaller if one believes that couples pool their incomes rather than keeping them separate.

5. Conclusions

State pension spending amounted to 5.8% of national income in the UK in 2013–14 and this is projected to grow to 7.9% by 2063–64 (Office for Budget Responsibility, 2014). In large part, this spending simply reflects a redistribution of money across individuals' own lifetimes – similar to saving in a private pension but achieved instead through paying taxes during working life and 'in return' receiving a state pension in later life. However, the state pension also redistributes between individuals, including from those with high lifetime earnings towards those with low lifetime earnings.

The redistributive objectives of the UK state pension system have often been somewhat ambiguous, and have changed over time as different governments have come and gone. In this paper, we have used detailed data on households' earnings histories to examine the degree of intragenerational redistribution achieved by the UK state pension system for the cohort born in the 1930s. Furthermore, we have investigated the degree of intragenerational redistribution that could have been achieved by a number of alternative stylised pension systems. These alternative systems were designed to approximate the steady-state version of some of the main reforms that have been implemented in the UK over the last 40 years.

We find that state pension benefits under the existing state pension system are unequally distributed across the 1930s cohort. The ratio of the 90th percentile of lifetime state pension benefits to the 10th percentile is 3.2, while the Gini coefficient is 0.24. However, this is much less unequal than the distribution of gross lifetime earnings among the cohort, which has a Gini coefficient of 0.47.

Men in the 1930s cohort are typically expected to receive higher lifetime state pension benefits than women. On average across the cohort, lifetime state pension benefits amount to £196,000 per person (expressed in 2014–15 terms). On average, men receive 120% of this figure while women receive only 70%. This is despite the fact that women in this cohort receive their state pension five years earlier than men and, on average, are expected to live longer.

Lifetime state pension benefits are also higher on average for higher earners than for lower earners. This reflects two factors. First, higher earners receive higher annual state pension benefits because of the earnings-related element of the state pension (SERPS). Second, our adjustment of life expectancy for socio-economic group extends life expectancy for those who tend to have higher earnings. On average, the top fifth of earners will receive state pension benefits worth just over 150% of the cohort average, compared with around half the cohort average level for the lowest-earning fifth.

Although state pension benefits are unevenly distributed, in large part this reflects unequal financial 'contributions' to the system. This is true both under

our preferred assumption that state pension spending is financed from a proportional tax on earnings and under the assumption that National Insurance contributions made by the cohort 'paid for' their state pension benefits. Comparing the benefits received and the financial contributions paid, we can calculate a benefit–contribution ratio for each individual. Under our assumption that, across the whole cohort, benefits exactly equal contributions, a benefit–contribution ratio equal to 1 means that an individual paid the same amount of contributions (in present-value terms) as the benefits he or she received. The calculated benefit–contribution ratios are found to be higher on average for women (2.0) than men (0.8) and higher for lower earners (5.2) than higher earners (0.7) under the existing state pension system.

We estimate that 20% of state pension spending on the 1930s cohort represents a transfer between different individuals, while 80% of spending simply reflects a transfer from earlier in individuals' lives to later in their own lives. This interpersonal redistribution is inequality reducing: the Gini coefficient for gross lifetime earnings is 0.47, while the Gini coefficient for 'net' lifetime earnings (defined as gross lifetime earnings less lifetime contributions plus lifetime state pension benefits) is 0.43.

The alternative state pension systems we consider differ in terms of the extent of redistribution they imply. If the state pension system were to approximate the basic state pension as it was originally introduced, we estimate that 30% of spending would reflect a transfer between different individuals, and the Gini coefficient for net lifetime earnings would be 0.41. Relative to this system, the reforms to the state pension in 1978 had two opposing effects. On the one hand, the system became more explicitly redistributive between people (for example, by acknowledging periods of childcare for credit to the BSP). On the other hand, the introduction of the more generous earnings-related pension increased the extent to which the state pension transferred resources across the life cycle for a given individual. We estimate that, for a fixed level of total spending, the latter effect dominates and – had the 1978 pension system existed for the whole of the working life for the 1930s cohort – 22% of state pension spending would have represented a transfer between different individuals. The Gini coefficient on net earnings would have been 0.43.

