

Top incomes and inequality in the UK: reconciling estimates from household survey and tax return data

By Richard V. Burkhauser,^a Nicolas Hérault,^b
Stephen P. Jenkins,^c and Roger Wilkins^d

^aCornell University, University of Melbourne, and University of Texas

^bUniversity of Melbourne

^cDepartment of Social Policy, London School of Economics and Political Science, London WC2A 2AE, ISER (University of Essex), University of Melbourne, and IZA; e-mail: s.jenkins@lse.ac.uk

^dUniversity of Melbourne and IZA

Abstract

We provide the first systematic comparison of UK inequality estimates derived from tax data (World Wealth and Income Database) and household survey data (the Households Below Average Income [HBAI] subfile of the Family Resources Survey). We document by how much existing survey data underestimate top income shares relative to tax data. Exploiting the flexibility that access to unit-record survey data provides, we then derive new top-income-adjusted data. These data enable us to: better track tax-data-estimated top income shares; change the definitions of income, income-sharing unit, and unit of analysis used and thereby undertake more comparable cross-national comparisons (we provide a UK-US illustration); and examine UK inequality levels and trends using four summary indices. Our estimates reveal a greater rise in the inequality of equivalized gross household income among all persons between the mid-1990s and late 2000s than shown by the corresponding HBAI series, especially between 2004/05 and 2007/08.

JEL classifications: C81, D31.

1. Introduction

Income inequality is increasingly a subject of public discussion and analysis. Major books about it receive public attention (e.g. Atkinson, 2015; Piketty, 2014). Productive debate about what is happening to inequality requires reliable estimates. Yet the two main sources of information—household survey and personal tax return data—provide very different estimates of inequality trends. We address this problem, demonstrating how to reconcile and combine survey-based and tax-based data in a manner that exploits the strengths of each,

© Oxford University Press 2017

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted reuse, distribution, and reproduction in any medium, provided the original work is properly cited.

thus providing better answers to questions such as: what has been happening to income inequality since the mid-1990s?

Household survey data are the usual source for monitoring income inequality in most countries. The UK and the USA use them to derive official statistics. They are the basis of OECD's (2008, 2011, 2015) cross-national comparative studies and the source for most other distributional analysis. Their definitions provide best-practice measures of personal living standards (as we discuss below). Their income-sharing unit is virtually always the household, and their income definition is disposable (post-tax post-transfer) income, adjusted for differences in household size and composition using an equivalence scale. Their unit of analysis is the individual (regardless of age). Inequality is typically summarized using indices based on the entire income distribution such as the Gini coefficient.

A long-standing challenge to survey-based estimates is that survey under-coverage of top incomes can cause an incomplete picture of inequality. The personal tax return data that top incomes researchers use do a much better job of capturing top incomes, but at a cost. Its income, income-sharing unit, and unit of analysis definitions are based on each country's tax administration (definitions that differ from the survey-based ones), and are restricted to summary inequality measures (top income shares) that do not incorporate differences across the full income range.

Figure 1 demonstrates the need to reconcile and combine data. It shows UK income inequality trends over the last five decades using commonly used measures derived from tax data (the share of total income received by the richest 1%) and from household survey data (the Gini coefficient and the ratio of the 90th to the 10th percentile, $p90/p10$). We express each measure relative to its 1962 value so that proportionate changes in the measures are comparable. The survey data estimates are the same as those provided by the UK's official income distribution statistics (the annual 'Households Below Average Income' reports), and

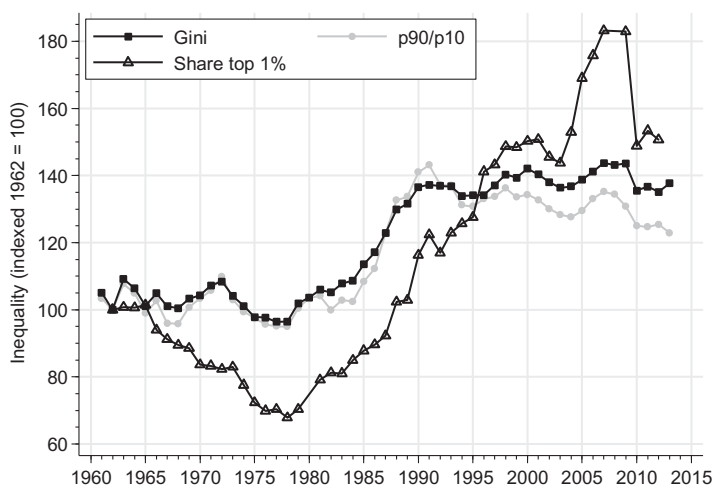


Fig. 1. Trends in UK income inequality since 1961

Notes: Household survey-based Gini and $p90/p10$ measures use the same definitions as employed by the UK's official income distribution statistics (source: spreadsheet accompanying Belfield *et al.* [2015]). Tax return-based top 1% share measure derived by the authors from Alvarado *et al.* [2015]. See Section 2 for further details.

the tax return data are derived from the World Wealth and Income Database (WID), which in turn derives estimates from the Survey of Personal Incomes (the UK tax data). As we explain later, the definitions of income, income-sharing unit, and unit of analysis differ in each source.

UK income inequality trends differ substantially across sources and inequality measure.¹ Between 1962 and 1978, the top 1%'s share fell by almost a third, far more than the 5% fall in Gini and $p90/p10$. The increase in the top 1%'s share between 1978 and 1991 is twice the Gini increase (80% vs. 42%). This striking contrast between series persists in more recent years. Between 1991 and 2007, the top 1%'s share rose by 50%. The Gini rose by only 5%, and the $p90/p10$ fell by 5%.

Referring to survey-based estimates (essentially those in Fig. 1), Young (2015) states that 'there's not much evidence that the United Kingdom became more unequal in the last parliament'. A Deputy Governor of the Bank of England has said that income inequality is 'broadly unchanged' over the past quarter century (Broadbent, 2016, p. 2). Referring to tax-based top income share estimates, Atkinson writes that 'the last quarter of the twentieth century saw an almost complete reversal of the decline in observed inequality at the top that had taken place in the preceding 25 years' (2007, p. 98). Figure 1 shows this U-shaped trend is not apparent for survey-based estimates. Roser (2015) comments that '[i]f anything, income inequality has actually fallen in the UK over the past 25 years', though he also remarks that 'the incomes of the poor in the UK are growing as fast as the incomes of the rich, apart from the top 1%, whose incomes are racing away'. Roser bases his conclusions on estimates from both survey and tax data (as in Fig. 1), but does not point out that these datasets employ different definitions of income, income-sharing unit, and unit of analysis.

We provide improved estimates of trends in UK income inequality since the mid-1990s, reconciling survey and tax data definitions and combining them to derive new series. Reconciliation of definitions is essential because otherwise like is not being compared with like. Our new series takes account of under-coverage of top incomes in the survey data. We do this by assuming that under-coverage is the result of income under-reporting among the very richest rather than unit non-response, and we provide evidence consistent with this assumption.

UK tax return data (the Survey of Personal Incomes, SPI) contain relatively few variables, and it is not possible to link individuals belonging to the same family or household. Consequently, we cannot use tax data to construct definitions of income, income-sharing unit (family and household), and unit of analysis (all persons) like those found in the survey-based UK, Eurostat, and OECD official income distribution statistics. However, because of the wealth of detail available in the survey we use (Family Resources Survey, FRS) and access to its unit record data, we can cross-walk from these survey-based definitions to the tax data definitions. With this reconciliation, we can combine data on a like-to-like basis and derive new inequality series. Moreover, we can explore the consequences of using alternative definitions and alternative summary inequality measures.

Section 2 provides key details about the tax and household survey data we use and explains how we reconcile and combine these two sources. As we explain, the UK Department for Work and Pensions (DWP) who produce official survey-based inequality estimates already employ a limited form of data combination in the form of an 'SPI-adjustment' to FRS data. (Other UK official inequality series do not include any such adjustments,

1 US income inequality trends also differ substantially depending on whether survey or tax return data are used: see Appendix Fig. A1.

and lead to lower Gini estimates than do the DWP's series: see [Burkhauser et al. \(2017\)](#)). These same concerns motivate us, but our combination procedure accounts for survey under-coverage of top incomes in a more extensive manner and we benchmark them against WID-based top income shares.

Sections 3–5 provide results. First, we show how poorly existing survey-based data estimates of top income shares track their tax-based data counterparts. Second, we show how with our combined data, we can derive estimates of top income shares that are almost identical to WID's. Then, exploiting the flexibility of our survey data, we employ our combined data to analyse the implications of changing definitions of income, income-sharing unit, and unit of analysis, and compare top income share estimates in the UK and the USA using more harmonized definitions. We show that conclusions about transatlantic differences in top income shares depend on which income group one considers. However, the UK trends are similar whichever distributional definitions we employ.

Finally, we use our combined data to examine inequality trends based on standard survey-based definitions with summary inequality measures that consider income differences over the full income range (Gini and generalized entropy indices). For the period spanning fiscal years 2004/05 and 2007/08, we find Gini increases that are greater in the combined data than the survey data. Using more top-sensitive inequality measures shows an even sharper differential. These trends differ from those implied by the survey-based data underlying the UK official income distribution statistics ([Fig. 1](#)).

