Institute for Fiscal Studies

The Case for Taking a Life-Cycle Perspective: Inequality, Redistribution, and Tax and Benefit Reforms

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Nuffield Foundation

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Preface

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Executive Summary

Most analysis of the impact of taxes and benefits on households is cross-sectional, with individuals classified as rich or poor, and gains and losses calculated, using a single snapshot of data (often relating to a week or month). In this report, we argue the case for taking a longer-run perspective. We do this by presenting some basic – but new – descriptive results on how our impression of individual circumstances and the effect of taxes and benefits changes as the horizon under consideration is extended. This report is a preliminary analysis that aims to lay the ground for future work, funded under the same Nuffield Foundation grant, that will perform a more comprehensive analysis of the tax and benefit system from a long-run perspective.

We begin by showing that income and circumstances do not remain constant over time but vary across the life cycle. In particular, employment outcomes, household composition and health status all exhibit strong age profiles, as has been shown by previous work. This variation means that many more individuals experience circumstances of interest to policymakers (e.g. unemployment or claiming out-of-work benefits) at some point in their life than at a given snapshot. In addition, we provide evidence that individuals are, for the most part, able to transfer resources across periods of life through saving and borrowing. Together, these imply that an exclusively snapshot perspective will tend to overstate disparity in living standards between individuals.

The second half of the report details how adopting a long-run perspective changes our impression of the tax and benefit system. We first look at how commonly-used measures of inequality and redistribution evolve as the horizon under consideration is extended. The Gini coefficients for gross and net income, which measure inequality, both fall by around a fifth when we use the full (18-wave) horizon of the British Household Panel Survey (BHPS) compared with a single snapshot. Extending the horizon also has a substantial effect on two common measures of the impact of taxes and benefits on inequality: it reduces the Kakwani index of tax progressivity by almost 30% and the Reynolds–Smolensky index of redistributive effect by 17%.

The reduction in the Gini coefficient is explained by the transitory nature of some of the variation in income across individuals at a point in time, which will tend to average out when considering multiple years together. The decline in the effectiveness of taxes and benefits at reducing inequality – as measured by the Kakwani and Reynolds–Smolensky indices – results from the fact that, from a life-cycle perspective, part of what the tax and benefit system does is effectively to redistribute resources across periods of life (rather than across individuals), with benefits at one age financed by taxes at another. We illustrate this with an exercise that decomposes total redistribution into two components: redistribution across periods of life (intrapersonal redistribution) and redistribution across individuals (interpersonal redistribution). As the number of periods increases, the share of intrapersonal redistribution rises steadily, exceeding 10% of the total after 15 years.

We then show what effect extending the horizon has on the distributional pattern of selected reforms to the tax and benefit system. It turns out that the size of the effect depends on the reform. For the in- and out-of-work benefit reforms between 1999 and 2002, the distributional impact looks more progressive from a long-run than from a snapshot perspective. This is true particularly for the bottom decile, whose share of the total giveaway rises from 21.7% at a snapshot to 25.0% in the long run. This ability to target the lifetime poor is quite an achievement, given the annual nature of taxes and benefits. It reflects the fact that being a low-wage parent (particularly a lone parent) is a good indicator for long-run poverty. In contrast, changing the horizon has relatively little effect (except perhaps for the second decile) when considering recent personal allowance increases or a 1p cut in the basic rate of income tax.

While some of these differences between a snapshot and a longer-run perspective may not seem all that large, they are substantial when one considers that they are obtained by extending the horizon to a period corresponding to less than two-fifths of the time individuals will be of working age, and that retirement marks the point where many net contributors to the tax and benefit system become net beneficiaries. Data limitations mean that estimation techniques will be required to pin down the extent to which the patterns shown here continue over longer horizons. Future work funded under the same grant from the Nuffield Foundation will attempt to do this.

1. Introduction

Most analysis of the impact of taxes and benefits on households is cross-sectional, with individuals classified as rich or poor, and gains and losses calculated, using a single snapshot of data (often relating to a week or month). There are counterexamples, including an extensive body of work by Stephen Jenkins and co-authors (e.g. Jenkins, 2011) and the measures of persistent poverty that form part of DWP's annual Households Below Average Income (HBAI) analysis (e.g. Department for Work and Pensions, 2013). In addition, work that measures living standards using consumption rather than snapshot income (e.g. Brewer, Etheridge and O'Dea, 2013) fits with this approach since consumption is often argued to be a better indicator of current well-being. Nevertheless, it remains routine to analyse tax and benefit reforms solely on a snapshot basis.

In this report, we argue the case for taking a longer-run perspective. In particular, we show that income and circumstances over longer horizons (such as several years) are likely to form a better basis for measuring living standards and how they are affected by taxes and benefits. Results from the two perspectives may look quite different from each other and, as a result, we could end up with contrasting impressions of the extent to which the tax and benefit system redistributes from rich to poor.

The report proceeds as follows. In Chapter 2, we show that individual income and circumstances do not remain constant over time but vary across the life cycle. This means that cross-sectional data are likely to overstate the degree of disparity in longer-run circumstances between individuals because part of the difference is simply a result of individuals being at different stages of life. In Chapter 3, we show how our impression of the effect of the tax and benefit system changes as the horizon under consideration is extended. As we will see, the effect of moving to longer-run measures of income varies depending on the reform, with notable patterns found for the in- and out-of-work benefit reforms between 1999 and 2002.

Our main data source for this analysis is the British Household Panel Survey (BHPS), a panel survey of around 5,500 households in the UK that ran between 1991 and 2008. The BHPS collected information about a wide range of socio-economic indicators, including family composition, employment, income and disability. For more information, see the appendix.

2. Why Horizons Longer than a Year Are Important

In this chapter, we demonstrate why taking a perspective longer than an annual snapshot is important.

2.1 Means and needs vary across the life cycle

If individuals experience significant variation in their circumstances over the life cycle, an exclusively annual (or shorter-run) perspective will tend to overstate long-run disparity between individuals (e.g. in earnings). This is because part of the variation across individuals at any point in time simply reflects the fact that they are at different stages of life.

The extent to which an annual perspective overstates long-run disparity between individuals depends on how much individuals' circumstances vary over their life cycles. In this section, we show how earnings and family circumstances vary across life on average. (Strictly speaking, figures show the combined effect of age, period and cohort on outcomes, i.e. not just the impact of age. We could have plotted profiles separately for different birth cohorts, but data limitations mean each cohort would have been present for only a limited range of ages. Moreover, for age ranges where comparisons can be made, cohort effects typically seem much less important than age effects. Where this is not the case, we point it out.[1])

Employment and earnings

First, we see from the left-hand panel of Figure 2.1 that labour market participation displays an inverted-U shape over the life cycle. On average, the activity rate (i.e. the percentage of individuals in, or seeking, paid employment) rises sharply for individuals in their early 20s, stabilises and remains broadly flat through their 30s and 40s, before falling quickly during their 50s and 60s. Unemployment also has a marked age profile, falling sharply for both men and women over their 20s and more gradually over their 30s (see the right-hand panel of Figure 2.1). At older ages, the unemployment rate rises slightly for men and falls for women up to retirement age, although this differential is driven by cohort rather than age effects.

Figure 2.2 shows median weekly earnings (from the main job) among employed individuals over the life cycle. This displays a marked humped profile, peaking at around 40 for men but earlier for women, which is due to the large increase in the share of women working part-time in their late 20s and early 30s as a result of

[1] See Hood and Joyce (2013) for a comprehensive overview of the differences between cohorts for a range of economic outcomes.

Figure 2.1. Age profile of employment status by sex

Note: Authors' calculations based on pooled data from all 18 waves of the BHPS. Includes all non-dependants aged 16–70. Results are weighted using cross-sectional weights. Employment and unemployment calculated according to International Labour Organisation (ILO) definitions. Labour market activity defined as being employed or unemployed.

Figure 2.2. Median gross earnings of employed workers by age and sex

Note: Authors' calculations based on pooled data from all 18 waves of the BHPS. Includes all employed non-dependants aged 16–70. Results are weighted using cross-sectional weights. Gross earnings are before taxes and benefits and are uprated to December 2012.

childcare responsibilities.[2] As earnings are the main source of income for most working-age families, the strong age profiles observed in labour market participation and earnings translate into substantial differences in income across the life cycle.

Figure 2.2 showed how earnings evolve across the life cycle, averaging across individuals at each age. This may mask what happens at the extremes of the distribution. To understand this, we can look at transition probabilities for the earnings distribution. This involves lining up all working individuals from highest to lowest on the basis of their earnings in a certain year and then dividing them into five groups (quintiles). Each quintile will contain 20% of earners, with the top (bottom) quintile containing those with the highest (lowest) earnings. We can repeat this exercise for each subsequent year, and then calculate the probability an individual is in a given quintile of the earnings distribution conditional on their quintile in an earlier year.

Table 2.1 shows that while there is a high degree of 'stickiness' in earnings in the short term for both males and females, there is a substantial amount of movement over longer horizons, particularly in the middle quintiles of the earnings distribution. For example, while 55% of males in the middle quintile of wave 1 earnings also appear in the middle quintile of wave 2 earnings, this falls to 26% by wave 18. Those in the bottom and top quintiles of wave 1 earnings are more likely to remain in the same quintile of wave 2 earnings, at 70% and 79% respectively for males, though this

Table 2.1. Gross earnings quintile transition probabilities

		Wave 2 quintile					Wave 18 quintile				
		Bottom	2	3	4	Top	Bottom	2	3	4	Top
Males											
Wave 1 quintile	Bottom	70%	13%	4%	6%	6%	24%	19%	19%	24%	13%
	2	21%	58%	14%	4%	3%	24%	32%	20%	10%	14%
	3	5%	22%	55%	13%	5%	21%	25%	26%	20%	9%
	4	3%	5%	23%	59%	9%	20%	14%	23%	30%	12%
	Top	1%	1%	3%	16%	79%	13%	10%	13%	26%	38%
Females											
Wave 1 quintile	Bottom	81%	11%	4%	2%	2%	26%	19%	23%	15%	17%
	2	16%	66%	15%	2%	0%	26%	27%	20%	19%	8%
	3	4%	13%	64%	16%	3%	12%	18%	32%	24%	14%
	4	1%	1%	15%	68%	14%	11%	18%	25%	28%	18%
	Top	1%	1%	2%	13%	83%	8%	13%	9%	20%	50%

Note: Authors' calculations based on pooled data from all 18 waves of the BHPS. Includes all non-dependants employed in both periods, aged at least 16 in wave 1 and no more than 70 in the destination wave. Results are weighted using cross-sectional weights. Gross earnings are before taxes and benefits and are uprated to December 2012.