The majority of reforms since then have acted to reduce the earnings-related component of the state pension system and therefore, for a fixed level of total spending, increase the focus on interpersonal redistribution rather than transfers across the life cycle. The single-tier pension that will be introduced from April 2016 has no earnings-related component. Under a stylised version of the single-tier pension system, applied to the 1930s cohort, we estimate that 33% of state pension spending would represent interpersonal transfers, and the Gini coefficient for net lifetime earnings would be 0.40 – in other words, the single-tier pension system would have a greater effect on reducing the inequality in the distribution of gross lifetime earnings than any of the other sets of state pension rules that we consider.

However, examining the benefits received and financial contributions paid by individuals can give a misleading picture if couples pool their resources. We find that, for any given pension scheme, the extent of redistribution provided by the state pension system is lower once we allow for within-household pooling. For example, we estimate that 14% of state pension spending under the existing state pension system would represent interpersonal transfers once we take into account within-household redistribution (compared with 20% when we consider benefits and financial contributions on an individual basis). The comparison between systems is also affected. If benefits and financial contributions are measured on an individual basis, moving from the existing state pension system to the single-tier system would appear to have an equalising effect on the state pension entitlements of men and women. However, once we take into account household pooling, there is little difference between the average pension entitlements of men and women under the two systems. The stance one takes on whether households do (or should) pool financial resources is therefore crucial when assessing the redistributive impact of the state pension system and how alternative system rules may affect behaviour and well-being.

Appendix A: Additional tables and figures

Table A.1. Impact of our restrictions on sample size

	Men	**Women**	**All**
	N (% of ELSA sample)	N (% of ELSA sample)	N (% of ELSA sample)
ELSA sample	1,736 (100%)	1,891 (100%)	3,627 (100%)
Less individuals with no NI linkage	1,218 (70%)	1,276 (67%)	2,494 (69%)
Less those without full benefit unit linked to NI records	1,117 (64%)	1,172 (62%)	2,289 (63%)
Less 'now single'	949 (55%)	778 (41%)	1,727 (48%)
Less long-term self-employed	821 (47%)	691 (37%)	1,512 (42%)
Less those with no positive earnings post 1975	709 (41%)	587 (31%)	1,296 (36%)

Source: Authors' calculations using English Longitudinal Study of Ageing linked with National Insurance records.

Table A.2. Comparison between full ELSA sample and sample for analysis

	Our sample		Full ELSA	
	Men	**Women**	**Men**	**Women**
N	709	587	1,736	1,891
Married or cohabiting (%)	92.2***	92.7***	81.1	63.9
Any children (%)	87.9	89.6	87.8	89.5
Low education (%)	64.4	59.8**	60.8	58.5
Medium education (%)	25.3*	30.4	27.7	32.4
High education (%)	10.3	9.8	11.4	9.2
Ever worked (%)	99.9*	99.3***	99.5	97.8
Current work status:				
Employee	12.1	7.5	12.6	7.3
Self-employed	2.0***	0.5***	5.7	1.8
Retired	76.6**	72.7	71.8	71.1
Unemployed	0.9	0.0	1.3	0.0
Long-term sick	6.5	2.6	6.6	3.2
Other	2.0	16.7	2.0	16.6
Homeowner	83.4**	85.4***	81.1	79.7
Self-reported health:				
Excellent (%)	12.2	13.2	12.1	12.1
Very good (%)	27.8	27.2	27.6	28.0
Good (%)	29.5	36.8**	29.5	33.1
Fair (%)	21.2	17.1**	21.9	20.0
Poor (%)	9.3	5.8	8.3	6.8
Mean wealth (£'000s)	207.3	203.7	225.8	198.5
Median wealth (£'000s)	138.0	143.0	138.2	131.4
Household wealth quintiles (%):				
Bottom	17.5***	14.4***	19.2	20.9
2nd	17.7	19.4	20.0	20.0
3rd	22.1**	22.1*	19.7	20.3
4th	23.2*	25.0***	20.3	19.7
Top	19.5**	19.2	20.9	19.2
Average year of birth	1935.0**	1935.1	1935.2	1935.1