2. Data sources and variables: reconciliation and combination

Here we explain how we reconcile tax and survey data on incomes for each year using common definitions and then combine them. [Figure 2](#) contains a flowchart summarizing the

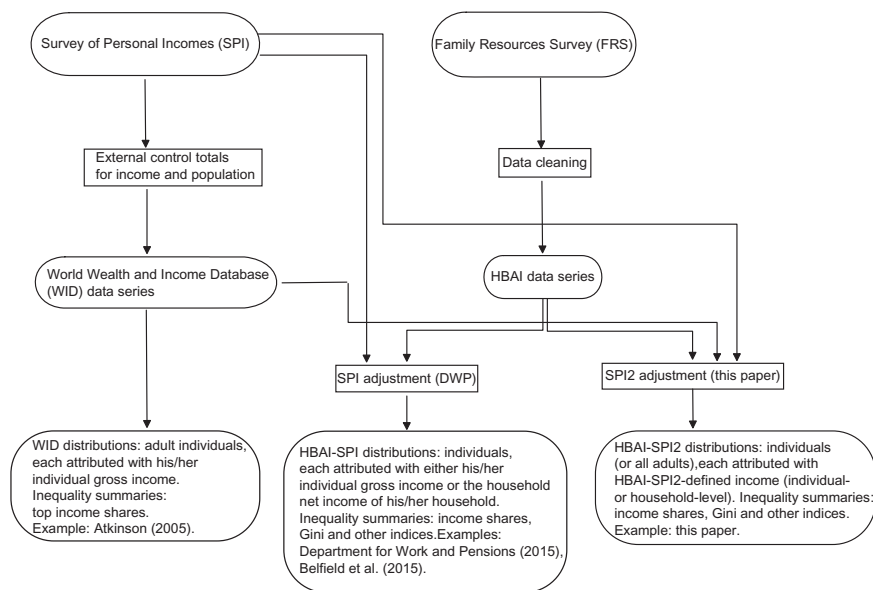


Fig. 2. Combining UK personal income tax and household survey data: flowchart

Notes: For further details, see Section 2.

main elements, from the data inputs (at the top) through data processing (middle), to the outputs in terms of derived income distribution series and analysis examples (bottom). We distinguish between wholly tax-based approaches (WID) and two data combination-based approaches (DWP's and ours).

2.1 Tax return data: the Survey of Personal Incomes and the World Wealth and Income Database

UK unit record income tax data are available from the Survey of Personal Incomes (SPI) since the mid-1990s. Each year's SPI observations are a stratified sample of administrative records for individuals potentially liable to UK tax. The data refer to individuals because, since 1990, that is the assessment unit for UK personal income taxes. The total number of SPI individuals increased steadily, from around 57,000 in 1995/96 to nearly 677,500 in 2010/11 (the latest available data year at the time of writing), corresponding to around 32 million taxpayers. See the documents accompanying [HM Revenue and Customs KAI Data, Policy and Co-ordination \(2014\)](#), and corresponding documentation for previous years' data.

The principal SPI income variable is gross income, i.e. total taxable income from the market ('market income') plus taxable government transfers, and before income tax deductions. [Atkinson \(2005\)](#) used these data as well as published tabulations from the SPI and from supertax and surtax returns for earlier years in his pioneering analysis of trends in UK top income shares since 1908. [Atkinson et al. \(2011\)](#) survey the methodology, main findings, and perspectives emerging from the research using personal income tax data. WID data for many countries, with top income share estimates and associated metadata such as control totals, are freely downloadable ([Alvaredo et al., 2015](#)).

Top income share estimates cannot be derived from SPI unit record data directly because the SPI does not cover all individuals in the UK population or all of their income. To derive top income shares estimates of 'shares in total income among all individuals aged 15 years or more', WID uses external population and income control totals for each year, i.e. estimates of all individuals aged 15 or more, and of the total income held by them. For 2009 and later years, WID derives its control totals for income from the national accounts ([Atkinson, 2012](#)). For earlier years, WID derives total income from income tax statistics and estimates of income from non-filers ([Atkinson, 2007](#); [Atkinson and Ooms, 2015](#)). WID control totals for the population aged 15 and over come from the Office for National Statistics mid-year population estimates ([Atkinson, 2012](#)). We use WID control totals throughout this paper.

2.2 Household survey data: the Family Resources Survey, and Households Below Average Income subfiles

The usual source for analysis of the UK income distribution is the Family Resources Survey (FRS), a large cross-sectional household survey, and the accompanying subfiles of derived income variables called the Households Below Average Income (HBAI) dataset. The DWP administers the FRS, and DWP staff produce the HBAI subfile that they use to derive the UK's official income distribution statistics.² Despite its label, the HBAI provides information about the entire income distribution.

2 See e.g. [Department for Work and Pensions \(2015\)](#) covering fiscal years 1994/95 through 2013/14. (The fiscal year runs from April to the following March.) The Institute for Fiscal Studies, whom the

A major shortcoming of household surveys in general, and the FRS in particular, is their inability to capture income in the top ranges fully. Atkinson *et al.* (2011) provide a striking US example of such under-coverage: ‘the top percentile plays a major role in the increase in the Gini over the last three decades and [Current Population Survey] data that do not measure top incomes fail to capture about half of this increase in overall inequality’ (2011, p. 32).

Under-coverage at the top has long exercised the producers of the UK’s HBAI statistics.³ Since 1992, the derived variables in the HBAI subfile include an ‘SPI-adjustment’ to ‘improve the quality of data on very high incomes and combat spurious volatility’ (Department of Social Security, 1996, p. 23), as we discuss in more detail later. We use the term HBAI-SPI data to refer to these DWP-produced variables and to distinguish them from HBAI-SPI2 data, which we derive using an alternative SPI adjustment procedure (Fig. 2). Later, we compare level and trend estimates of top income shares and other inequality measures using the FRS, HBAI, HBAI-SPI, and HBAI-SPI2 series.

We address the problem that the HBAI-SPI and the SPI-based WID series use different definitions of income, income-sharing unit, and unit of analysis. The principal HBAI-SPI measures refer to household net (‘disposable’) income, i.e. the sum over all individuals within a household of all income from the market plus government cash transfers and after the deduction of personal income taxes, national insurance contributions, and some other deductions. The SPI definitions reflect the administration of the UK personal income tax system, which has been individual-based since 1990: the WID tax-based data capture the taxable gross incomes of adult individuals.

The public-release FRS files contain a large number of income variables, but the separately released HBAI subfiles are the primary data source of analysis of the UK income distribution and its trends. The HBAI subfiles’ income variables incorporate a number of DWP staff adjustments to improve their validity (we refer to these as the HBAI variables). In addition, the HBAI subfiles contain another set of variables incorporating a further modification—the SPI adjustment. These ‘HBAI-SPI’ variables are the source of the official income distribution statistics and the ones most researchers use (cf. Fig. 1).

The income statistics that the DWP publish (e.g. Department for Work and Pensions, 2015) are based on a specific income distribution definition: household net income adjusted for size and composition using the modified-OECD equivalence scale, with each individual (adult or child) attributed the equivalized net income of the household to which s/he belongs. However, access to unit record data allows researchers like us to change the definitions of income and income-sharing unit, though we are constrained by which derived variables are released. Such variables change over time.

Table 1 lists the income variables we use. There are three income definitions (market, gross, and net income) and three income-sharing units (the individual, the family, and the household).⁴ We distinguish between variables made available to researchers—those

DWP contract to check its HBAI calculations, produces their own annual report based on the data (e.g. Belfield *et al.*, 2015).

- 3 The quality of survey data on the very lowest incomes is also a concern (e.g. Brewer *et al.*, 2017, and references therein). We do not consider this issue.
- 4 Our definition of ‘family’ follows the use in UK household surveys and assessments of benefit eligibility. A family is either a single adult living alone, or a couple with or without dependent children. See Department for Work and Pensions (2015, Annex 5). A household refers to the group of people residing at a particular address and may include multiple families who may or may not be related

Table 1. Income variables in the FRS, HBAI, and HBAI-SPI unit record data: available versus derived by the authors

Income-sharing unit	Income definition	Dataset		
		FRS	HBAI (without SPI adjustments)	HBAI-SPI (including SPI adjustments)
Individual	Market	Derived by the authors	Derived by the authors	Derived by the authors
	Gross	Available	Derived by the authors	Only available for 2005/06 and later years, but derived by the authors for earlier years
Family	Net	Available	Unavailable	Unavailable
	Market	Derived by the authors	Derived by the authors	Derived by the authors
	Gross	Available	Available	Available
Household	Net	Unavailable	Available	Available
	Market	Derived by the authors	Derived by the authors	Derived by the authors
	Gross	Available	Available	Available
	Net	Unavailable	Available	Available

Notes: ‘Available’ refers to variables either available in the FRS files or variables derived by the DWP and released in the public-use files for each year from 1994/95 through 2012/13. Market income is pre-tax pre-transfer income; gross income is pre-tax post-transfer income; net income is post-tax post-transfer income. Derivations by the authors are explained in the main text.

coming from the survey directly or from DWP’s calculations—and variables we construct. We discuss the available variables in the next subsection and our constructed ones in Section 2.4.

2.3 Households Below Average Income data and the SPI-adjustment

The yearly SPI-adjustment to HBAI data consists of two elements. First, to include more top income, the DWP replaces the individual incomes of a small number of very rich individuals in the FRS with individual incomes they derive from the SPI. Second, to improve representation of top income individuals per se, the DWP modifies survey weights slightly. The new weights use the SPI-derived numbers of very rich individuals as control totals alongside the other control totals used to create the weights for FRS and non-SPI-adjusted HBAI data (Department for Work and Pensions, 2010, Appendix 2).