[2] The age profiles of earnings at other points in the distribution follow a similar pattern, though the 75th percentile of female earnings exhibits a less pronounced and the 25th percentile a more pronounced hump at ages 25–30.

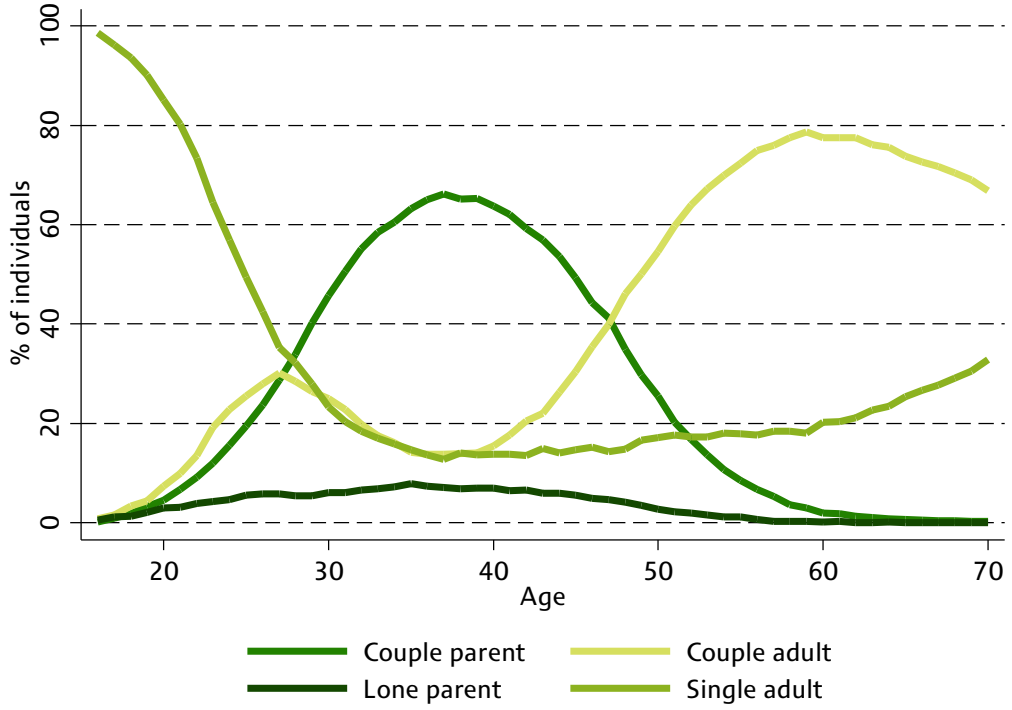
'stickiness' diminishes for people in those quintiles by wave 18. Females tend to experience a greater degree of stickiness than males in the short term and at the top of the distribution for transitions by wave 18. It should be noted, however, that there is likely to be substantial measurement error in the earnings variable used to construct the quintiles, which is likely to result in overestimates of transitions across quintiles over time.

In short, the marked changes we have observed in employment and earnings across the life cycle imply that differences across individuals at a snapshot will, to a considerable degree, reflect differences in age and will not be a good measure of longer-term living standards.

Family composition

Perhaps the most significant events affecting individuals' needs are also those experienced by most individuals at some stage over their life cycle: changes in family composition (the formation and dissolution of relationships and the arrival and departure of children). Figure 2.3 gives a picture of how family composition varies by age. The probability of living with a partner rises sharply over an individual's 20s and 30s, with about 80% of individuals in a couple by the late 30s. The probability of living with children exhibits a similar hump over the life cycle, peaking at over 70% by the mid-30s. Cross-sectional analysis that fails to take these transitions into account is likely to provide a poor indication of longer-term living standards.

Figure 2.3. Family composition by age

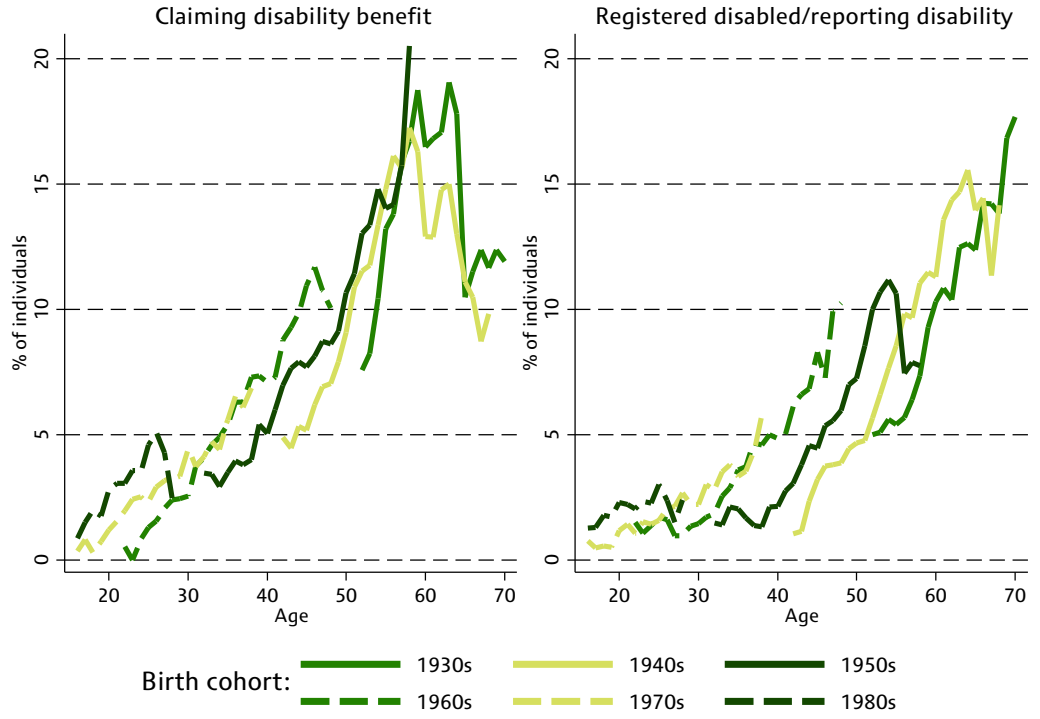


Note: Authors' calculations based on pooled data from all 18 waves of the BHPS. Includes all non-dependants aged 16–70. Results are weighted using cross-sectional weights.

Disability

An important factor that affects both an individual's needs and their ability to provide for those needs is their health status. Figure 2.4 shows the age profile of two measures of disability for individuals grouped by decade of birth. The first measure (left-hand panel) shows the percentage of individuals claiming a disability benefit, while the second (right-hand panel) shows the percentage of individuals reporting being registered disabled (for waves 1–11) or considering themselves to be disabled (subsequent waves).

Figure 2.4. Disability by age and cohort



Note: Authors' calculations based on pooled data from all 18 waves of the BHPS. Includes all non-dependants aged 16–70. Results are weighted using cross-sectional weights. The right-hand panel plots individuals who report being registered disabled (waves 1–11) or report considering themselves to be disabled (wave 12+).

Both measures display strong age and cohort effects, with the probability of claiming a disability benefit or reporting a disability being greater at older ages and, in general, for later cohort groups. The increase with age again suggests that snapshot measures of circumstances will not provide a good indication of longer-term living standards. The increase across cohort groups is explained by some combination of increased prevalence of disability, increased diagnosis of disability and more generous treatment of disability in the benefit system.

2.2 Long-run experiences

So far, we have shown there is substantial variation across the life cycle for a number of important outcomes. As a result, many more individuals experience a given

circumstance (e.g. unemployment) at some stage over their life than at a particular point in time. Table 2.2 shows this for a selection of demographic and employment indicators. The first column gives the percentage of adults observed in a given state at a snapshot (the average percentage of adults across all 18 waves of the BHPS), while subsequent columns give the percentage ever observed in that state as the time horizon increases.[3] For example, while 28% of adults lived with a child aged 18 or younger at a point in time, this rose to 38% of adults over a six-wave interval and 52% over the full 18-wave interval. The table also reveals that while unemployment appears concentrated among relatively few individuals when adopting a snapshot perspective (4.7%), this is less true over longer horizons, with almost a quarter of adults observed unemployed at some point during an 18-year interval. Our estimates of these statistics for longer horizons will be lower than the true statistics to the extent that individuals enter and exit the particular state within a year, as our long-horizon estimates are based on 18 snapshots rather than an event history.

Another set of circumstances of interest to policymakers is the reach of the benefit system, in the sense of how many individuals come into contact with different types of benefit payments. As most analysis of the tax and benefit system in the UK takes an exclusively cross-sectional perspective, it will understate the reach of the system by considering only the number of individuals claiming a benefit in the snapshot period covered by the survey. Using the panel dimension of the BHPS, we can estimate the extent to which benefit claims are concentrated among relatively few or distributed across many families over a longer horizon.