Note: Stars indicate that the difference between our sample and the full ELSA sample (comparing columns 1 with 3 and 2 with 4) is statistically significant at the 10% level (*), 5% level (**) or 1% level (***). 'Full ELSA' is all individuals in ELSA born in the 1930s. 'Our sample' is ELSA respondents born in the 1930s who are successfully linked to the NI data, and who are either single (having never married) or in a couple with a partner who both responded to ELSA and is successfully linked to the NI data, and who we observe as self-employed for nine years or less. 'Low' education defined as leaving school at or before the compulsory school-leaving age. 'Medium' education defined as leaving school between the compulsory school-leaving age and 18. 'High' education assigned to those who left education at the age of 19 or later. Wealth is total non-pension wealth of the benefit unit. In the full ELSA sample, 103 individuals have missing education information, information on whether individuals ever worked is missing for 3 respondents and self-reported health is missing for 54 respondents.

Figure A.1(a). Distribution of state pension entitlements – men only

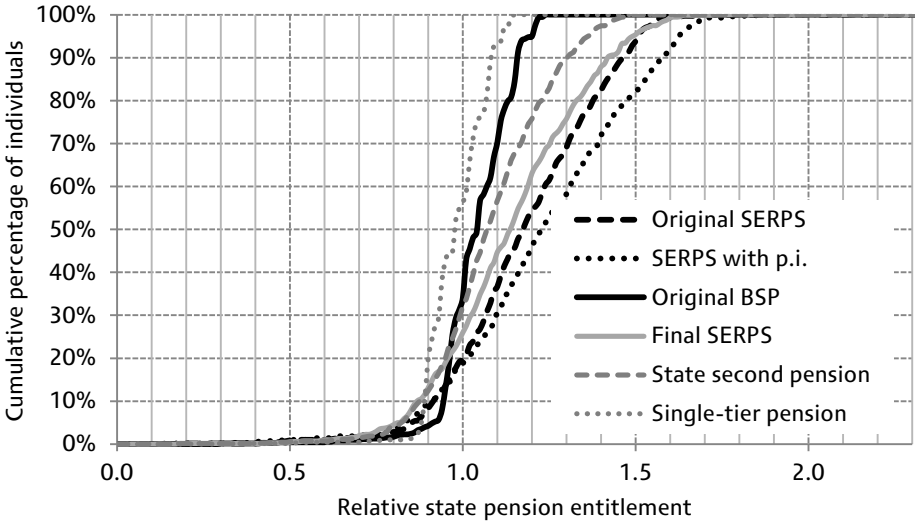


Figure A.1(b). Distribution of state pension entitlements – women only

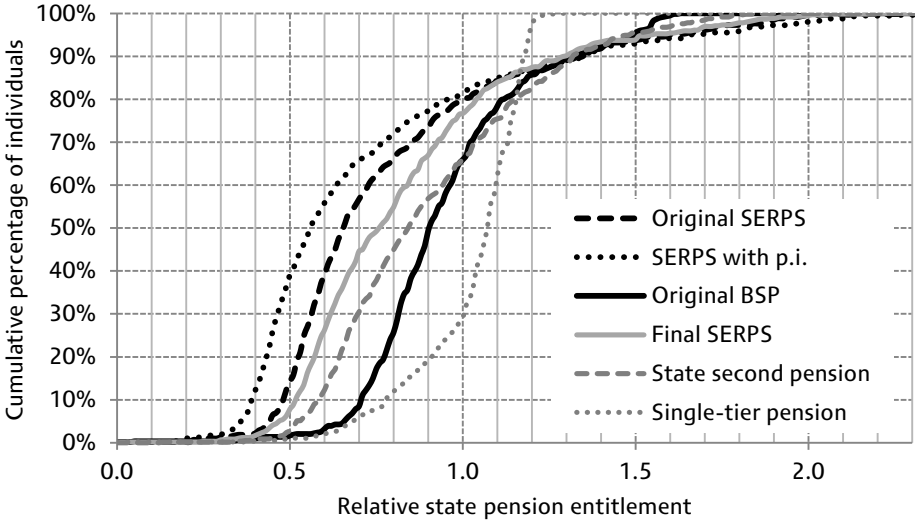
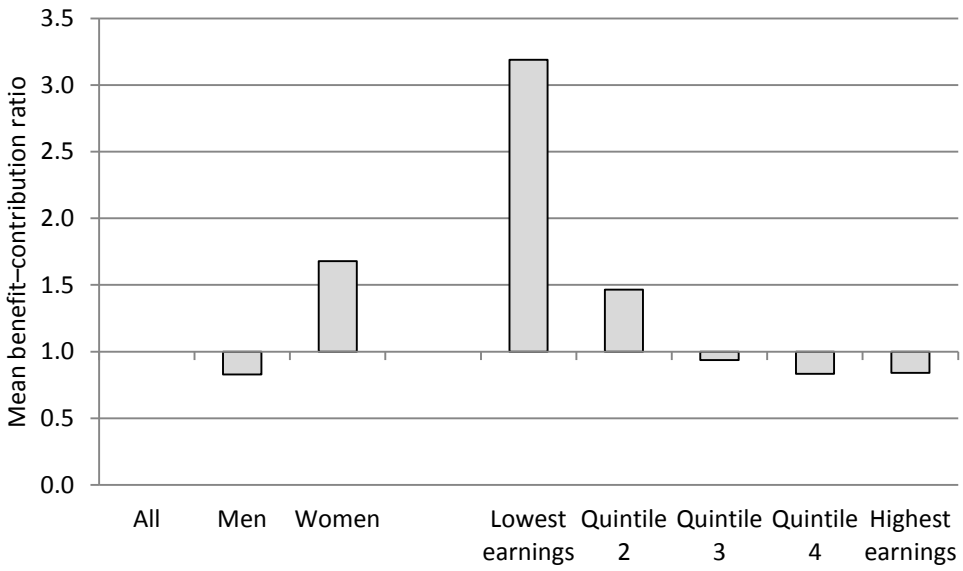
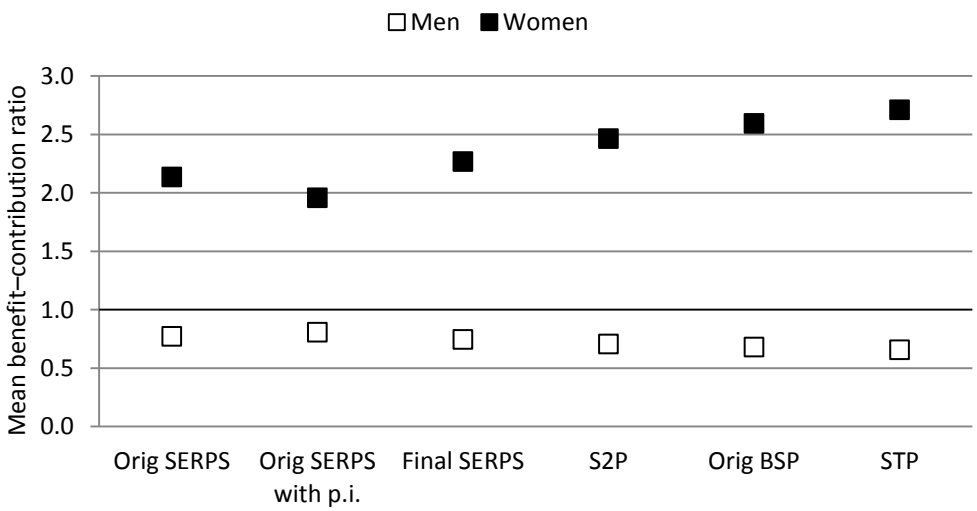


Figure A.2. Mean benefit–contribution ratios, by characteristics: contributions are NI contributions