To implement the first element, DWP staff derive each adult’s income variables to match the SPI annual income definition. They use four different high-income thresholds to determine an FRS individual’s eligibility: whether the individual is a pensioner or not, and whether resident in Great Britain or Northern Ireland. Importantly, this implies that individuals subject to SPI adjustments are not necessarily those with the highest incomes.

(e.g. a couple and a co-resident adult son or daughter count as two families). A couple refers to two adults in a de jure or a de facto cohabiting union.

The DWP adjusts thresholds annually and has changed the adjustment rule slightly over time. Most notably, a change was introduced in 2009/10 to base ‘the SPI adjustment methodology . . . on adjusting a fixed fraction of the population rather than on adjusting the incomes of all those individuals with incomes above a fixed cash terms level. This should prevent an increasing fraction of the dataset being adjusted’ (Department for Work and Pensions, 2010, p. 242). The DWP introduced a further change in 2009/10, basing the threshold for non-pensioners on net rather than gross income. SPI adjustment rules were also modified from 2002/03 when the FRS expanded its coverage to include respondents from Northern Ireland. Because of these changes, the number of individuals in the HBAI subject to adjustment varies from year to year. Focusing on individuals aged 15 years or more (the population included in WID analyses), between 45 and 175 individuals are subject to the SPI adjustment each year from 1994/95 to 2012/13, representing between 0.12% and 0.52% of the weighted adult population. For further details, see Burkhauser *et al.* (2017).

Once an FRS individual eligible for the SPI adjustment is identified, his or her individual income is replaced by the average SPI income above the high-income threshold among SPI respondents with the same pensioner-location status as the FRS individual. Because SPI data take longer to become available than the survey data, SPI income values used for a given year’s adjustment are based on HMRC staff projections using SPI data from one or two years earlier. (Details of the projection method are undocumented.) Because the age variable in the public-use SPI data is too broadly grouped to accurately identify female pensioners, we cannot recreate the SPI-adjustment cell-means on an out-turn basis.

After the individual-level income imputations, DWP statisticians recalculate incomes at the family and household levels. The official income distribution statistics use these SPI-adjusted household income variables in their HBAI-SPI series (e.g. Department for Work and Pensions, 2015).

2.4 Our construction of missing individual-level HBAI and HBAI-SPI variables

Our analysis requires individual-level income variables. With them, we can also derive family- and household-level variables. However, the individual-level variables we need are not available in the HBAI and HBAI-SPI public-use datasets: see Table 1, top panel. The exception is HBAI-SPI individual-level gross income, which is available but only from 2005/06. Here we explain how we constructed a full set of individual-level market and gross income variables in the HBAI and HBAI-SPI datasets for the whole period. We do not do so for net income, as we explain below.

The FRS documentation lists all income components that enter into the computation of each FRS income variable. By contrast, the HBAI subfile documentation is limited and does not explain the construction of all its new income variables.⁵ However, in some cases the files contain enough income components that when added up allow us to reconstruct some HBAI and HBAI-SPI income variables. For example, government transfers are provided for each income series. Therefore, we can construct market income variables at all three income-sharing unit levels.

5 For FRS details, see Department for Work and Pensions *et al.* (2014). For HBAI subfile details, see Department for Work and Pensions (2013).

To obtain HBAI individual-level income variables, we proceed in two steps. From the FRS, we extract the share of family income accruing to each adult family member.⁶ We do this separately for gross and market incomes. We then apply these shares to the HBAI family gross and market incomes to obtain our new HBAI individual gross and market income variables. Assuming that these adjustments do not change individuals' income shares within each family, our derived HBAI individual-income series are fully consistent with the HBAI family and household income data.⁷

Once we obtain our HBAI individual-income series, we derive HBAI-SPI individual-income series from it. For all individuals in families not subject to the SPI adjustments, we set individual gross and market incomes equal to the corresponding HBAI values for years before 2005/06.

For individuals in a family subject to the SPI-adjustment, we start from the raw FRS individual gross and market income series rather than the HBAI series. This is because the HBAI-SPI individual-income series available from 2005/06 onwards reveal that members of couples who are not subject to the SPI-adjustment themselves, but who belong to an SPI-adjusted family, are assigned their FRS income rather than their HBAI income.

We calculate the income change associated with the SPI-adjustment as the difference between HBAI-SPI and FRS incomes at the family level for gross and market incomes, respectively. We then identify individuals subject to the SPI-adjustments and add the income change to their individual income.

Before 1997/98, this is straightforward because individuals subject to the SPI-adjustment within each family are identified in the HBAI subfiles. For 1997/98 onwards, we know only the number of individuals within each family subject to the SPI-adjustment; and whether these individuals are pensioners or non-pensioners. If this is insufficient information to identify the individual subject to the SPI-adjustment uniquely, we adjust the income of the individual with the largest FRS individual gross income. In the few cases where both members of a couple are subject to the SPI-adjustment, we assume they share it equally. We ignore the post-SPI-adjustment modifications made to individual incomes by DWP statisticians.

Comparisons of our derived variables and the actual SPI-adjustment variables, an exercise possible since 2005/06, show that we can accurately identify the individuals subject to the SPI-adjustment with few exceptions, and our methods yield a close approximation to the actual SPI-adjustment variables. For the 1,105 individuals subject to SPI-adjustments between 2005/06 and 2012/13 and their 939 partners, the average difference between our derived gross income variables and their HBAI-SPI counterpart is £0.01 per week. The difference is greater than £4 in 66 cases only. In addition, we obtain almost exactly the same mean and median for gross and market incomes (Appendix Fig. B1).

Although we construct individual-level market and gross incomes, we do not do so for net incomes. The DWP makes individual-level FRS net income variables available in the public-use files, from which we could derive HBAI and HBAI-SPI individual-level net income variables as described above. We did not do so for two reasons. First, family net

6 We never change children's incomes because they are identical in the FRS and HBAI data.

7 Although our assumption that income shares of individuals within families are unaffected by HBAI adjustments is often violated, the deviations from this assumption only have minor effects: for years when they can be compared, our SPI-adjusted income variables are very close to those created by the DWP (see below).

income is not available in the FRS, so it is not possible to compute the size of the HBAI and SPI income adjustments at the family level and reallocate them to individual family members as we do for gross income. Second, and more importantly, the tax-benefit calculator the DWP uses to determine net incomes is not publicly accessible and there are no comparable alternatives available for the years we consider.

2.5 Our HBAI-SPI2 adjustment

We show below that HBAI-SPI-based estimates of top income shares do not match their WID tax-based counterparts. This motivates our ‘SPI2’ adjustment to improve the top income coverage of the HBAI data.

With respect to DWP’s goals of improving the quality of data on top incomes and combating spurious volatility (see the Introduction) with its SPI-adjustment, we focus on the former. However, as we show below, our approach also reduces year-to-year volatility.

The essential problem is survey under-coverage of top incomes. We assume this is the result of income-under-reporting among the very richest rather than unit non-response, and we provide evidence consistent with this assumption. Choosing how to adjust survey data depends on the nature of the under-reporting. In particular, at what income level does it begin and where within the range above this threshold are incomes under-represented? We answer these questions first, as it helps explain the principles underlying our SPI2 adjustment method, which we then describe in detail.

Figure 3 shows that survey under-coverage of top incomes is a serious problem. We take survey-based top income groups and their WID tax-based counterparts each year and

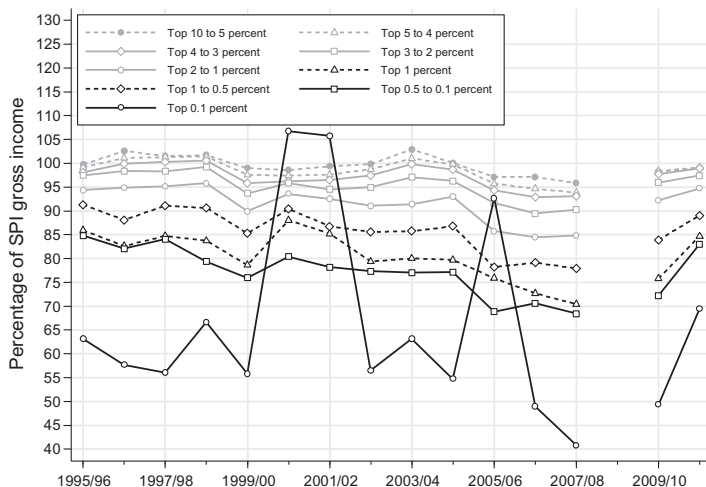


Fig. 3. Survey under-coverage of top incomes, by income group and year

Notes: We construct the figure by first defining, for each year, and separately for the HBAI survey data and the SPI data, each of the income groups shown in the legend (using a common base for the size of the UK adult population, provided by WID). Second, for each group and year, we calculate and plot the ratio of the mean income from the survey data to the mean income from the tax data. Ratios below 100% indicate survey under-coverage of top incomes. For further details of the data series (and acronyms), see Section 2 and Fig. 2. Northern Ireland is included only from 2002/03 onwards.

Source: Authors’ calculations using FRS, HBAI, SPI, and WID data (see main text). There are no SPI data for 2008/09.