Table 2.2. Ever in state over different horizons

State	Average across waves	Ever observed in state between wave 1 and ...			
		Wave 2	Wave 6	Wave 12	Wave 18
In a couple	64.4%	68.0%	75.6%	83.9%	87.2%
Married	56.0%	60.8%	67.6%	76.7%	80.7%
Has a child[a]	28.1%	31.5%	37.8%	46.3%	52.3%
Disabled	7.7%	5.9%	8.9%	17.2%	26.8%
Unemployed	4.7%	11.9%	18.3%	21.1%	23.9%
In bottom earnings quintile	20.0%	23.3%	33.6%	43.4%	50.7%
In top earnings quintile	20.0%	23.1%	29.8%	38.2%	42.1%

[a] Aged 18 or younger.

Note: Authors' calculations based on BHPS data. Includes all non-dependants aged 16+. The 'average across waves' column includes all waves and is weighted using cross-sectional weights. The 'ever observed' columns are calculated for individuals observed in all waves from wave 1 to the destination wave and weighted using longitudinal weights. The final two lines (earnings quintiles) only include individuals who are employed in all relevant waves.

[3] As we use various waves of the BHPS with enumerated longitudinal weights applied, these statistics give the percentage of the 1991 adult population ever observed in a state over various intervals. To the extent that the adult population of today is similar to that of 1991, the table should give an appropriate estimate of the statistics if today's adult population were subjected to the same tax and benefit system and macroeconomic environment.

Table 2.3. Ever in family claiming benefit over different horizons

Benefit type	Average across waves	Ever reported claiming benefit between wave 1 and ...			
		Wave 2	Wave 6	Wave 12	Wave 18
Child benefit	28.5%	31.5%	37.7%	46.0%	51.9%
Tax credits[a]	3.6%	1.9%	5.1%	9.0%	17.5%
Income support	6.1%	11.1%	16.8%	17.0%	17.5%
Council tax benefit	10.9%	15.7%	24.8%	29.1%	32.7%
Housing benefit	7.0%	11.1%	15.2%	16.3%	17.3%
Unemployment benefit / IS for unemployed / JSA[b]	1.7%	5.4%	10.8%	13.9%	16.4%
All above (excl. child benefit)	16.5%	22.8%	33.9%	39.8%	47.8%

[a] The substantial increase as the horizon is extended in the share of individuals in a family claiming tax credits partly reflects the large expansion of tax credits from 1999 onwards.
[b] This measure combines families claiming unemployment benefit and income support for the unemployed (in operation until October 1996) with families claiming jobseeker's allowance (subsequently).
Note: Authors' calculations based on BHPS data. Includes all non-dependants aged 16+. The 'average across waves' column includes all waves and is weighted using cross-sectional weights. The 'ever reported' columns are calculated for individuals observed in all waves from wave 1 to the destination wave and weighted using longitudinal weights.

Table 2.3 shows, for example, that although 11% of individuals are in a family claiming council tax benefit in any given year on average, this rises to 16% over a two-wave horizon, 25% over a six-wave horizon and just under a third of individuals over the full (18-wave) horizon of the BHPS. Other benefits for which we see large increases in the proportion of individuals affected when the reference horizon is extended are tax credits, unemployment benefits and income support. Indeed, the proportion of individuals observed in a household with someone claiming unemployment benefit / jobseeker's allowance rises from around 2% on average across all waves to 11% over a six-wave horizon and 16% over the full horizon. Taking all benefits and tax credits together (except child benefit), the share of individuals in families receiving at least one rises from 17% in a single wave to almost 50% across all 18 waves.

However, our estimates will be an underestimate of the true proportion of individuals affected over the horizon, for two reasons. First, as with any survey-based data set, there is significant under-reporting of benefit claims in the BHPS: Table A.1 in the appendix shows that in some waves it captures less than half the number of families that the Department for Work and Pensions (DWP) reports claim income support, council tax benefit and housing benefit, though this share rises substantially for later waves. Second, as with Table 2.2, our long-run estimates are based on 18 snapshots and so will miss some benefit claims occurring between waves.

2.3 Periods of life are linked

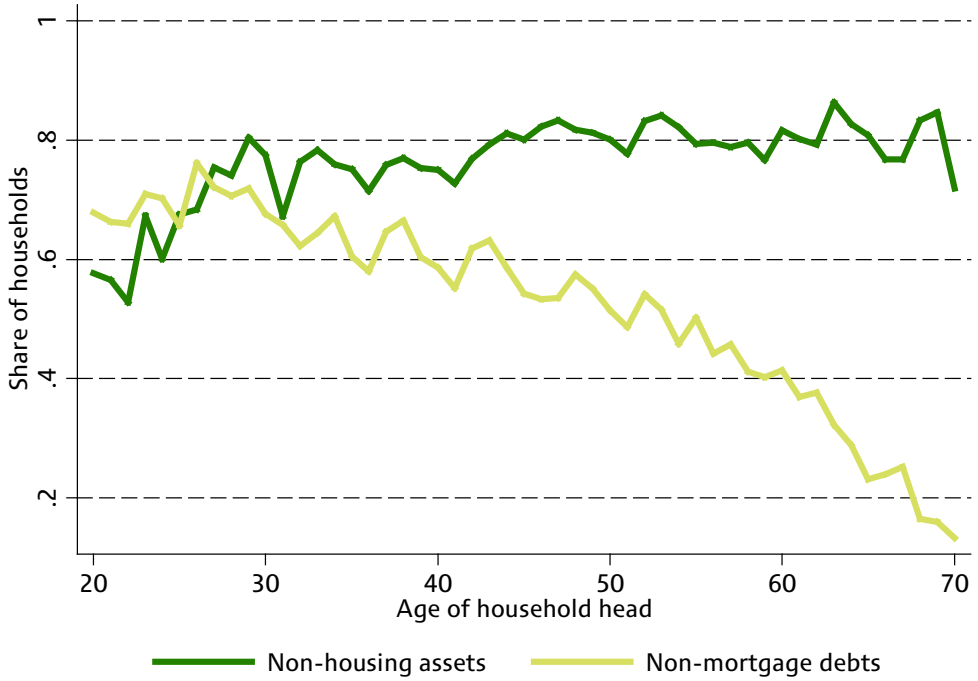
So far, we have seen that earnings and family circumstances vary considerably across life. This means that snapshots often do not give an accurate impression of longer-run circumstances. But if individuals are able to transfer resources across periods of life

through saving and borrowing and have some influence over their future needs, then snapshot measures give an incomplete impression even of short-run circumstances.

The theoretical set-up adopted by economists to express these ideas is called the life-cycle framework. The unifying feature of this framework is that 'agents make sequential decisions to achieve a coherent (and "stable") goal using currently available information as best they can' (Browning and Crossley, 2001, p. 3). Many models based on this framework share the characteristic that consumption is determined by permanent income (an estimate of lifetime income) rather than transitory income. The implication of this is that individuals and households will borrow and save to smooth out fluctuations in income over time to achieve their desired level of consumption.

Taking an exclusively static perspective ignores such considerations and can give a misleading assessment of outcomes of interest to policymakers. For instance, there is much concern in policy circles that low-income households have savings rates that are 'too low' and require some corrective policy action. Life-cycle models offer the important insight that the correlation between income and savings at a point in time is not good evidence of this proposition. Households with temporarily low income will transfer resources from future (and past) periods when income is above lifetime income – in other words, when income is temporarily high – and so we should expect there to be a positive relationship between current income and savings, whether or not savings rates are on average lower for households that are 'lifetime poor'. We now look at evidence on the ability of individuals and households to transfer resources across time.

Figure 2.5. Share of households with assets or debts by age of household head



Note: Authors' calculations based on pooled data from all 18 waves of the BHPS. Results are weighted using cross-sectional weights. Excludes housing assets, mortgage debt and student loan debt.

Ideally, we might like to look at household savings rates (saving less borrowing expressed as a share of income) to see what fraction of households are saving or borrowing in any given year (rather than approximately spending what they earn). Unfortunately, the measures of saving and borrowing we have in the data are noisy and unreliable and are therefore unlikely to give an accurate impression of what saving and borrowing is going on. Instead, we look at measures of accumulated assets and debts, which will be non-zero if individuals save or borrow over time.

Figure 2.5 shows that a substantial share of households have non-housing assets and a substantial share have non-mortgage debts. This indicates that many households are able to save and to borrow. Of course, this does not rule out a minority of families being unable to borrow, or families not having access to a full range of different types

Table 2.4. Use of household saving and borrowing instruments

Great Britain	**2006–08**	**2008–10**
Saving instruments		
All current accounts[a]	92.3	96.4
Current accounts in credit	84.8	89.6
Savings accounts	61.8	67.4
ISAs[b]	42.5	49.4
National Savings certificates and bonds[c]	23.8	27.4
UK shares	14.9	15.4
Insurance products[d]	10.5	10.4
Fixed-term bonds	8.3	11.8
Employee shares and share options	7.3	7.9
Unit/Investment trusts	5.9	6.4
Overseas shares	1.8	2.1
UK bonds/gilts	1.1	1.1
Overseas bonds/gilts	0.1	0.2
Any formal financial asset[a]	**96.1**	**98.1**
Borrowing instruments		
Formal loans	15.5	18.7
Informal loans	1.1	1.4
Loans from the Student Loans Company	2.7	3.3
Hire purchase	13.8	13.1
Credit and charge cards	25.5	25.4
Overdrafts	17.2	17.4
Any non-mortgage borrowing	**48.2**	**49.2**
Excluding overdrafts	*44.3*	*45.8*
Excluding loans from the Student Loans Company	*47.7*	*48.4*

[a] Includes households with current accounts in credit and/or current accounts in debit.
[b] Individual Savings Accounts. Includes Personal Equity Plans (PEPs). At wave 1, PEPs were separately identified, but in April 2008 PEPs were regulated as ISAs, so in wave 2 they are included as ISAs.
[c] Including Premium Bonds.
[d] Excluding life insurance policies that only pay out in the event of death.
Source: Wealth and Assets Survey (Office for National Statistics, 2012).

of borrowing. The households we might expect to have most difficulty in borrowing are those with younger members, but the share with non-mortgage debts is in fact highest for this group (around 70% for those under the age of 30).[4] The fact that the share declines with age may simply reflect household preferences.