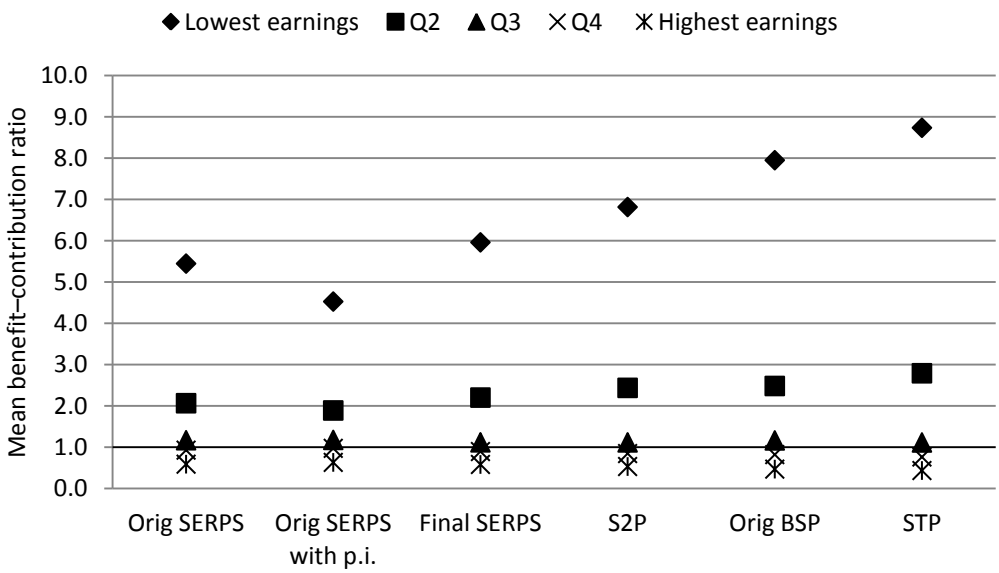
Note: Earnings quintiles are defined on the basis of individual earnings. 'Mean' benefit–contribution ratio is the 'group mean', i.e. calculated by dividing total benefits for the group by total contributions for the group.

Figure A.3. Mean benefit–contribution ratios under alternative systems, by sex



Note: 'Mean' benefit–contribution ratio is the 'group mean', i.e. calculated by dividing total benefits for the group by total contributions for the group.

Figure A.4. Mean benefit–contribution ratios under alternative systems, by lifetime earnings quintile



Note: Earnings quintiles are defined on the basis of individual earnings. 'Mean' benefit–contribution ratio is the 'group mean', i.e. calculated by dividing total benefits for the group by total contributions for the group.

Appendix B: Calculating individual pension entitlements and contributions

The value of lifetime state pension benefits and the value of lifetime contributions that are analysed in Sections 4–6 are calculated according to the following equations:

1. **Value of lifetime state pension benefits:**

$$LTSP_i = \sum_{t=R}^{D} \delta^{2014-t} P_t$$

where P_t is state pension income in year t (expressed in 2014–15 prices), δ is the annual discount rate, R is the year in which the individual reaches the state pension age and D is the year the individual dies.

2. **Value of lifetime contributions:**

$$LTC_i = \sum_{t=\tau}^{R} \delta^{2014-t} C_t$$

where C_t is the contribution to the state pension system in year t (expressed in 2014–15 prices) and τ is the year the individual reached age 16.

Here we describe in more detail how each of the components of these equations is calculated or decided.

B.1 Calculating annual pension income (P_t)

Entitlement from earnings

We use individuals' life histories of earnings (the estimation of which is described in Section 2.1) to estimate their entitlements to state pension under any system on the basis of earnings, simply by applying the rules of that system.

Entitlement from creditable activities

The NI data contain, from 1975, information on whether individuals have received NI credits, and what these credits are for, though the latter is only available reliably from the mid 1990s. Credited activities include spells of unemployment, disability, jury service and caring.

For the alternative state pension systems that we consider, it is important to have information on when individuals were engaged in childcare. This information is not recorded in the NI data prior to 1975, as the NI system did not credit

childcare activities in any way prior to that date. Therefore, we estimate childcare activities prior to 1975 using information from the ELSA survey about the age of any children. Women are assumed to be undertaking childcare activities in any year in which they are not assumed to be in work (based on the estimation of earnings histories described in Section 2.1) and have children under a certain age (the relevant age differs across the alternative systems that we consider). We do not have sufficient information to identify whether (or when) individuals were undertaking other potentially creditable activities prior to 1975 and so we are essentially assuming that no individuals undertook such activities in this period.[20]

Individuals are given credit towards the state pension for years in which they undertook childcare activities or other creditable activities if the state pension system in question includes credits for these activities.