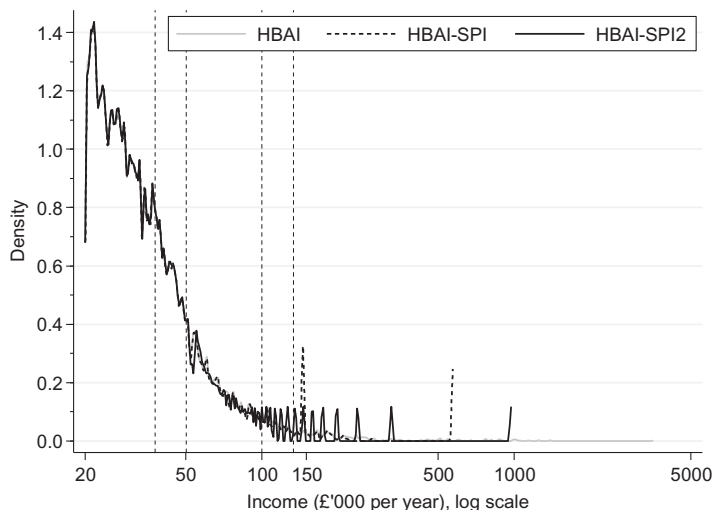


Fig. 4. Density estimates of the upper tails of the HBAI, HBAI-SPI, and HBAI-SPI2 income distributions, 2010/11

Notes: We calculate kernel density estimates for the distribution of log income using observations with income $>£20,000$ per year, using an Epanechnikov kernel and bandwidth of 0.008. The dashed vertical lines show the 90th, 95th, 99th, and 99.5th percentiles in the HBAI data. See Section 2 and Fig. 2 for explanations of the data series and acronyms.

Source: Authors' calculations using FRS, HBAI, SPI, and WID data.

compare their group mean incomes. Ratios below 100% represent under-coverage. Under-coverage is particularly acute at the extreme top of the distribution (at the 99th percentile or above). There are ratios of 90% or smaller. This is especially so for the top 0.1%, but here the few respondents underlying the survey-based estimates lead to great year-on-year volatility as well. However, under-coverage also occurs further down the distribution, especially in the mid- to late 2000s. Importantly, it occurs below the DWP's SPI-adjustment range (approximately the top 1/2% in recent years). Under-coverage is much less of a problem for the 'top 10% to 5%' group for most of the period (ratios around 100%), though more so later.⁸

Under-coverage means that we observe an insufficiently large fraction of the population in the top income ranges. Our SPI2-adjustment works by using the information that tax data provide to place more people in the critical ranges. It does so more extensively than the DWP's SPI-adjustment. Figure 4 illustrates this with kernel density estimates of the upper tail of three distributions for 2010/11—HBAI (i.e. unadjusted), HBAI-SPI (with the DWP's adjustment), and HBAI-SPI2 (our adjustment using the variant based on adjusting the top 5% of survey incomes—see below). A higher density at a given income value means a greater concentration of people. We present estimates for distributions of $\log(\text{income})$ rather than income itself to focus attention on the upper tail and use a small bandwidth to bring out the fine structure. The dashed vertical lines mark the HBAI distribution's 90th, 95th, 99th, and 99.5th percentiles. The HBAI distribution (grey density line) has a long right-

⁸ Jenkins (2017) provides more evidence.

hand tail with a very tiny amount of density mass. In 2010/11, the maximum observed value is approximately £3.54M. The next 48 highest values range down to £323,321.

The DWP's SPI-adjustment replaces the sparse upper tail in the HBAI distribution with only two clumps of density mass (for the non-pensioner groups): look at the dashed density line. The effect of changing the incomes of individuals in the two 'very rich' pensioner groups is imperceptible.

Our SPI2-adjustment places density mass over a greater income range than the SPI-adjustment, and the concentration in the top income range is greater in total: look at the solid black line. (By contrast with the HBAI distribution, the highest 49 observations in the raw HBAI-SPI2 distribution each have an income value of around £971,000.) The reduction in sparsity of coverage of top incomes by the SPI2-adjustment also reduces the chances of non-robustness in inequality estimates due to 'high leverage' outliers in the survey data (Cowell and Flachaire, 2007) and the likelihood of spurious volatility in estimates of inequality trends.⁹

Seam problem minimization is another of our design principles. When we adjust the incomes of the top p percent in the survey data, we do not want to have big differences in the density of the HBAI-SPI2 and HBAI distributions around the 'join' (the $100(1-p)$ th percentile of the HBAI distribution). Figure 4 demonstrates that our SPI2-adjustment (focusing on the top 5%) does not introduce seam problems around the 95th percentile of the HBAI distribution: the density functions for the HBAI-SPI2 and HBAI distributions are very similar around that point. The fact that 95th percentile estimates are very close in the HBAI and in SPI data provides evidence consistent with our assumption that HBAI under-reporting rather than unit non-response is responsible for under-coverage at the top.¹⁰

We analysed SPI2 variants with adjustments made to the incomes of the top 10, 5, 4, 3, 2, 1, or 1/2%, but we prefer the 5% adjustment. It best addresses under-coverage (and potential seam effects) while also being a suitable compromise given the changes in under-coverage over the entire period. The SPI2 analysis we report henceforth uses this variant. However, our SPI2-based estimates are insensitive to variants that include at least the top 2%.¹¹

Here follow the details of the derivation of our HBAI-SPI2 income variables for each fiscal year. First, we rank individuals in the SPI unit record data by their taxable gross income. Second, we allocate individuals to income groups, with the size of each group equal to 1/1000 of the total adult population shown by the WID control total for the relevant year. Third, we calculate the average income for each income group. Next, we repeat the first and second steps with the HBAI data for the same year using our derived measure of (pre-SPI-adjustment) HBAI individual gross income and the FRS grossing-up weights.¹² Finally,

9 A parametric functional form such as a Pareto distribution fitted to tax data (Jenkins, 2017) is an alternative to using discrete mass points to approximate the density function.

10 In support of this, Jenkins (2017, Appendix I) shows that close to 5% of the SPI distribution have incomes greater than the 95th percentile calculated from the corresponding year's survey data.

11 Our findings are almost identical to those in the first version of this paper using a 10% variant (Burkhauser *et al.*, 2016). Results based on other variants are available on request.

12 Re-estimating our inequality estimates using HBAI-SPI grossing-up weights instead of FRS weights has virtually no effect because the differences in the weights are small. Estimates are available on request.

for each of the 50 top HBAI income groups (i.e. the top 5%), we replace the individual-level HBAI incomes with the mean income of the corresponding group in the SPI.¹³

Our procedures ensure that total taxable gross income for the top 5%—and for each of the 50 centile groups of the top 5%—is the same in HBAI and SPI/WID data. We also apply the same approach to derive SPI2-adjustment market income variables using SPI group mean incomes.

Because the same SPI unit record data underlie both our HBAI-based data imputations and the WID estimates, we ensure consistency in the total income of individuals in the top 5% of the distribution. Hence, we obtain the same top income shares from the two sources (for groups within and including the top 5%), provided we use the same income and population control totals. For gross income, we can use either the WID income control total or the internal HBAI control total (i.e. the weighted sum of individual incomes) and assess the difference it makes. However, when considering different income definitions—for instance, market income—we cannot use the WID, which does not contain suitable UK income control totals. Therefore, we use internal HBAI control totals for these other income definitions.

By using the WID estimates of the total adult population, we ensure that the HBAI and WID data contain the same number of individuals in each top income group. However, WID population controls are unavailable for alternative definitions of the income-receiving unit such as the family or the household. Instead, we rely on the internal HBAI population control totals (the sum of the relevant grossing-up weights in each year). This approach slightly underestimates the size of the top income groups, and thus top income shares, since HBAI fails to capture between 1% (in recent years) and 6% (in early years) of the full UK adult population. This is because the FRS excludes homeless and institutionalized people as well as households containing a married adult whose spouse is temporarily absent and, before 2002/03, individuals living in Northern Ireland.

3. How well do survey-based estimates of top income shares match those from the WID?

Our cross-walk of income and income-sharing unit definitions from standard HBAI ones to those WID uses (individual-level gross income for those aged 15 years or more) allows us to compare like with like. Here we analyse how well our various survey data estimates of top income shares match those WID tax-based data provide.

Figure 5 summarizes our first comparison. It shows estimates for the income shares of the top 1% for 1995/96 through 2010/11 derived using multiple data sources and definitions.¹⁴ (Figure 2 defines series acronyms used here and elsewhere.)

- 13 For the other SPI2 variants, we change the number of income groups appropriately (maintaining each group's size at 1/1000 of the total adult population). E.g. to adjust the incomes of the top 10%, we use 100 groups. We also repeated the analysis for a 'top 5%' variant using 10 equal-sized groups rather than 50. Coarsening the grouping affects the results little. We could use group sizes smaller than 1/1000 of the total adult population but chose not to because the discrete approximation to the density worked well and increasing the number of groups would substantially increase computational intensity.
- 14 We discuss point estimates, assessing differences associated with changing definitions and sources (non-sampling variation) rather than sampling variability. However, estimates of standard errors for all inequality measures appear in Appendices E and F.