Table 2.4 uses data from a different survey (the Wealth and Assets Survey) to show the share of individuals who own different classes of saving and borrowing instruments (i.e. different types of financial assets and debts). From this table, we see that 98% of households own some form of saving instrument and just under half have some form of borrowing instrument. While this differential may reflect borrowing constraints, it is also likely to reflect household preferences.

We have seen that individuals and households have considerable ability to transfer resources across periods of life. In general, we might imagine they have somewhat less control over how needs vary across life, thinking particularly about family composition and disability. This is certainly true for the current period and also holds to a large degree for future periods, particularly for disability. But partnering and fertility choices today do have implications for the future, and lifestyle choices affect the likelihood of poor health later in life. As a result, characteristics that are fixed from the perspective of today are to some degree malleable from the life-cycle perspective.

2.4 Summary

If individual circumstances vary across life, then a snapshot perspective risks overstating the longer-run disparity between individuals. This is because part of the variation across individuals at any point in time reflects the fact that they are at different stages of life. If individuals have the ability to transfer resources across periods of life and affect their future circumstances, then a snapshot perspective does not give an accurate impression even of shorter-run circumstances.

In this chapter, we have shown that employment, earnings, family composition and disability all vary substantially across the life cycle. Most individuals have the ability to transfer resources across periods of life through borrowing and saving. And individuals are able to some degree to affect their future circumstances in terms of family composition and disability. Together, these point in favour of considering longer horizons when analysing the effect of the tax and benefit system.

[4] Note that this excludes student loan debts.

3. The Difference a Long-Run Perspective Makes to Our Impression of the Tax and Benefit System

In this chapter, we show how a long-run perspective affects our impression of what the tax and benefit system does. We consider standard measures of inequality and redistribution (in Section 3.1) and then discuss distributional analyses of tax and benefit reforms (in Section 3.2).

Section 3.1 is based on self-reported measures of gross income (before taxes and benefits) and net income (after taxes and benefits).[5] Section 3.2 uses self-reported gross earnings but simulated taxes and benefits because it concerns counterfactual policy scenarios. In both cases, most of the main personal taxes and benefits are included. See the appendix for further details on how the income measures were constructed.

3.1 Inequality and redistribution

We use two measures of inequality: the *Gini coefficient* and the *90/10 ratio*. The Gini coefficient summarises the disparity between individuals as a number between 0 and 1. Higher values indicate greater inequality; a value of 0 means no inequality (everyone in the population has the same income), while a value of 1 means perfect inequality (all income is in the hands of a single individual). The 90/10 ratio is an alternative inequality measure, calculated simply as the ratio of the 90th percentile to the 10th percentile of the income distribution.[6] The lowest possible value is 1 (when the 10th and 90th percentiles are the same) and higher values imply greater inequality.

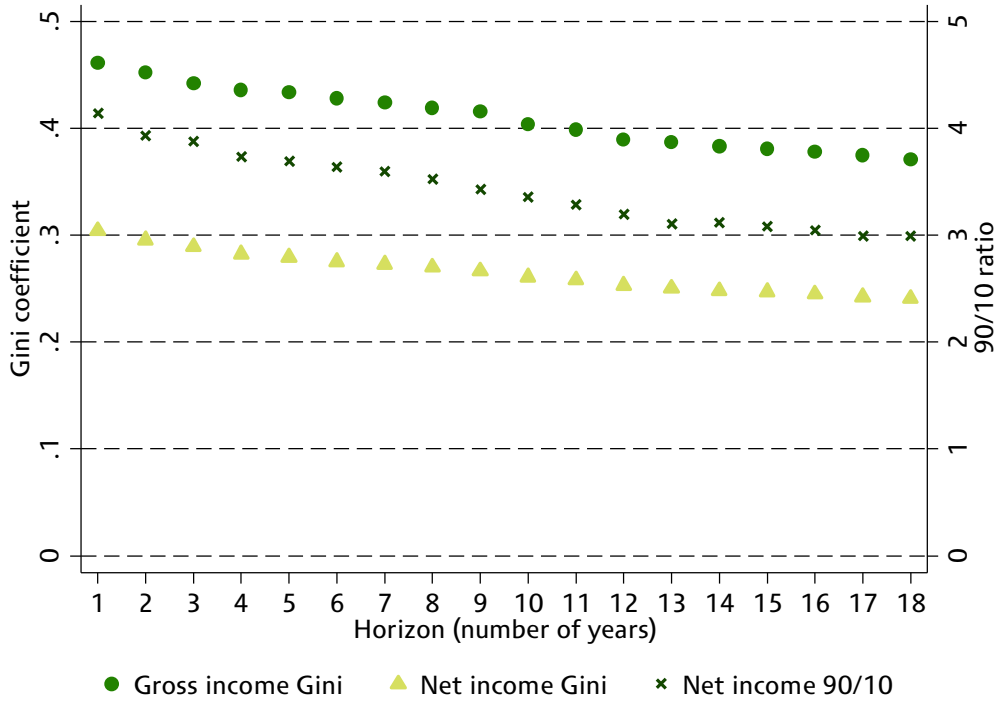
Figure 3.1 shows what happens to the Gini coefficient for gross and net income and the 90/10 ratio for net income as the horizon is extended from one to 18 years.[7] The figure includes all individuals aged at least 16 who are not dependent children. For both gross and net income, the Gini coefficient falls steadily as more years are added. For example, the gross and net income Ginis fall respectively from 0.461 and 0.304 for a single year to 0.371 and 0.241 across all 18 waves (both declines of around 20%). The decline is larger for the 90/10 ratio for net income, which falls from 4.14 to 2.99 (a 28% reduction). The reason inequality falls as the horizon increases is that some of the

[5] We use the derived annual income variables described by Levy and Jenkins (2012). See the appendix for details.

[6] The 10th percentile is the income of the individual who is richer than 10% of the population and poorer than the other 90%. The 90th percentile is defined analogously.

[7] We do not include the 90/10 ratio for gross income because the 10th percentile of the gross income distribution is often close to zero, making the 90/10 ratio large and very volatile.

Figure 3.1. Gini coefficients and 90/10 ratio as horizon increases



Note: Authors' calculations based on BHPS data. Includes all individuals aged at least 16 who are not dependent children and who have been observed from wave 1 up to the relevant horizon. Income for different horizons is derived from reported income over time and is expressed in real terms, equivalised and discounted. Results are weighted using longitudinal weights (cross-sectional weights for one-year horizon). See the appendix for more details.

variation in income across individuals at a point in time is transitory and will tend to average out when considering multiple years together.[8]

We now examine how our impression of the redistribution done by the tax and benefit system changes as the horizon increases. Two common measures of the impact of taxes and benefits on inequality are the *Kakwani index* of tax progressivity and the *Reynolds–Smolensky index* of redistributive effect. A tax and benefit system is *progressive* if the average tax rate increases with gross income, *regressive* if it falls and *proportional* if it is constant. The Kakwani (1977) index of progressivity describes the disproportionality of taxes and benefits (or tax and benefit reforms) relative to gross income (i.e. are taxes and benefits more unequally distributed than gross incomes?).[9] A positive index value indicates that the system is progressive, a negative value that it is

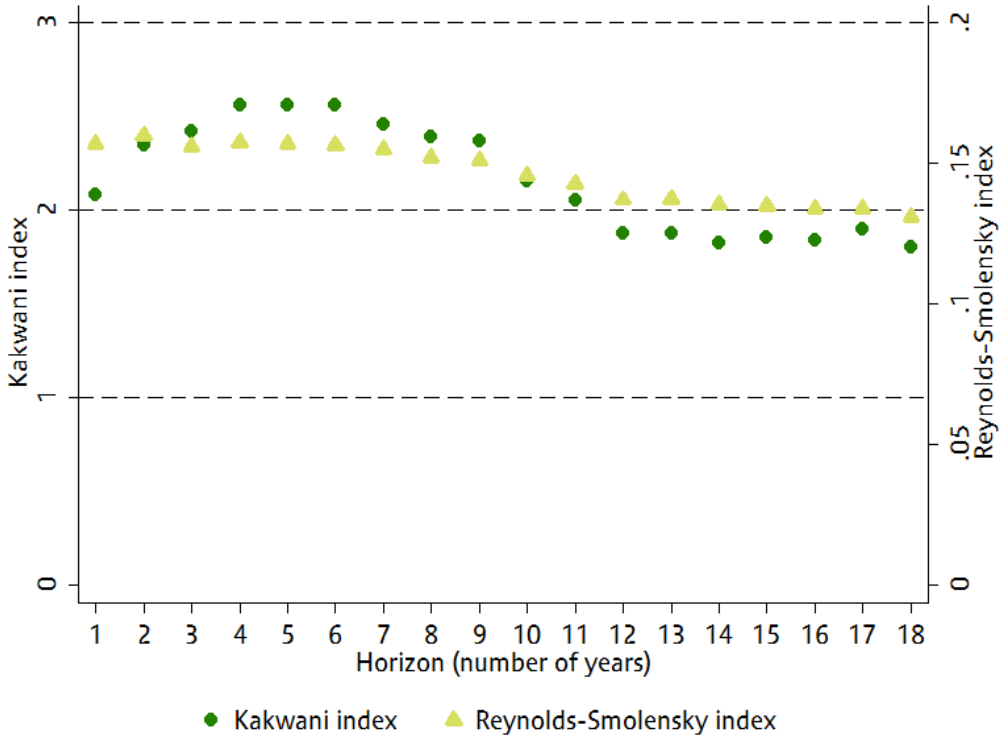
[8] In theory, changes to the Gini coefficient as the horizon is extended could reflect changes to the annual income distribution over time. But this is unlikely to play an important role here since the annual Gini coefficient was relatively stable over the period in question (if anything, it may have increased slightly).