Contracting out

When the government first introduced SERPS, there was a concern that it would crowd out private pension saving. Individuals were therefore given the option[21] (effectively) to pay lower NI contributions in return for a corresponding reduction in their state pension entitlement, provided they received instead an equally generous pension from their existing pension scheme. This is known as 'contracting out'. This option was taken up by many people and so many individuals today consequently have a relatively low state pension entitlement, but instead have higher private pension income.

In our analysis, we wish to describe the distribution of state pension entitlements abstracting from this individual choice, which distorts the picture. We therefore calculate state pension entitlements and contributions for all individuals assuming that there was no 'contracting out'.

Married women's reduced rate

Between 1948 and April 1977, women were allowed to elect to pay a reduced rate of NI contributions in return for receiving a proportion of the state pension based on their husband's contributions rather than a state pension in their own right. This was called the 'married women's reduced rate'. Beyond 1977, women could only pay a reduced rate of NI if they had elected to do so before 1977 and had done so continuously ever since. Just over half of women in our sample were observed paying contributions at the reduced rate in 1975 (three-quarters of those observed with positive earnings).

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[20] In 1975, under the existing state pension system, just 0.5% of our sample earned a qualifying year towards the basic state pension by accruing NI credits.

[21] Many occupational (particularly, defined benefit) pension schemes require all their members to be contracted out.

For years prior to 1975, it is not possible to distinguish in the NI data between women who were paying the reduced rate of NI and women who were not in work. This has three drawbacks for our analysis.

First, we underestimate contributions for women who paid the reduced rate because we are essentially treating them as having zero earnings prior to 1975.

Second, we would like to illustrate how individuals' ratio of benefits to contributions would differ if they hadn't opted to pay the reduced rate compared with if they had. However, we cannot estimate this counterfactual since we do not observe when women are working but paying the reduced rate prior to 1975, and so cannot estimate what their tax contributions during that period would have been in the absence of the reduced rate or what state pension entitlement they would have accrued.

Third, under the proposed single-tier pension, there is no option for women to receive an entitlement based on their husband's contributions rather than their own and therefore accrual pre-1975 is important to the state pension entitlement of women. Since we do not observe earnings pre-1975, we underestimate both pension entitlement and contributions for women who worked prior to 1975 (unless the women also had children aged under 12 during those years of work, in which case we only underestimate contributions because these women will get childcare credits for these years under the rules of the single-tier pension).

B.2 Discount rate (δ)

A real discount rate is applied to annual pension benefits and contributions to take account of the fact that income received or relinquished earlier is more valuable to an individual in real terms than income received or relinquished later. This is important from both the individual's and the government's points of view.

From the individual's point of view, money received in one year can be invested to accrue a real return and will therefore be worth more in the following year than receiving the same initial real amount later on.

From the government's point of view, receiving contributions in one year would reduce government borrowing in that year, and so would be worth more in the following year since the lower borrowing will have also resulted in lower debt interest payments.

We use a real discount rate of 2% per year and discount (or inflate) all our figures to the year 2014–15. This 2% rate is chosen because it is close to the long-run growth rate of average earnings in the UK over this period.

The price index we use to convert benefits and contributions into real terms is the ONS long-run series for the retail price index (RPI). While this index is now not considered to be a good indicator of changes in the cost of living (specifically, it is widely believed to overestimate inflation), it is the only price index available

on a sufficiently long-run basis for our analysis.[22] Furthermore, many of the problems with the RPI have only become acute in recent years.

Our results are sensitive to the discount rate used. A higher discount rate would reduce the relative value of benefits received in later years and so would, for example, reduce the value of lifetime state pension benefits among those who live a long time relative to those who do not. Similarly, it would increase the value of contributions relatively more for those who contribute relatively more during earlier years.