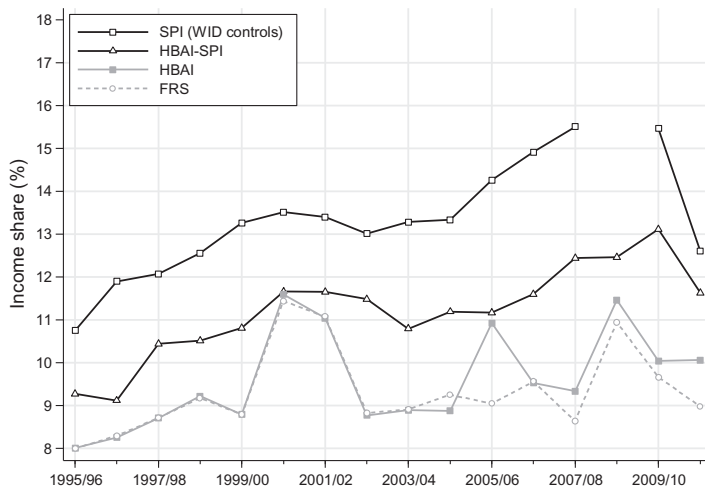


Fig. 5 Top 1% income shares: estimates from survey and tax return data

Notes: Northern Ireland is included in the survey-based series only from 2002/03 onwards. There are no SPI data for 2008/09. The data series (and their acronyms) are explained in Section 2 and Fig. 2. All refer to distributions of individual taxable gross income among tax units.

Source: Authors' calculations based on FRS, HBAI, SPI, and WID data.

The benchmark in Fig. 5 is the WID series, the uppermost one. Its top 1%'s share increases from around 11% in 1995/96 to 13.5% in 2000/01, and is slightly smaller over the next four years, before increasing to around 15.5% in 2007/08.

There is a sharp fall between 2009/10 and 2010/11. The Great Recession and its aftermath provide one obvious explanation, but this conclusion is suspect. A 50% top marginal income tax rate was introduced in April 2010 (up from 40%). Its announcement and introduction provided incentives for high income tax payers to bring forward income to 2009/10 that they would otherwise report in 2010/11 or later. Seely (2014) discusses this 'forestalling' process in detail. Forestalling and the unavailability of SPI data for 2008/09 make assessing recent UK income distribution trends problematic for any measure using data on top incomes, especially top income share statistics. We therefore focus our discussion through to 2007/08.

The series shown in grey in Fig. 5 refer to FRS and HBAI survey-based estimates, i.e. without SPI-adjustments. These provide broadly similar estimates of levels and trends to each other, but compared to the WID tax-based series, the yearly estimates are not only substantially lower but also fluctuate appreciably between years. This fluctuation is the spurious volatility the HBAI's producers aimed to offset with their SPI-adjustment.

The SPI-adjustment is successful in this respect: the HBAI-SPI series is much smoother than the two non-adjusted series, and its estimates are generally larger in each year. However, HBAI-SPI series estimates are distinctly smaller than WID series estimates. Differences range from 1½ to 3 percentage points, with the larger differences more apparent in the mid- to late 2000s. This UK evidence is consistent with Atkinson *et al.*'s (2011) findings for the USA that household survey estimates do not fully capture the rise in inequality shown by tax data (see the Introduction).

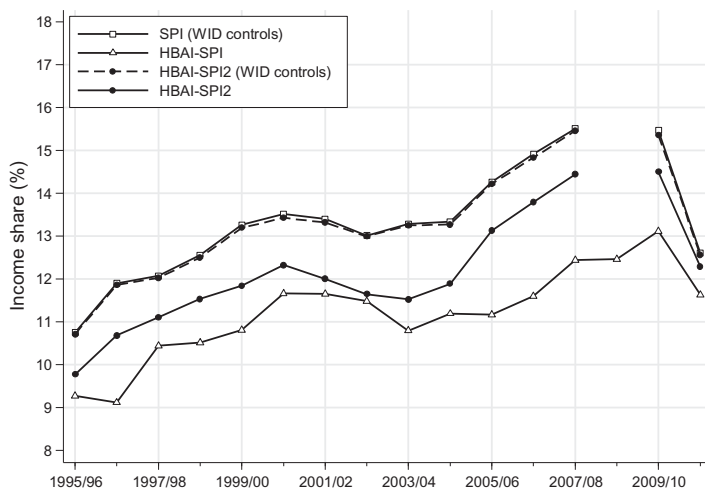


Fig. 6. Top 1% income shares: estimates from SPI/WTID data and combined survey data

Notes and sources: As for Fig. 5.

Do our HBAI-SPI2 estimates of the share of the top 1% do better? Look at Fig. 6, which shows the SPI (WID control), which we hereafter label as WID, and HBAI-SPI series (as in Fig. 5) plus two HBAI-SPI2 series. The first uses the WID population and income controls, and SPI-adjusted values in the HBAI as discussed in Section 2.2. This is the series labelled ‘HBAI-SPI2 (WID controls)’. The second series uses the same SPI-adjusted values in the HBAI, but uses HBAI-estimated population and gross income control totals. The HBAI-SPI2 series with WID controls is virtually identical to the WID series (by construction). The HBAI-SPI2 series using HBAI control totals does less well but much better than the HBAI-SPI series: it is much closer in levels and trends to the WID series. Put differently, the use of the internal HBAI control totals rather than the WID ones leads to an under-estimation of the income share of the top 1% by around 1 percentage point, but the trends are similar.¹⁵

We also find this close match between estimates based on HBAI-SPI2 data with WID controls and the WID estimates for other top income share groups. See Appendix Figs D1, D2, and D3 for comparisons of series for the top 0.1, 1 to 0.1, 10 to 5, and 5 to 1% income groups.

Our HBAI-SPI2 data almost exactly capture WID levels and trends based on the SPI unit record data when we use WID controls and do a reasonable job even when we use internal HBAI controls. It is the latter we use in the next two sections, for the reasons given earlier.

15 Appendix C provides more information on WID and internal HBAI control total differences. Fig. C1 summarizes differences in denominators. The increasing gap between WID and HBAI-SPI2 total income between 2001/02 and 2004/05 largely explains the increasing gap between the top 1%’s income share based on WID and HBAI control totals. In contrast, differences in population control totals in the WID and HBAI adult populations do not appear to play an important role (Fig. C2).

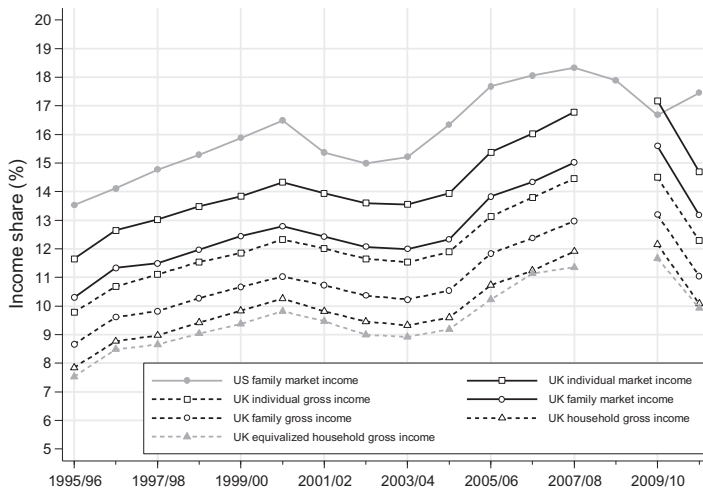


Fig. 7. Top 1% income shares in the UK (HBAI-SPI2 series), with alternative units of analysis and income definitions and comparison with the USA

Notes: The data series (and their acronyms) are explained in Section 2 and Fig. 2. The income-sharing unit and unit of analysis is the individual (aged 15+), the family, or the household, as indicated in each series' label for all but the equivalized series for which the unit of analysis is the individual (all ages).

Sources: As for Fig. 5.

4. Using our combined (HBAI-SPI2) data for better cross-national comparisons of top incomes in the UK and USA

Top incomes researchers employ tax-based data and are therefore limited to looking at distributions of taxable income among tax units. Because the definitions of the tax unit and taxable income differ across countries, there are potential comparability problems for cross-national comparisons of top income shares. By exploiting the flexibility of household survey data and using cross-walked definitions, we can address this issue.

We illustrate this lesson with the UK-US comparison summarized in Fig. 7. The first top 1% income share series for the USA comes from Piketty and Saez (2003) and their updates found in WID. Reflecting US personal tax administration, these estimates refer to taxable market income and the income-sharing unit and unit of analysis is the family. We focus on the US top income series that excludes taxable realized capital gains, since the UK series does not include realized capital gains.¹⁶

Figure 7 shows that the share of market income held by the top 1% of US families—the series labelled 'US family market income'—increased from around 13.5% in 1995 to around 16.5% in 2000 before falling over the recession years of the early 2000s. The share then reached a peak of just over 18% in 2007, just before the Great Recession hit the USA. Shares then declined over the next two years but started to recover in 2010/11.

Top incomes researchers often compare these US estimates of levels and trends with WID estimates for the UK (e.g. Atkinson *et al.*, 2011; Roine and Waldenström, 2015). According to the WID series, UK top 1% income shares are substantially lower than in the

16 Armour *et al.* (2013, 2014) and Larrimore *et al.* (2016) discuss the merits of including taxable realized capital gains.

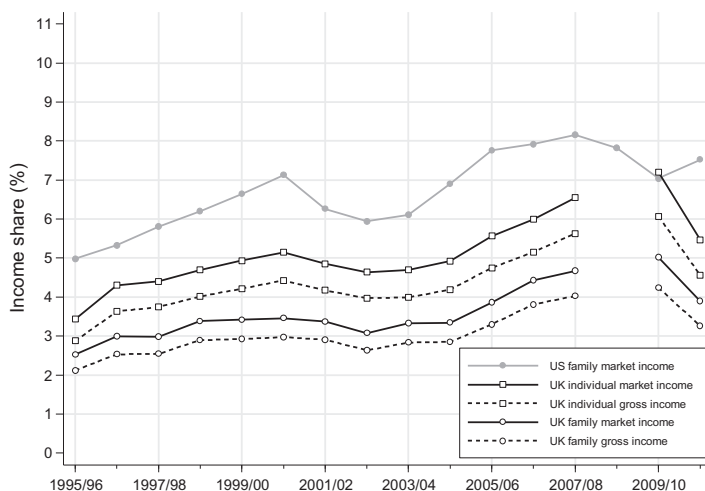


Fig. 8. Top 0.1% income shares in the UK (HBAI-SPI2 series), with alternative units of analysis and income definitions and comparison with the USA

Notes and sources: As for Fig. 7.