[9] Formally, the Kakwani index is equal to the concentration index for taxes and benefits less the Gini coefficient for gross incomes. The concentration index measures how concentrated net taxes (taxes less benefits) are. Positive concentration index values indicate that net taxes are progressive (e.g. individuals in the bottom 10% of gross incomes pay less than 10% of net taxes) and the converse for negative values. If net taxes are non-negative for everyone, the concentration index ranges between –1 and +1, but if net taxes are positive for some and negative for others, there are no such bounds. For more details, see Murray et al. (2003), for example.

regressive, and zero that it is proportional. For systems where everyone is a net contributor (i.e. taxes are at least as large as benefits), the Kakwani index ranges from –2 to +1; if some individuals are net recipients, it can lie outside this range.[10] The index takes the size of taxes and benefits relative to pre-tax incomes into account, so larger taxes and benefits are not necessarily associated with larger Kakwani values.

While the Kakwani index measures departures from proportionality, the Reynolds–Smolensky (1977) index measures the extent to which the tax and benefit system redistributes income in a way that reduces inequality (which is why it is often called the redistributive effect). It is simply the difference between the Gini coefficients for gross and net incomes. Since the Gini coefficient ranges in value from 0 to +1, the Reynolds–Smolensky index ranges from –1 to +1, with positive values indicating inequality-reducing redistribution, and the converse for negative values. The index does not take the size of taxes and benefits into account, so larger taxes and benefits are usually associated with larger index values.

Figure 3.2. Kakwani and Reynolds–Smolensky indexes as horizon increases



Note: Authors' calculations based on BHPS data. Includes all individuals aged at least 16 who are not dependent children and who have been observed from wave 1 up to the relevant horizon. Income for different horizons is derived from reported income over time and is expressed in real terms, equivalised and discounted. Results are weighted using longitudinal weights (cross-sectional weights for one-year horizon). See the appendix for more details.

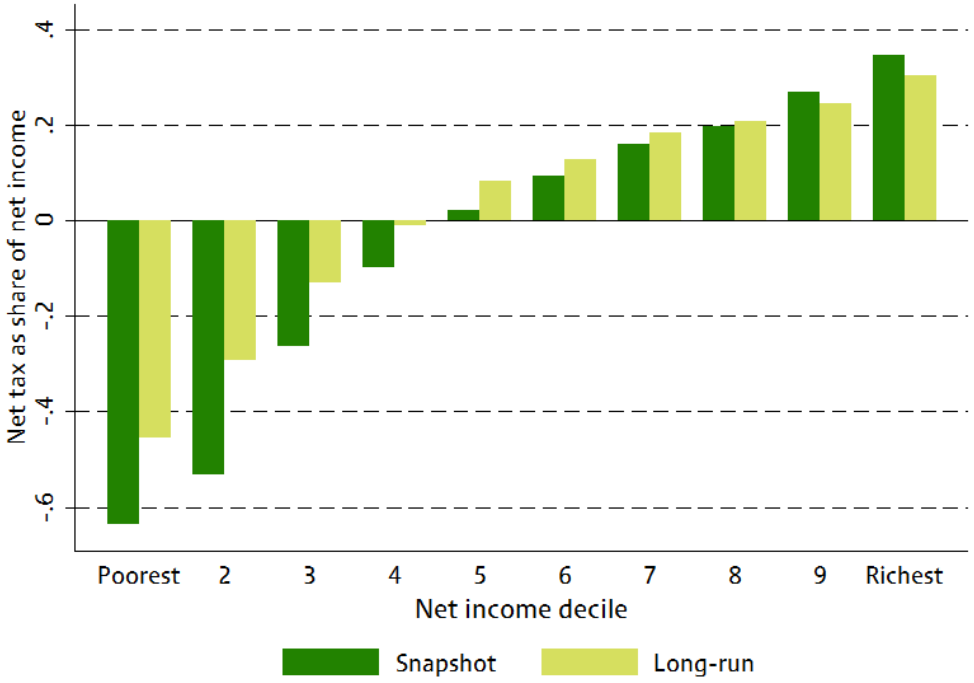
[10] For systems where everyone is a net contributor, the Kakwani index ranges from –2 to +1 because it is equal to the concentration index (which takes on values from –1 to +1) less the Gini coefficient (which lies between 0 and +1).

We can calculate each of these measures varying the horizon under consideration, as shown in Figure 3.2. Both measures display interesting patterns. The Kakwani index looks *more* progressive for up to four waves, increasing from 2.08 to 2.56. Thereafter it declines, reaching 1.81 for 18 waves. The Reynolds–Smolensky index is fairly constant over the first seven waves, at around 0.157, but then declines steadily to a value of 0.131 for 18 waves.

The initial rise in the Kakwani index and steady Reynolds–Smolensky index may seem puzzling given the uniform decline in Gini coefficients. One possible explanation is measurement error. If gross and net incomes are mismeasured by different amounts, then the tax and benefit system will appear less progressive in the cross-section than it actually is. But taking a number of waves together will tend to average out the effect of measurement error, thereby counteracting the downward pressure on the Kakwani and Reynolds–Smolensky indexes.

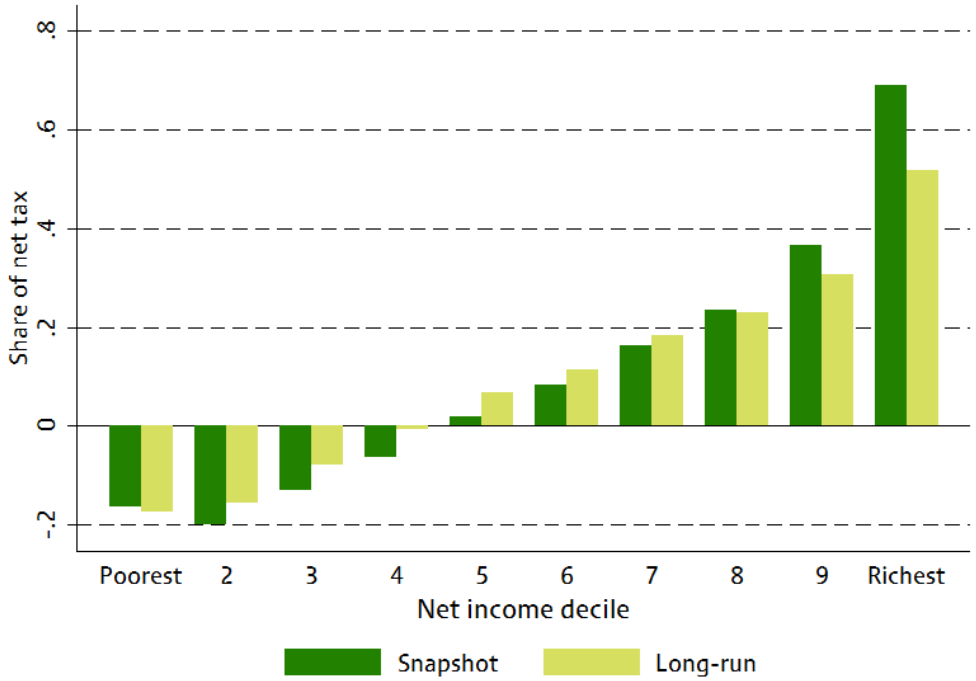
The decline in both indexes from their respective peaks is substantial: the Kakwani index falls by almost 30% and the Reynolds–Smolensky index by 17%. What explains the gradual decline in the effectiveness of taxes and benefits at reducing inequality as the horizon increases? The answer is that, from a life-cycle perspective, part of what the tax and benefit system does is effectively to redistribute resources across periods

Figure 3.3. Net tax as a share of net income across the income distribution



Note: Authors' calculations based on BHPS data. Includes all individuals aged at least 16 who are not dependent children and who are observed in wave 1 ('snapshot' series) or in each of waves 1–18 ('long-run' series). Income is derived from reported income and is expressed in real terms, equivalised and (for the long-run series) discounted. The snapshot series is weighted using cross-sectional weights, while the long-run series is weighted using longitudinal weights. For the snapshot series, both the income deciles and the net tax shares are calculated using snapshot income from wave 1. Likewise, the long-run series is based on long-run income deciles and net tax shares across all 18 waves. Deciles and changes in net income are defined on the basis of equivalised income. Changes in net income are average changes as a percentage of average incomes in each decile. See the appendix for more details.

Figure 3.4. Share of net tax paid by each net income decile



Note: Authors' calculations based on BHPS data. Includes all individuals aged at least 16 who are not dependent children and who are observed in wave 1 ('snapshot' series) or in each of waves 1–18 ('long-run' series). Income is derived from reported income and is expressed in real terms, equivalised and (for the long-run series) discounted. The snapshot series is weighted using cross-sectional weights, while the long-run series is weighted using longitudinal weights. For the snapshot series, both the income deciles and the share of net tax are calculated using snapshot income from wave 1. Likewise, the long-run series is based on long-run income deciles and shares of net tax across all 18 waves. Deciles and changes in net income are defined on the basis of equivalised income. Changes in net income are average changes as a percentage of average incomes in each decile. See the appendix for more details.

of life (rather than across individuals), with benefits at one age financed by taxes at another. This means that a growing share of what taxes and benefits do is ineffective at reducing long-run inequality across individuals.

To get a sense of what is driving this, we can look at net taxes (taxes less benefits) as a proportion of net income across the income distribution and compare the snapshot and long-run results.[11] This is shown in Figure 3.3. Our snapshot income measure is equivalised net income in wave 1 of the BHPS. Our long-run income measure is discounted average equivalised net income over all 18 waves of the BHPS.