Discounting earnings

We also discount lifetime earnings, which are described in Section 2.2, in the same way as annual pension benefits and contributions. Our division of individuals into groups based on the level of their lifetime earnings will potentially be sensitive to this choice of discount rate: a higher discount rate would increase the position of someone who received their earnings earlier in life relative to someone who received the same real earnings but later in working life. Table B.1, however, illustrates that assuming a discount rate of 0% rather than 2% has relatively little impact on the earnings quintile to which individuals are assigned. For example, 96% of individuals in the lowest earnings quintile using a 2% discount rate are also found to be in the lowest earnings quintile when a 0% discount rate is used. Similarly, 90% of individuals in the top earnings quintile when a 2% discount rate is used are also in the top earnings quintile when a 0% discount rate is used. No individuals move more than one quintile up or down as a result of reducing the discount rate from 2% to 0%.

Table B.1. Re-ranking across earnings quintiles when using a discount rate of 2% and 0%

	Of which: % in quintile of earnings distribution on the basis of a 0% discount rate:				
Earnings quintiles on the basis of a 2% discount rate	Lowest earnings	2	3	4	Highest earnings
Lowest earnings	96%	4%	0%	0%	0%
Quintile 2	4%	91%	5%	0%	0%
Quintile 3	0%	5%	86%	9%	0%
Quintile 4	0%	0%	9%	81%	10%
Highest earnings	0%	0%	0%	10%	90%

[22] For a discussion of the issues involved with the RPI, see Levell (2014), for example.

B.3 Life expectancies

We assume that all individuals die at the average life expectancy from the SPA of someone of their cohort, sex and socio-economic status. These life expectancies are estimated from ONS life tables – which provide estimates of life expectancy at the SPA for individuals of a given sex and single-year date of birth – and ONS estimates of how life expectancies vary by social class.

Table B.2. Life expectancy at the age of 65 by National Statistics Socio-Economic Classification (NS-SEC)

	Years of birth		
	1927–31	1932–36	1937–41
Men			
Large employers and higher managers	16.2	17.9	18.6
Higher professional	17.1	18.2	19.0
Lower managerial and professional	15.9	17.0	17.9
Intermediate	15.5	16.2	17.4
Small employers and own a/c workers	15.4	15.9	17.3
Lower supervisory and technical	14.3	15.2	16.2
Semi-routine	13.7	14.5	15.6
Routine	13.2	13.7	15.0
Unclassified	11.2	12.0	14.2
All men	14.5	15.5	16.7
Women			
Large employers and higher managers	21.2	20.7	21.6
Higher professional	20.9	21.0	22.2
Lower managerial and professional	19.3	20.3	21.0
Intermediate	19.4	19.7	20.2
Small employers and own a/c workers	19.5	19.1	20.3
Lower supervisory and technical	18.3	18.4	19.2
Semi-routine	18.1	18.0	18.8
Routine	17.4	17.2	17.9
Unclassified	16.3	16.6	17.4
All women	18.0	18.5	19.5

Note: Life expectancies are from the age of 65, and so are implicitly conditioning on survival to 65.
Source: ONS Longitudinal Study age-specific mortality data by National Statistics Socio-Economic Classification, 1982–86 to 2002–06, http://www.ons.gov.uk/ons/rel/hsq/health-statistics-quarterly/spring-2011/deriving-trends-in-life-expectancy-by-the-national-statistics-socio-economic-classification-using-the-ons-longitudinal-study.pdf.

The ONS estimates of how life expectancies vary by social class are set out in Table B.2. We adjust life expectancies from the standard ONS life tables by applying the ratio between the life expectancy of each social class group and the average; the results of this are described in Table B.3.

B.4 Calculating annual contributions (C_t)

To calculate contributions under an assumed simple proportional tax on earnings, we simply take each individual's life history of annual earnings (the estimation of which is described in Section 2.1) and apply a single proportional tax rate each year. In other words, $C_t = \tau E_t$ where E_t is earnings in year t and τ is the tax rate. The tax rate τ is calculated to be such that the total value of contributions raised from individuals in this cohort is equal to the total value of their lifetime state pension benefits, with both benefits and contributions being discounted to 2014–15 terms as described above.

We also measure the contributions individuals (and their employers) actually made through the NI system that existed over the course of their working lives. To calculate employee and employer NI contributions, we take individuals' annual earnings and apply the rules of the contemporaneous NI system.

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