USA, but follow approximately the same trend through 2007. However, this is not a comparison of like to like. The UK series refers to gross income and its sharing unit and unit of analysis is the individual (adult).

When we cross-walk our UK survey data from a gross income definition to a market income definition (moving from the series labelled ‘individual gross income’ to the one labelled ‘individual market income’), the estimated top 1% share increases by around 2 percentage points each year, a relatively large change.¹⁷ Alternatively, if we shift to the family but retain the gross income definition, estimated top 1% shares fall by about 1 percentage point or slightly more: look at the ‘family gross income’ series.

The UK definition that is most like the US one is the distribution of market income among families (the ‘family market income’ series). The net result of using this series, rather than the ‘individual gross income’ series, is a relatively small increase in the share of income held by the top 1%. However, this is the coincidental result of the two definitional changes going in opposite directions and almost completely offsetting one another.

This robustness in the cross-national comparison is not necessarily the general rule. See the series for the top 0.1, 1 to 0.1, 5 to 1, and 10 to 5% shares presented in figs 8–11 in the same format as Fig. 7. The further up the distribution the shares refer to, the more important is the shift from an individual to a family definition of the tax unit (unit of analysis) and the less important is the shift from gross to market income (at the very highest top income ranges almost all income is market income).

For the top 0.1%, the shift downward from individual to family more than offsets the upward shift from gross to market income. The result is that our like-to-like comparison of USA and UK ‘family market income’ shows an even greater difference in shares than the conventional top income literature comparisons (Fig. 8). However, this quickly turns

17 The UK estimate is slightly larger than is its US counterpart in 2009/10 most likely because of the forestalling problem discussed earlier.

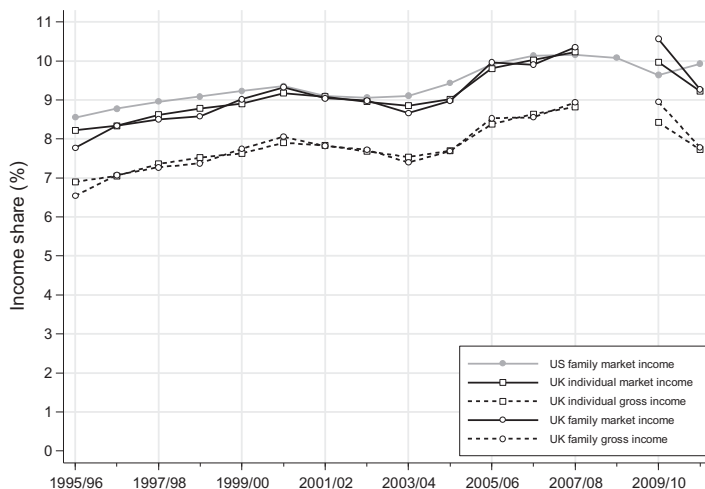


Fig. 9. Top 1% to 0.1% income shares in the UK (HBAI-SPI2 series), with alternative units of analysis and income definitions and comparison with the USA

Notes and sources: As for Fig. 7.

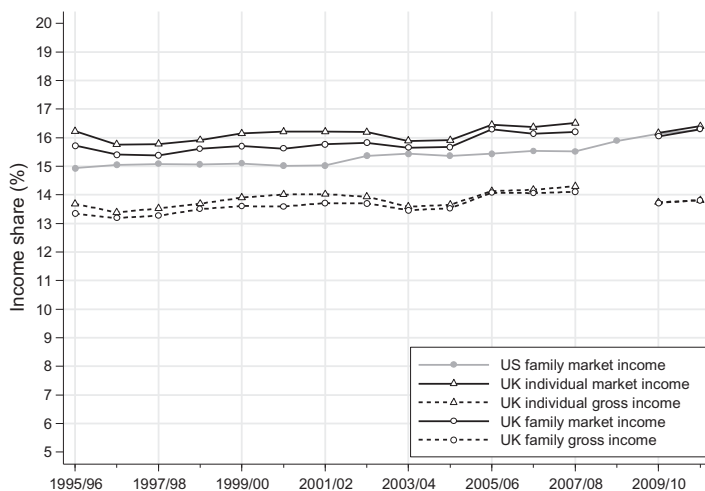


Fig. 10. Top 5% to 1% income shares in the UK (HBAI-SPI2 series), with alternative units of analysis and income definitions and comparison with the USA

Notes and sources: As for Fig. 7.

around. When we focus on the top 1% to 0.1% (Fig. 9), the difference in top income shares between the two countries almost completely disappears. When we move to lower top income ranges, not only are the estimates from the 'UK family market income' series greater than the 'UK individual gross income' estimates, they are greater than the corresponding estimates for the USA (Figs 10 and 11).

The other two series in Fig. 7 show what happens to top income shares if we employ the standard definitions of household survey-based income distribution analysis. 'UK

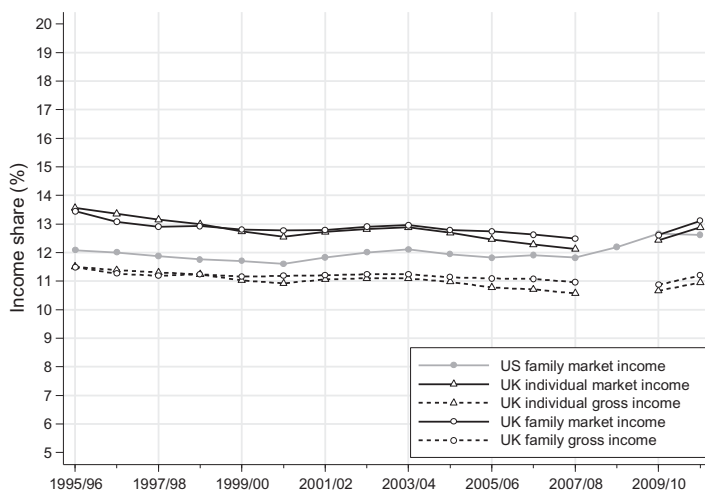


Fig. 11. Top 10% to 5% income shares in the UK (HBAI-SPI2 series), with alternative units of analysis and income definitions and comparison with the USA

Notes and sources: As for Fig. 7.

household gross income' uses the household as both the income-sharing unit and unit of analysis. 'UK equivalized household gross income' shifts to a more appropriate definition of income: household income is adjusted using an equivalence scale depending on the number of adults and children and with each person assigned his/her household's value. Its distributional statistics relate to all individuals in the population, including dependents. Gottschalk and Smeeding (1997), d'Ercole and Förster (2012), and the influential *Canberra Group* (2011) make the case for this standard set of survey definitions. Burtless (2015) criticizes the definitions used in the top incomes literature for not following these standards.

Figure 7 shows that once these factors are taken into consideration, the share of equivalized income held by the top 1% of all individuals is substantially reduced relative to the 'UK individual gross income' series which employs top incomes literature definitions. This finding is reassuring since households are institutions that enable individuals to pool and share income, and larger households benefit from economies of scale relative to smaller-sized ones. We have summarized the impact of different definitional choices in more detail (using the top 1% share data in Appendix Table E1), regressing top 1% shares on sets of binary indicator variables that characterize differences in survey year, data source, income definition, income sharing unit, and types of control total. Relative to baseline, using a market income rather than a gross income definition is associated with an increase in the top 1% share of 2 percentage points, other things being equal. By contrast, using household equivalized income reduces the top 1% share by 2.6 percentage points. Using the family (household) as income-sharing unit rather than the individual tax unit is associated with a top 1% share some 1.4 (2.3) percentage points lower.

Although estimates of top income share levels are sensitive to the choice of definition of income and income-sharing unit, figs 7–11 show that estimates of trends are similar. All of the UK series move closely in parallel with each other. This finding echoes that of Lakner (2014), who showed that US top income share trends were similar across various tax-unit size adjustments.

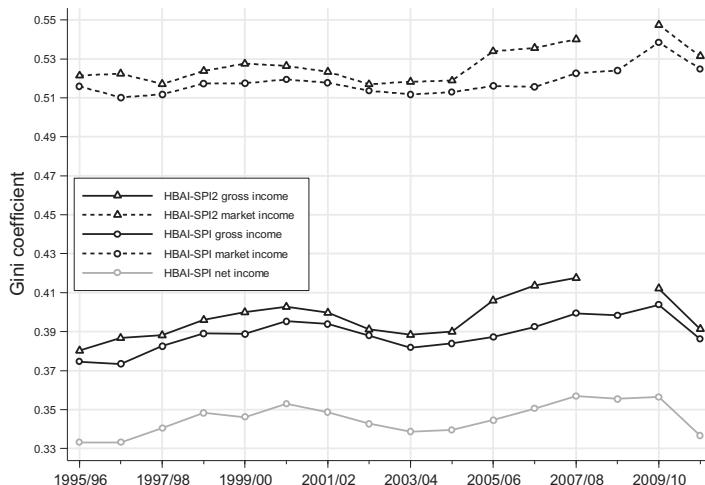


Fig. 12. Gini coefficients using different household income definitions: HBAI-SP2 versus HBAI-SPI estimates

Notes: In each series, household income is equivalized using the modified-OECD scale. The individual is the unit of analysis. Estimates are based on the full population (aged less than 15 as well as aged 15+).