If the tax and benefit system were equally effective at reducing snapshot and long-run inequality, we would expect the bars to be similar across the two series. In fact, the snapshot pattern is considerably more progressive, with the difference particularly marked at the bottom of the income distribution. This means that the tax and benefit

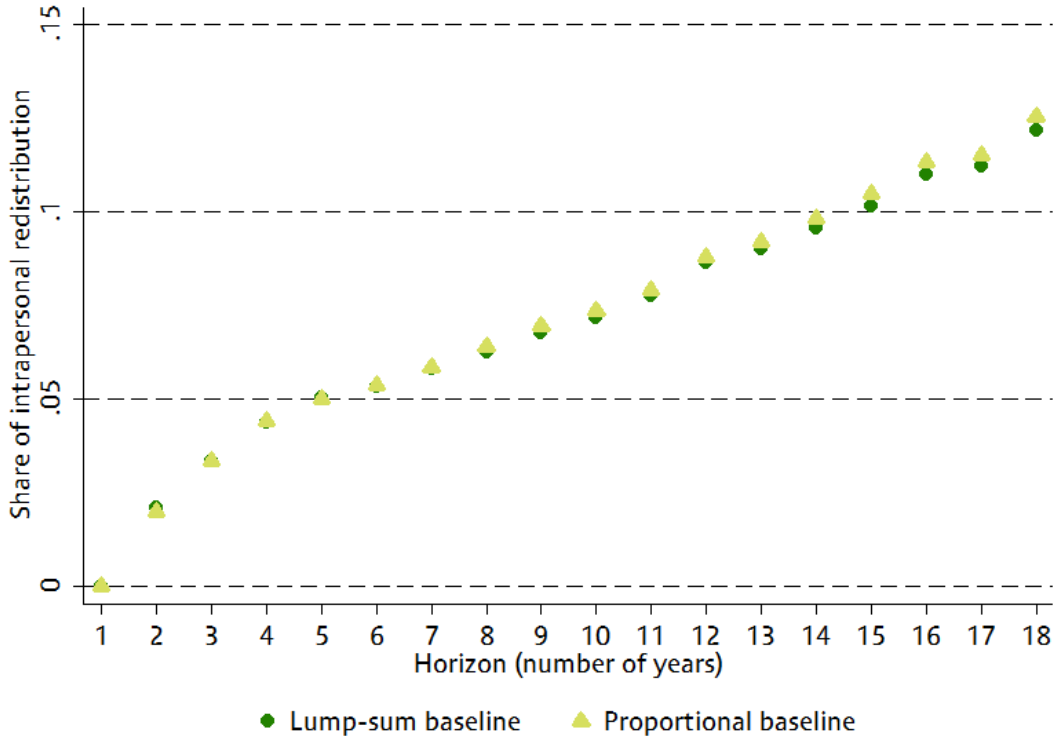
[11] In principle, we could look at net taxes as a proportion of gross (rather than net) income. In this case, the snapshot bar for the bottom decile becomes highly negative because almost half of that decile has zero gross income. This distorts the scale, making the rest of the graph unreadable. Nevertheless, the same patterns emerge as for the net income case discussed in the text.

system is more effective at redistributing towards those who are temporarily poor than towards those who are poor in the long run.

We can also look at the share of net tax revenue collected from each decile in the snapshot and the long run. This is given in Figure 3.4. Comparing snapshot and long-run results, we see that a greater share of net tax revenue comes from the richest deciles, and the size of the giveaway is greater for the poorest deciles, under the snapshot measure. Interestingly, however, the snapshot giveaway is smaller for the poorest decile than for the second decile and no bigger than the long-run giveaway for the poorest decile. This reflects the fact that a lot of support is targeted towards low-paid workers, and most individuals in the bottom snapshot decile are not in work.[12]

We can analyse this issue more formally, decomposing total redistribution into two components: redistribution across periods of life (intrapersonal redistribution) and

Figure 3.5. Share of intrapersonal redistribution in total as horizon increases



Note: Authors' calculations based on BHPS data. Includes all individuals aged at least 16 who are not dependent children and who have been observed from wave 1 up to the relevant horizon. Income is expressed in real terms and discounted. Results are weighted using longitudinal weights (cross-sectional weights for the one-year horizon). Instead of equivalising incomes, redistribution is assumed to be split equally between members of a couple. This ensures that the decomposition adds up correctly. The series labelled 'lump-sum baseline' defines no redistribution as the situation in which each individual pays the same cash amount in net taxes. The series labelled 'proportional baseline' defines no redistribution as the situation in which each individual pays the same proportion of their gross income in net taxes. In both cases, the level of the baseline is set so as to be revenue-neutral relative to the actual system. See the appendix for more details.

[12] It may also reflect the fact that those in the bottom snapshot decile often do not appear to be as poor as those in the second decile (e.g. in terms of consumption). See Brewer, Etheridge and O'Dea (2013).

redistribution across individuals (interpersonal redistribution).[13] We can then investigate how intrapersonal redistribution as a share of total redistribution changes as the horizon changes. Figure 3.5 sets out the results for two alternative no-redistribution baselines (there is no single best baseline): where taxes net of benefits are either a constant lump-sum amount or a constant proportion of gross income.

There is very little difference between the two baselines (lump-sum and proportional). By definition, there is no intrapersonal redistribution with only one period. As the number of periods increases, the share of intrapersonal redistribution rises steadily, exceeding 10% of the total after 15 years. This means that more than 10% of redistribution has no effect on inequality measured over 15 waves. While this might not sound all that large, much of the redistribution across periods of life is likely to happen at a lower frequency than 18 waves of data can easily capture (e.g. redistribution towards periods with children around and towards retirement). As a result, it does not seem unreasonable to expect the steady rate of increase in intrapersonal redistribution to continue as the horizon is extended further, reaching a much more substantial share of the total.

3.2 Assessment of policy reforms

Policymakers and the public are frequently interested in the distributional impact of actual and hypothesised policy reforms. Charts showing gains and losses across the income distribution (e.g. by income decile) have become a staple part of policy analysis carried out by the government and others. But such analysis is usually based on cross-sectional data alone, so only shows the impact of a reform at a point in time. As documented in Chapter 2, individuals experience significant changes in their circumstances over time, meaning that those most affected by a reform at a point in time may be a very different group from those affected most over the long term. As a result, it is instructive to consider the impact of reforms over a longer horizon.

In this section, we contrast the snapshot and long-run distributional effects of three distinct policy reforms: the current coalition government's discretionary increases in the personal allowance, a 1p reduction in the basic rate of income tax, and the 1999–2002 reforms to benefits and tax credits. Moving from a snapshot to a long-run perspective actually involves two changes: a change in how individuals are assigned to income deciles and a change in the horizon over which the effect of reforms is measured. Both of these changes are interesting, so we compare three alternatives in the analysis that follows:

- snapshot effects for snapshot deciles;
- snapshot effects for long-run deciles;
- long-run effects for long-run deciles.

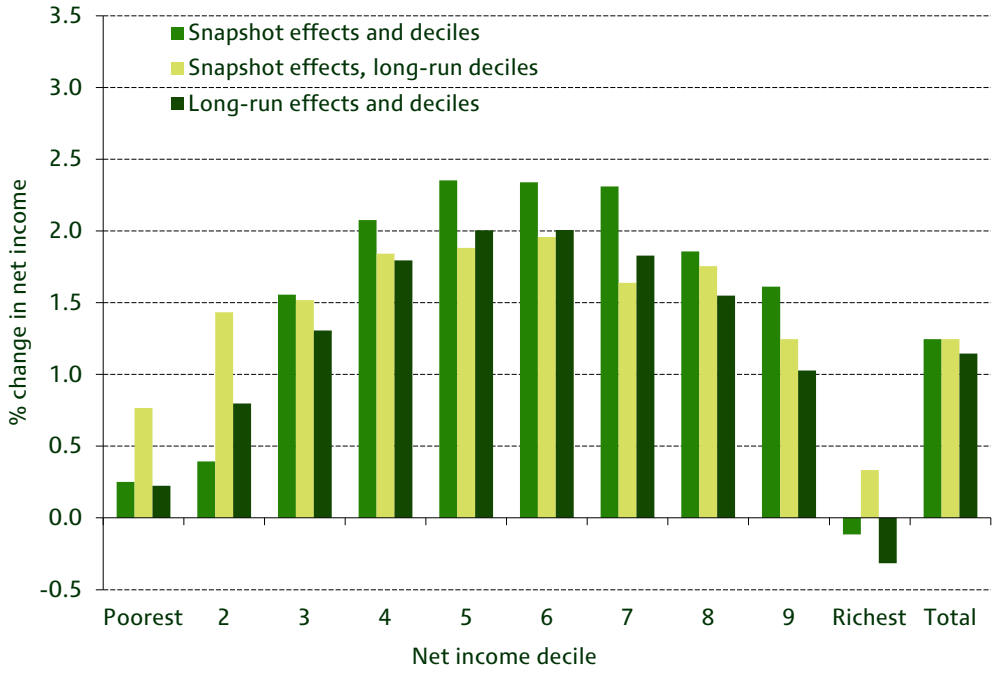
[13] For this analysis, redistribution simply refers to transfers of resources between households via taxes and benefits, regardless of whether they reduce inequality. See the appendix for details of the decomposition.

Differences between these three alternatives will help elucidate the effect that each policy has. The charts we present are similar to the standard decile charts that IFS produces for its post-Budget and Green Budget analysis (e.g. Adam, Emmerson and Roantree, 2013). The main difference is that we use the individual as the unit of analysis rather than the household, because following households across time is problematic (due to changes in family structure). Our snapshot income measure is equivalised net income in wave 1 of the BHPS. Our long-run income measure is discounted average equivalised net income over all 18 waves of the BHPS. Further details are contained in the appendix.