Sources: As for Fig. 5.

5. Using our combined (HBAI-SPI2) data to summarize inequality differently

Using tax-based data requires that inequality be summarized using top income share estimates. In this literature, the share usually refers to people with incomes above the 90th percentile or an even higher threshold. By contrast, most of the survey-based income distribution literature summarizes inequality with indices that account for differences throughout the full income range. A further advantage of our survey-based approach is that we can calculate these measures in addition to top income shares, and see the extent to which they move in tandem with top income shares.¹⁸

As in our ‘UK equivalized household gross income’ series, the income-sharing unit is the household; the unit of analysis is the individual (adults and children); and we equalize household incomes in Fig. 12 and the two tables below. In Fig. 12, we compare Gini coefficient estimates based on HBAI-SPI and HBAI-SPI2 data, and for both gross and market income definitions. Reassuringly, market income is more unequally distributed than gross income (the latter includes redistributive government transfers), regardless of the series employed, and the Gini coefficients are larger for the HBAI-SPI2 series than for the HBAI-SPI in corresponding years, since the HBAI-SPI2 data better capture top incomes.

Note also the marked increase in the Gini coefficient between 2004/05 and 2007/08—reflecting better capture of the rise in top income shares over this period. The bottom series,

18 Leigh (2007) finds a positive but far from perfect correlation between movements in top income shares and Gini coefficients using a 13-country panel dataset. Our UK case study examines in more detail when and how trends differ for these two measures and the sources of any divergence in trends.

Table 2. Percentage growth in equivalized gross household income between 1995/96 and 2007/08: HBAI-SPI versus HBAI-SPI2 estimates, by income group

Income group	1995/96 to 2007/08		1995/96 to 2001/02		2001/02 to 2004/05		2004/05 to 2007/08	
	HBAI-SPI	HBAI-SPI2	HBAI-SPI	HBAI-SPI2	HBAI-SPI	HBAI-SPI2	HBAI-SPI	HBAI-SPI2
Poorest fifth	22.7	22.6	17.3	17.2	6.2	6.3	-1.5	-1.6
2 nd poorest fifth	30.1	29.9	22.4	22.3	5.2	5.3	1.0	0.9
Middle fifth	25.5	25.3	19.3	19.2	3.7	3.8	1.5	1.3
2 nd richest fifth	24.3	24.2	17.8	17.8	3.4	3.4	2.0	2.0
Richest fifth	38.2	44.8	28.6	28.7	0.7	0.8	6.7	11.6
Percentiles 81 to 90	25.3	26.2	19.3	19.6	1.8	1.3	3.2	4.1
Percentiles 91 to 95	27.3	29.8	21.7	22.4	1.5	0.9	3.1	5.1
Percentiles 96 to 99	41.3	45.6	28.1	29.3	2.6	0.9	7.5	11.6
Top 1%	76.1	102.2	59.3	55.0	-4.4	-0.3	15.7	30.9
Median	25.4	25.2	19.3	20.2	3.4	3.6	1.6	1.3
Mean	31.1	34.1	23.3	22.1	2.6	2.6	3.7	5.9

Notes and sources: As for Fig. 5. Household income is equivalized using the modified-OECD scale. The individual is the unit of analysis. Estimates are based on the full population (aged less than 15 as well as aged 15+). The price index used is the all items RPI excluding Council tax (agg4111), a bespoke index created for the Department for Work and Pensions by the Office for National Statistics.

in grey, is the HBAI-SPI series for household net income. This corresponds to the series reported in the official HBAI statistics (see also Fig. 1).¹⁹ These Gini estimates are 4 to 5 percentage points lower than their gross income counterparts, but the trends are similar.

Table 2 extends our comparisons of the HBAI-SPI2 and HBAI-SPI data. It compares the growth in equivalized household gross income across the distribution. Reassuringly, there is very little difference between datasets in estimated income growth for the bottom 90% of the distribution regardless of the comparison years chosen, since the SPI-adjustments in both series focus on the richest individuals. For the top 10%, the patterns are more complex. Over the entire period from 1995/96 to 2007/08, HBAI-SPI2 data show higher income growth than HBAI-SPI data for individuals between the 91st and 99th percentiles, and substantially greater income growth for the top 1% (102% versus 76%). However, most of this difference in growth occurs over the period 2004/05 to 2007/08. Importantly, and with regard to the credibility of the DWP's current adjustment procedure for the HBAI (focusing on the prevalence of people with incomes below 60% of median income), there is virtually no difference in estimates of the change in the median across the datasets. However, there are slightly more pronounced differences for the mean (34% versus 31%), and these differences also appear to be driven by a divergence in income growth in the final sub-period (4% versus 6% between 2004/05 and 2007/08).

19 Recall that we cannot derive individual net income variables: see Section 2.4.

Table 3 expands our comparisons between datasets by, in addition to the Gini coefficient, considering the mean logarithmic deviation (MLD), the Theil index, and half the squared coefficient of variation (HSCV). These are generalized entropy indices with sensitivity parameters 0, 1, and 2, respectively. The larger the parameter, the more sensitive is the index to income differences at the top of the distribution relative to those in the middle or at the bottom—the MLD (and Gini coefficient) are middle-sensitive indices. Table 3 shows inequality levels for four years between 1995/96 and 2007/08 and changes over periods between those years. Period-specific changes are quite similar for HBAI-SPI gross and net definitions; the main contrast is between the differently adjusted gross income series. The exception is the period 1995/96 to 2001/02 when, for each index, all income definitions show similar inequality increases.

The Gini coefficient for the HBAI-SPI2 data is greater than the HBAI-SPI data for both 1995/96 and 2007/08, as is the percentage change between those two years (10% versus 7%). For the other three indices, the level of inequality is again greater in the HBAI-SPI2 data. However, the more top-sensitive the index (as we move down the panels in the table), the larger is the measured inequality increase. For example, the increase between 1995/96 and 2007/08 in the HBAI-SPI2-based HSCV is much larger than in its HBAI-SPI-based counterpart (141% versus 52%).

Regardless of the index chosen, most of the increase in its value over the period 1995/96 to 2007/08 occurs between 2004/05 and 2007/08. We know from the WID estimates that the concentration of incomes at the very top increased substantially over the period as a whole but especially over this latter period, according to the top income shares (cf. Figs 1 and 5), and the more comprehensive top-sensitive indices pick this up. (The sub-period changes—inequality rise, fall, and rise again—are also similar.) In short, the more we adjust the survey data to better account for survey under-coverage of top incomes, the greater is the observed effect on inequality.

6. Summary and conclusions

Exploiting the flexibility provided by access to unit record household survey data, notably the ability to cross-walk between different sets of definitions so that like is compared with like, we provide the most extensive comparison of UK inequality estimates derived from survey and income tax data. Using our reconciled definitions, we combine these two data sources to yield better estimates of UK inequality levels and trends, accounting for survey under-coverage of top incomes. The magnitude of our estimate of the increase in inequality, especially between 2004/05 and 2007/08, depends on whether the index is middle- or top-sensitive. Nonetheless, all our indices show a greater increase in inequality than do the headline income distribution statistics based on the DWP's HBAI-SPI data.

The flexibility of unit record survey data also allows us to employ different definitions of income, income-sharing unit, and unit of analysis to improve the comparability of cross-national comparisons. With UK definitions cross-walked to the definitions underlying the US top income share series, we show that conclusions about transatlantic differences in top income shares depend on which top income group one compares.

More generally, we show that it is possible to adjust household survey data to take better account of their non-coverage of top incomes using tax data for top income groups. Official UK income distribution statistics have long done so using their SPI-adjustment. Our SPI2-adjustment better addresses the problem of under-coverage of top incomes.

Table 3. Increase in inequality of equivalized gross household income between 1995/96 and 2010/11 according to four inequality indices: HBAl-SPI2 versus HBAl-SPI data

Inequality index	Dataset	Income definition	Level				Percentage change			
			1995/96	2001/02	2004/05	2007/08	1995/96 to 2001/02	2001/02 to 2004/05	2004/05 to 2007/08	1995/96 to 2007/08
Gini coefficient	HBAl-SPI2	Gross	0.380	0.400	0.390	0.418	5.1	-2.4	7.1	9.8
	HBAl-SPI	Gross	0.375	0.394	0.384	0.399	5.2	-2.5	4.0	6.6
	HBAl-SPI	Net	0.333	0.349	0.339	0.357	4.7	-2.6	5.1	7.1
Mean logarithmic deviation	HBAl-SPI2	Gross	0.245	0.275	0.261	0.304	12.1	-5.1	16.4	23.9
	HBAl-SPI	Gross	0.239	0.268	0.254	0.277	12.4	-5.3	9.1	16.1
	HBAl-SPI	Net	0.186	0.208	0.195	0.217	11.6	-6.1	11.0	16.4
Theil index	HBAl-SPI2	Gross	0.275	0.333	0.317	0.396	21.3	-5.0	24.9	44.1
	HBAl-SPI	Gross	0.266	0.325	0.299	0.332	22.5	-8.0	10.7	24.8
	HBAl-SPI	Net	0.205	0.250	0.229	0.258	22.0	-8.3	12.7	26.0
Half squared coefficient of variation	HBAl-SPI2	Gross	0.486	0.778	0.721	1.170	59.9	-7.2	62.2	140.5
	HBAl-SPI	Gross	0.470	0.765	0.619	0.705	62.5	-19.0	13.8	49.8
	HBAl-SPI	Net	0.330	0.527	0.430	0.501	59.8	-18.4	16.5	52.0

Notes and sources: As for Table 2.