Increasing the personal allowance to £10,000

The coalition government has sought to cut income tax for low- to middle-income individuals by increasing the personal allowance to £10,000 by the end of the current parliament, costing an estimated £10.7 billion per year. To this end, it has made repeated discretionary increases above those required by statutory uprating, restricting gains to basic-rate taxpayers by making corresponding cuts to the higher-rate threshold. We contrast the snapshot and long-run distributional impacts of these

Figure 3.6. Decile chart for coalition's personal allowance increases, 2010–11 to 2014–15



Note: Authors' calculations based on BHPS data and net incomes simulated using TAXBEN assuming full take-up. Includes all individuals aged at least 16 who are not dependent children and who are observed in wave 1 ('snapshot effects and deciles' series) or across all 18 waves (the other series). Results weighted using cross-sectional weights for the 'snapshot effects and deciles' series and longitudinal weights for the other series. For the 'snapshot effects and deciles' series, both the income deciles and net income changes are calculated using snapshot income from wave 1. For the 'snapshot effects, long-run deciles' series, net income changes are calculated using snapshot income from wave 1, while income deciles are based on long-run income across all 18 waves. For the 'long-run effects and deciles' series, both the income deciles and net income changes are calculated using long-run income across all 18 waves. Deciles and changes in net income are defined on the basis of equivalised income. Changes in net income are average changes as a percentage of average incomes in each decile. See the appendix for more details.

reforms against a no-reform world in which the personal allowance and higher-rate threshold rose in line with statutory indexation.

The mid green bars in Figure 3.6 show that, on a snapshot basis, the reforms primarily benefit better-off individuals, with over two-thirds of the gains accruing to the top half of the snapshot income distribution. The poorest two deciles see an average gain of less than 0.5% of snapshot income. This is because few of those in the poorest snapshot deciles earn enough to pay much income tax in any given year.

However, some of those in the poorest snapshot deciles do earn enough in later periods to pay income tax, and so benefit from the increased personal allowance. As a result, the distributional pattern is somewhat less regressive if we define deciles on the basis of long-run income (the light green bars), particularly for deciles 1 and 2.

Adopting a fully long-run perspective – long-run effects for long-run deciles (the dark green bars) – moves the distributional pattern back towards that for the wholly snapshot perspective, with gains concentrated among those in the upper-middle of the income distribution. Decile 2 does do better than in the snapshot, with its share of the total giveaway increasing from 1.2% to 4.0%. Nevertheless, the overall pattern remains regressive. Therefore, the idea that the long-run impact of the reform might be less regressive than its snapshot impact is largely unfounded.

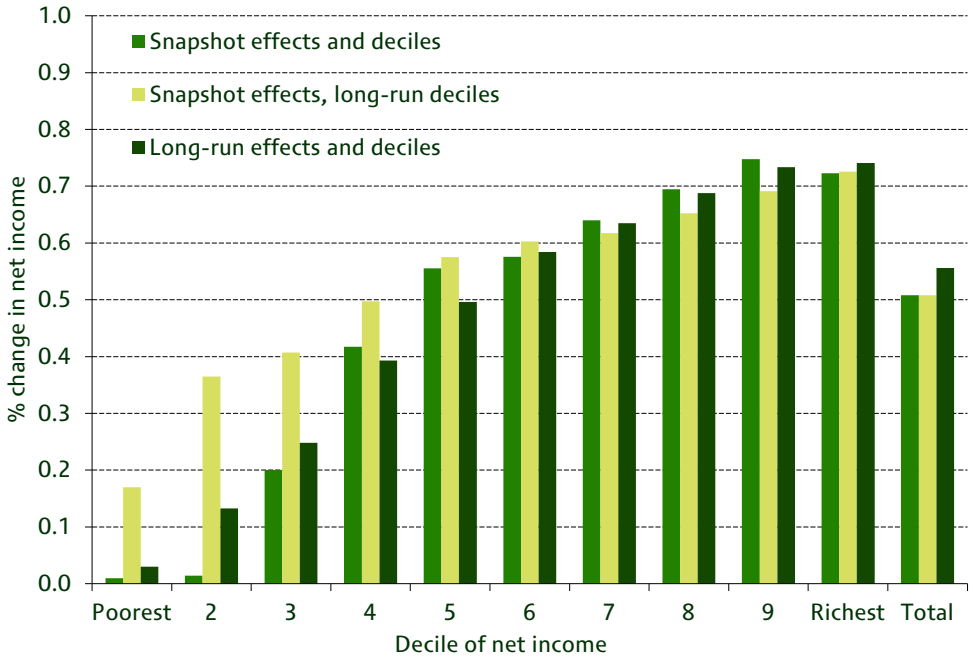
Reducing the basic rate of income tax by 1p

The second reform we consider involves cutting the basic rate of income tax by 1 percentage point. In Figure 3.7, the mid green bars show that the measure looks strongly regressive from a snapshot perspective, with gains almost uniformly increasing with the income decile. The poorest individuals at a snapshot are on average unaffected by the reform in the current period because they earn too little to pay income tax.

As with the personal allowance changes, ordering individuals by long-run rather than snapshot income (light green bars) moderates this pattern, particularly at the bottom of the distribution. This is because the long-run poor are not always snapshot poor, so will end up benefiting from the income tax cut in at least some periods. Nevertheless, the broad patterns remain the same.

For most deciles, taking a fully long-run perspective (dark green bars) brings the picture back closer to the fully snapshot case. Decile 2 is the only decile where there is a substantive difference from the mid green snapshot bars – the share of the total giveaway going to decile 2 rises from 0.1% in the fully snapshot case to 1.3% in the fully long-run case.

Figure 3.7. Decile chart for 1p cut in basic rate of income tax



Note: Authors' calculations based on BHPS data and net incomes simulated using TAXBEN assuming full take-up. Includes all individuals aged at least 16 who are not dependent children and who are observed in wave 1 ('snapshot effects and deciles' series) or across all 18 waves (the other series). Results weighted using cross-sectional weights for the 'snapshot effects and deciles' series and longitudinal weights for the other series. For the 'snapshot effects and deciles' series, both the income deciles and net income changes are calculated using snapshot income from wave 1. For the 'snapshot effects, long-run deciles' series, net income changes are calculated using snapshot income from wave 1, while income deciles are based on long-run income across all 18 waves. For the 'long-run effects and deciles' series, both the income deciles and net income changes are calculated using long-run income across all 18 waves. Deciles and changes in net income are defined on the basis of equivalised income. Changes in net income are average changes as a percentage of average incomes in each decile. See the appendix for more details.

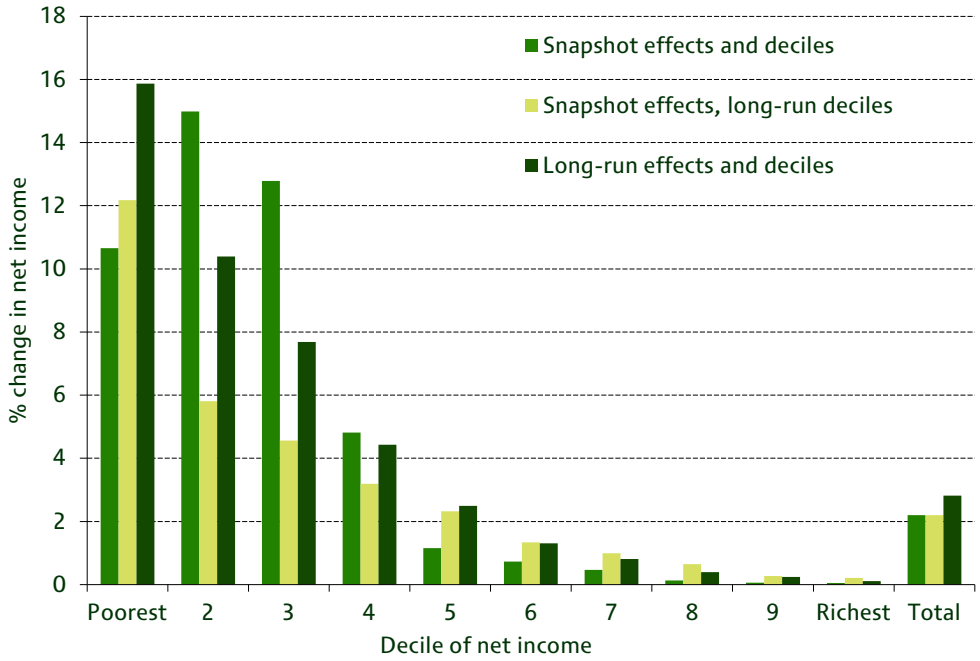
Increasing the generosity of in- and out-of-work benefits

The final reform we consider is that to in- and out-of-work benefits between 1999 and 2002. Readers interested in the details of that reform should see Blundell et al. (2000), but for our purposes it is sufficient to say that it increased substantially the generosity of out-of-work benefits and in-work tax credits for families with children (particularly lone parents).

On a snapshot basis (mid green bars in Figure 3.8), the reform is strongly progressive, with gains concentrated among the poorest half of individuals. On average, those in the poorest three deciles saw gains of more than 10% of snapshot income. The average gain is highest for the second decile because generosity was increased most for working families (whose members typically are not right at the bottom of the income distribution).

Moving to long-run deciles (light green bars) increases the gains to the bottom decile and deciles 5–10, while reducing the gains to deciles 2–4. In the fully long-run case (dark green bars), the pattern is, if anything, more progressive. The share of the total giveaway going to the poorest decile rises from 21.7% in the snapshot to 25.0% in the long run, thereby succeeding in providing additional support to those who are life-

Figure 3.8. Decile chart for in- and out-of-work benefit reforms, 1999–2002



Note: Authors' calculations based on BHPS data and net incomes simulated using TAXBEN assuming full take-up. Includes all individuals aged at least 16 who are not dependent children and who are observed in wave 1 ('snapshot effects and deciles' series) or across all 18 waves (the other series). Results weighted using cross-sectional weights for the 'snapshot effects and deciles' series and longitudinal weights for the other series. For the 'snapshot effects and deciles' series, both the income deciles and net income changes are calculated using snapshot income from wave 1. For the 'snapshot effects, long-run deciles' series, net income changes are calculated using snapshot income from wave 1, while income deciles are based on long-run income across all 18 waves. For the 'long-run effects and deciles' series, both the income deciles and net income changes are calculated using long-run income across all 18 waves. Deciles and changes in net income are defined on the basis of equivalised income. Changes in net income are average changes as a percentage of average incomes in each decile. See the appendix for more details.

cycle poor. This is quite an achievement given the annual nature of the tax and benefit system, and is a consequence of the fact that being low-wage parents (particularly lone parents) is a good indicator for long-run low income.

The fact that the long-run analysis is significantly different from the snapshot analysis demonstrates the value of considering longer horizons.

3.3 Summary

This chapter has shown that extending the reference horizon from a snapshot to one based on multiple periods changes our impression of what the tax and benefit system does, both in terms of standard measures of inequality and redistribution and in terms of the distributional impact of reforms to the system. While some of the differences outlined may not seem huge, it should be borne in mind that they result from adopting an 18-year horizon, corresponding to less than two-fifths of the time individuals will be of working age. Over longer horizons, it is reasonable to expect observed trends to continue. If so, the difference between snapshot and life-cycle measures will indeed be substantial.

4. Conclusion

In this report, we have tried to make the case for taking a long-run perspective when analysing the tax and benefit system, and shown how this changes our impressions of individual circumstances and of the effect of taxes and benefits relative to the standard cross-sectional approach.

We have shown that employment, earnings, disability and family composition all vary across the life cycle in systematic ways that mean that cross-sectional data are likely to overstate the degree of disparity between individuals. This is because part of the variation across individuals at a point in time is simply a reflection of them being at different stages of life. As a result, cross-sectional analysis is likely to paint a different – and possibly somewhat misleading – picture of the distributional consequences of taxes and benefits.

It turns out that the effect of moving to a long-run perspective varies depending on the analysis. For example, we find that, while inequality tends to decline as the horizon is extended, so does the effectiveness of the tax and benefit system at reducing inequality. We also show that the distributional impact of the in- and out-of-work benefit reforms between 1999 and 2002 looks more progressive from a long-run than from a snapshot perspective, particularly for the bottom decile. In contrast, changing the horizon has relatively little effect (except perhaps for the second decile) when considering recent personal allowance increases or a 1p cut in the basic rate of income tax.

While the magnitude of some changes may not be enormous, it should be remembered that they are obtained by extending the horizon to a period corresponding to less than two-fifths of the time individuals will be of working age. As moving into retirement marks the point at which many individuals who were net contributors to the tax and benefit system become net beneficiaries, we can reasonably expect the share of intrapersonal redistribution to increase substantially when a full lifetime perspective is adopted. However, as this report has demonstrated, even the longest-running UK panel data set does not provide enough information to properly evaluate the effects of moving from a snapshot to a lifetime perspective. Instead, estimation techniques will be required to pin down the extent to which the patterns shown here continue. Future work funded under the same grant from the Nuffield Foundation will attempt to do this.

Appendix

A.1 Data

Our analysis is based on the British Household Panel Survey (BHPS), a panel survey following around 5,500 households in the UK between 1991 and 2008. The BHPS collected information about a wide range of socio-economic indicators, including family composition, employment, income and disability.

We use information from all 18 waves and, unless otherwise noted, include all individuals aged at least 16 who are not dependent children. Students and retirees are included but are likely to be under-represented because institutional addresses (e.g. halls of residence and nursing homes) are not sampled. Students tend to be counted at their term-time address, so if they are living away from the parental home they will typically be treated as part of a separate household.

To account for non-random attrition, all analysis is weighted. Cross-sectional results are weighted using the cross-sectional enumerated weight (*exwgt*), while results that involve extending the horizon across multiple waves use *exwgt* for wave 1 and the longitudinal enumerated weight (*elwgt*) thereafter. For the longitudinal analysis, individuals are included for a specified horizon only if they are observed continuously from wave 1 up to that horizon (consistent with how the weights are defined).

With the exception of Section 3.2, we use self-reported (rather than simulated) taxes and benefits. Our gross and net income variables are based on the derived annual income variables described in Levy and Jenkins (2012) and in greater detail in Jenkins (2011). These are constructed in a way that matches the methodology used for the Households Below Average Income (HBAI) publication of inequality and poverty statistics; see Department for Work and Pensions (2013). Gross annual household income is the sum across all household members of earnings from employment and self-employment, investment and savings income, private and occupational pensions, other market income and private transfers (e.g. maintenance). Net annual household income adds to this the sum across all household members of benefits less taxes. The following benefits are included: income support, jobseeker's allowance, housing benefit, council tax benefit, child benefit, family credit, tax credits (working families' tax credit, working tax credit and child tax credit), maternity grant, state pensions and disability benefits (including incapacity benefit, severe disablement allowance, disability living allowance, attendance allowance, invalid care allowance and carer's allowance). The included taxes are income tax and employee National Insurance (but not the community charge or council tax). Incomes are uprated to December 2012 prices using the retail price index (RPI).

In Section 3.2 (the assessment of policy reforms), we use net income measures that are simulated using IFS's tax and benefit simulator, TAXBEN. This is necessary because modelling policy reforms requires that individuals are exposed to counterfactual tax and benefit systems. We take information from the BHPS on family characteristics and usual gross earnings (primary jobs only) to calculate tax liabilities and benefit

entitlements under different base and reform systems. We ignore unearned income. Each wave of data is uprated to December 2012 prices before being passed through TAXBEN. The benefits we include are income support, jobseeker's allowance, housing benefit, council tax benefit, child benefit, family credit, tax credits (working families' tax credit, working tax credit and child tax credit), state pension, maternity grant and free school meals. We assume full take-up. The taxes included are income tax, employee National Insurance and council tax.

For both self-reported and simulated income measures, we equivalise using the modified OECD equivalence scale. Income measures across multiple years are calculated as a discounted sum, discounting to the initial period using a discount rate of 2% (i.e. a discount factor $\beta = 1/1.02$) and expressing incomes in terms of the annual equivalent (i.e. divided by the sum of the discount factors). We discount incomes (rather than simply averaging across periods) because income is more valuable to individuals the earlier it is received (e.g. because interest can be earned on it). In practice, our substantive conclusions are unaffected if we do not discount.

A.2 Reporting of benefit receipt

As described above, much of our analysis is based on self-reported income data. The extent to which individuals correctly report benefit receipt is therefore important.

Table A.1. BHPS claimants as a percentage of reported caseload

Year	Child benefit	Income support	Council tax benefit	Housing benefit
1992	99.3%	49.3%	46.3%	63.9%
1993	90.2%	49.5%	61.3%	40.3%
1994	89.4%	50.6%	48.8%	34.7%
1995	90.8%	52.9%	57.1%	35.4%
1996	91.2%	50.9%	54.3%	33.2%
1997	92.9%	64.9%	63.7%	36.5%
1998	93.1%	59.5%	68.8%	53.2%
1999	93.9%	55.8%	82.7%	38.9%
2000	91.7%	53.1%	86.7%	74.9%
2001	92.7%	46.5%	88.1%	73.0%
2002	88.5%	45.9%	81.5%	69.5%
2003	-[a]	56.1%	70.5%	61.9%
2004	-	80.1%	70.0%	59.3%
2005	-	60.0%	70.8%	58.8%
2006	-	65.2%	77.3%	68.6%
2007	-	64.4%	91.0%	69.5%
2008	-	66.0%	81.6%	68.8%
2009	-	68.7%	72.0%	64.7%

[a] Responsibility for child benefit was transferred to HM Revenue and Customs in April 2003.
Note: Authors' calculations from BHPS grossed to Office for National Statistics mid-year population estimates and Department for Work and Pensions benefit expenditure and caseload tables (Budget 2013), available at https://www.gov.uk/government/publications/benefit-expenditure-and-caseload-tables-2013.

Table A.1 sets out the number of BHPS claimants for selected means-tested benefits, expressed as a share of the total DWP administrative caseload figures. Early waves of the BHPS did not do a great job of capturing income support, council tax benefit or housing benefit, but things seemed to improve significantly in later waves.

A.3 Decomposition of redistribution

In Section 3.1, we decompose total redistribution into two components: redistribution across periods of life (intrapersonal redistribution) and redistribution across individuals (interpersonal redistribution). Here, we set out the details of this decomposition.

The decomposition relies on defining a no-redistribution baseline. Were we able to attribute the benefit of all government spending back to individuals, then the natural baseline would be where taxes equal total benefits (cash benefits and public services) for each individual. But data limitations mean that we cannot easily take public services into account. As a result, the choice of baseline is less clear-cut because the system raises net revenue (to fund public services). We therefore use two revenue-neutral alternatives: baselines where taxes net of benefits are either a constant lump-sum amount or a constant proportion of gross income.

With that in hand, let $N \equiv B - T$ be net benefits (benefits less taxes). Let K be the revenue-neutral no-redistribution baseline and let $R = N - K$ be the amount of redistribution relative to the no-redistribution baseline. Notice that there is nothing in this definition that requires redistribution to be from rich to poor: it is simply a transfer of resources. We will use i to index individuals and t to index time, and the absence of a subscript indicates summation, e.g. $R_i = \sum_t R_{it}$. We can decompose total redistribution into intrapersonal and interpersonal components as follows:

$$\underbrace{\sum_i \sum_t (R_{it} | R_{it} > 0)}_{\text{Total redistribution}} = \underbrace{\sum_i \min\left\{\sum_t (R_{it} | R_{it} > 0), -\sum_t (R_{it} | R_{it} < 0)\right\}}_{\text{Intrapersonal redistribution}} + \underbrace{\sum_i 1[R_i > 0] R_i}_{\text{Interpersonal redistribution}}$$

This is similar to the decomposition used in a number of previous papers (e.g. Bovenberg, Hansen and Sørensen, 2008).

The left-hand side of the equation is total redistribution. The summation only includes periods when redistribution is positive (that is what the condition to the right of the vertical pipe '|' means). This is to avoid everything cancelling out: since we are comparing against a revenue-neutral baseline, redistribution towards one individual at a given age must come from another individual or age.

If we express the intrapersonal component as a proportion of total redistribution, this gives the share of redistribution that is effectively across periods of life.

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