One advantage of our data combination approach relative to the DWP's is that we exploit WID estimates to provide a benchmark. However, their accuracy is conditional on the reliability of the estimates of the population and income control totals that WID employs. Assessment of these would be a valuable topic for further research, with pay-offs for the top incomes literature as well as for survey-based approaches like ours.

Our SPI2-adjustment comes entirely from comparisons of unconditional distributions of income. Unlike the DWP's SPI-adjustment procedure, we do not use other personal characteristics to construct stratification groups. We improve overall inequality estimates by seeking better coverage of high incomes, regardless of who has them. The DWP's SPI-adjustment procedure applies to the incomes of individuals outside the entire population's top income group. If the primary goal is to improve estimates of the distributions of income for specific subgroups of the population (e.g. men/women; individuals in families with/without children), then modifications of our approach are necessary. However, implementation depends on the personal characteristics of interest being in both the tax and survey data. For example, for individuals in UK SPI data, we can identify men and women but know nothing about marital status or family size.

Arguably, the DWP SPI-adjustment is fit for purpose because the official HBAI reports' principal focus is the prevalence of low income with assessments based on low-income cut-offs equal to fractions of median income (not fractions of mean income). Estimates of median-based cut-offs and of low-income prevalence are insensitive to the SPI-adjustment variation used.

However, this argument fails to recognise that the DWP's HBAI data are the most often used source for assessing UK inequality levels and trends. Researchers in most other countries also employ survey data for this purpose, and for cross-national comparisons. Yet household surveys in all countries are subject to under-coverage of top incomes. We therefore hope that our reconciled and combined data approach will stimulate further research on how to take better account of top incomes in inequality assessments. What can be done for different countries and periods will depend on the availability of comparable data from surveys and tax return data or other sources that can be used to provide suitable benchmarks regarding survey under-coverage of top incomes.

Supplementary material

The FRS, HBAI, and SPI data used in this paper are available from the UK Data Service to researchers who register with them. The Stata code used to create derived variables and for the analysis is available online at the OUP website, along with the Appendix.

Funding

This work was supported by an Australian Research Council Discovery Grant (number DP150102409), and core funding of the Research Centre on Micro-Social Change at the Institute for Social and Economic Research by the University of Essex and the UK Economic and Social Research Council (grant number ES/L009153). For helpful discussions and perceptive comments on an earlier version, we thank Facundo Alvaredo, Tony Atkinson, and Peter Matejic (DWP), three referees, and audiences at the IARIW 2016 conference, Nuffield College, York, Alicante, and Clermont Ferrand.

References

- Alvaredo, F., Atkinson, A.B., Piketty, T., and Saez, E. (2015) The World Top Incomes Database, accessed 28 November 2015.
- Armour, P., Burkhauser, R.V., and Larrimore, J. (2013) Deconstructing income and income inequality measures: a crosswalk from market income to comprehensive income. *American Economic Review*, 101, 173–77.
- Armour, P., Burkhauser, R.V., and Larrimore, J. (2014) Levels and trends in United States income and its distribution: a crosswalk from market income towards a comprehensive Haig-Simons income measure. *Southern Economic Journal*, 14, 271–93.
- Atkinson, A.B. (2005) Top incomes in the UK over the twentieth century. *Journal of the Royal Statistical Society, Series A*, 168, 325–43.
- Atkinson, A.B. (2007) Measuring top incomes: methodological issues. In A.B. Atkinson and T. Piketty (eds) *Top Incomes over the Twentieth Century: A Contrast Between Continental European and English-Speaking Countries*, Oxford University Press, Oxford.
- Atkinson, A.B. (2012) UK estimates of top income shares 2009–2010: revised note on methods, World Top Incomes Database Methodological Notes, 12 April.
- Atkinson, A.B. (2015) *Inequality. What Can Be Done?*, Harvard University Press, Cambridge, MA.
- Atkinson, A.B. and Ooms, T. (2015) UK estimates of top income shares 2012/2013: note on methods, World Top Incomes Database Methodological Notes, 25 March.
- Atkinson, A.B., Piketty, T., and Saez, E. (2011) Top incomes in the long run of history. *Journal of Economic Literature*, 49, 3–71.
- Belfield, C., Cribb, J., Hood, A., and Joyce, R. (2015) *Living Standards, Poverty and Inequality in the UK: 2015*. Report 107, Institute for Fiscal Studies, London.
- Brewer, M., Etheridge, B., and O’Dea, C. (2017) Why are households that report the lowest incomes so well-off? *Economic Journal*, forthcoming.
- Broadbent, B. (2016) The distributional implications of low structural interest rates and some remarks about monetary policy trade-offs. Speech at Society of Business Economists Annual Conference, 18 November.
- Burkhauser, R.V., Hérault, N., Jenkins, S.P., and Wilkins, R. (2016) What has been happening to UK income inequality since the mid-1990s? Answers from reconciled and combined household survey and tax return data. ISER Working Paper 2016–03, University of Essex, Colchester.
- Burkhauser, R. V., Hérault, N., Jenkins, S.P., and Wilkins, R. (2017) Survey under-coverage of top incomes and estimation of inequality: what is the role of the UK’s SPI adjustment?, *Fiscal Studies*, forthcoming.
- Burtless, G. (2015) Review of Thomas Piketty’s *Capital in the Twenty-First Century*. *Journal of Policy Analysis and Management*, 34, 719–27.
- Canberra Group (2011) *Handbook on Household Income Statistics*, 2nd ed., United Nations Economic Commission for Europe, Geneva.
- Cowell, F.A. and Flachaire, E. (2007) Income distribution and inequality measurement: the problem of extreme values. *Journal of Econometrics*, 141, 1044–72.
- d’Ercole, M.M. and Förster, M. (2012) The OECD approach to measuring income distribution and poverty: strengths, limits and statistical issues. In D.J. Besharov and K.A. Couch (eds) *European Measures of Income and Poverty: Lessons for the US*, Oxford University Press, New York, 27–58.
- Department of Social Security (1996) *Households Below Average Income. Methodological Review*. Report of a Working Group, Department of Social Security, London.
- Department for Work and Pensions (2010) *Households Below Average Income. An Analysis of the Income Distribution 1994/95–2008/09*, Department for Work and Pensions, London.

- Department for Work and Pensions (2013) *Households Below Average Income, 1994/95–2012/13* [computer file], 7th ed. UK Data Archive [distributor], Colchester, October. SN: 5828.
- Department for Work and Pensions (2015) *Households Below Average Income. An Analysis of the Income Distribution 1994/95–2013/14*. Department for Work and Pensions, London.
- Department for Work and Pensions, National Centre for Social Research and Office for National Statistics Social and Vital Statistics Division (2014) *Family Resources Survey, 2010–2011* [computer file], 2nd ed. UK Data Archive [distributor], Colchester, October. SN: 7085.
- Gottschalk, P. and Smeeding, T.M. (1997) Cross-national comparisons of earnings and income inequality. *Journal of Economic Literature*, 35, 633–87.
- HM Revenue and Customs KAI Data, Policy and Co-ordination (2014) *Survey of Personal Incomes, 2010–2011: Public Use Tape* [computer file]. UK Data Archive [distributor], Colchester, November. SN: 7569.
- Jenkins, S.P. (2017) Pareto models, top incomes, and recent trends in UK income inequality. *Economica*, 84, 261–89.
- Lakner, C. (2014) Top incomes in the USA, 1960–2005: family size and factor income composition. Chapter 2 in *The determinants of incomes and inequality: evidence from poor and rich countries*, DPhil thesis, University of Oxford, Oxford.
- Larrimore, J., Burkhauser, R.V., Auten, G., and Armour, P. (2016) Recent trends in US top income shares in tax record data using more comprehensive measures of income including accrued capital gains. Working Paper w23007. NBER, Cambridge, MA.
- Leigh, A. (2007) How closely do top income shares track other measures of inequality? *Economic Journal*, 117, F619–F633.
- OECD (2008) *Growing Unequal? Income Distribution and Poverty in OECD Countries*. OECD Publishing, Paris.
- OECD (2011) *Divided We Stand: Why Inequality Keeps Rising*. OECD Publishing, Paris.
- OECD (2015) *In It Together: Why Less Inequality Benefits All*. OECD Publishing, Paris.
- Piketty, T. (2014) *Capital in the Twentieth-First Century*. Belknap Press, Cambridge, MA, and London.
- Piketty, T. and Saez, E. (2003) Income inequality in the United States, 1913–1998. *Quarterly Journal of Economics*, 118, 1–39.
- Roine, J. and Waldenström, D. (2015) Long run trends in the distribution of income and wealth. In A.B. Atkinson and F. Bourguignon (eds) *Handbook of Income Distribution*, vol. 2A. Elsevier-North Holland, Amsterdam.
- Roser, M. (2015) Income inequality: poverty falling faster than ever but the 1% are racing ahead, *The Guardian*, 27 March.
- Seely, A. (2014) *Income tax: the additional 50p rate*, Standard Note SN 249. House of Commons Library, London.
- Young, T. (2015) Lefty myths about inequality, *The Spectator*, 4 April.