Office for National Statistics

Article

Using tax data to better capture top earners in household income inequality statistics

Adjustments to deal with issues of under-reporting of UK top incomes. Builds on methods from the Department for Work and Pensions, using administrative data supplied by HM Revenue and Customs.

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1 . Introduction

The Office for National Statistics (ONS) and its predecessors have published statistics on the distribution of household income that date back to 1961. Beginning with “The Incidence of Taxes and Social Service Benefits”, which was one of the first publications in the world to give such a complete examination of these issues.

Throughout this time, ONS’s statistics on income inequality have been based primarily on household surveys, in common with the majority of official statistics on the distribution of household finances globally. Data are currently derived from the Living Costs and Food Survey (LCF), a voluntary sample survey of around 5,000 private households in the UK. While household surveys have several important benefits over relying solely on administrative records, there is a well-recognised challenge: they do not fully capture the incomes of the very richest individuals and households, particularly those among the so-called “top 1%”.

There are several potential reasons for this challenge (see Measuring the distribution of household income, consumption and wealth for more information), the relative importance of which vary across countries and across surveys depending on the methods used. These include:

- frame or noncoverage error, where the frame used to select the sample for the survey does not fully cover the population of interest (in this case, households in the UK)
- unit nonresponse error, which may occur if individuals or households with higher incomes are less likely to participate in surveys than those in the rest of the income distribution
- item nonresponse error, if those with higher incomes participating in surveys do not report all their sources of income
- under-reporting, where the levels of income received for some sources may be intentionally or unintentionally underreported by survey respondents
- sparseness, where data on top incomes are limited due to the fewer number of observations within the dataset with very high incomes, making it difficult to estimate the true distribution

Economic research has employed a variety of methods to address these issues, a detailed taxonomy is provided in Measuring the distribution of household income, consumption and wealth for more information. Broadly speaking, these can be divided into three groups:

- methods that use survey data only
- methods that use tax data only
- those that combine survey and administrative data in some way

In the first of these approaches, income estimates are calculated directly from the survey data, for all but the very richest. To derive an estimate of overall inequality, these are combined with estimates of inequality amongst the very rich calculated by approximating the tail of the distribution by a Pareto distribution (for example, see What do household surveys suggest about the top 1% incomes and inequality in OECD countries?). However, Jenkins (2017) notes in Pareto Models, Top Incomes and Recent Trends in UK Income Inequality that such an approach may be unreliable, due to under-coverage, resulting in downwards bias, particularly where sparseness in the survey data is an issue.

Sources such as World Inequality Database (WID.world) do not use survey data at all for their UK estimates, making use of HM Revenue and Customs data about personal incomes subject to tax, supported by population and income control totals from the mid-year population estimates and national accounts respectively (see UK Estimates of Top Income Shares 2012 to 2013: Note on Methods (PDF, 595KB) and UK estimates of top income shares 2014 to 2014 and 2014 to 2015: Note on methods (PDF, 579KB)).

However, tax data-based approaches also have their limitations. For example, while such an approach can provide estimates of measures such as top-income shares, it does not provide microdata that allow analysis of the full income distribution. Also, such methods can typically only provide measures of individual income rather than household income, as well as excluding several important income sources such as inter-household transfers and ISA interest.

For these reasons, in trying to address the issue of measuring top earners' income, we have focused on approaches that combine both survey and administrative sources. This is with the aim of drawing on the relative strengths of each. In the slightly longer-term, our ambition is to make direct use of linked survey and administrative data. However, there is also a need to develop and introduce a method of bringing together the survey and administrative data that does not rely on direct record linkage, particularly for the production of historical data.

Other criteria we have prioritised in selecting an approach for this work are ensuring that it is methodologically sound, based on academic research and existing best practice, as well as being relatively transparent and understandable by users. These criteria have led us to the set of methods first implemented in the UK by the Department for Work and Pensions (DWP) for the Households Below Average Incomes Series (HBAI), which is based on the Family Resources Survey (FRS), and later adapted by Stephen Jenkins and colleagues (see Top incomes and inequality in the UK: reconciling estimates from household survey and tax return data and Survey Under-Coverage of Top Incomes and Estimation of Inequality: What is the Role of the UK's SPI Adjustment?). These methods replace the highest incomes in the survey with cell-mean imputations based on corresponding observations in tax return data. In the UK context, this adjustment is often referred to as the "SPI adjustment", due to its use of HMRC's Survey of Personal Incomes (SPI), a sample of individuals potentially liable to UK tax (with the Burkhauser and others (2018a) modification referred to as the "SPI2").

This article builds on the work of both DWP and Burkhauser and others (2018a), through exploring different methodological choices with the aim of identifying a perceived optimum variant for use with ONS's household income statistics, considering the various constraints that exist.

2 . Overview of methodology

The broad methodology for how tax data from HM Revenue and Customs' (HMRC's) Survey of Personal Incomes (SPI) are used to apply a top-income adjustment to ONS's household income data is described in this section. However, there are several variants that can be employed, details of which are explored later in this article:

- rank individuals in survey data and SPI data by equivalent measures of gross income, separating for retired and non-retired (based on State Pension age (SPA)); in doing this, the SPI data also need to be adjusted to reflect that they only contain individuals who are potentially liable for UK tax in the current year, rather than the full population

- calculate the average gross income of each quantile group in SPI above a chosen threshold; both the size of these quantile groups and the threshold used can be varied

- impute the average gross income for each SPI quantile group to individuals in the corresponding quantile group in the survey data

- add back to each survey observation, several income components not represented in SPI data, such as ISAs, transfers between households and so on

- re-estimate income tax and national insurance contributions based on new levels of individual gross (pre-tax) income

- re-aggregate individual-level data to the household level

In applying these methods, it was decided to adjust the income of retired and non-retired individuals (defined as being above and below SPA) separately, in common with the approach taken by DWP. The rationale being that there is considerable analytical focus, both by ONS and users of these data, looking at retired and non-retired individuals separately. There is also evidence to suggest there is under-reporting at the top of each distribution. So, adjusting separately ensures that the tops of the pensioner distribution are more accurately reflected. Particularly, as the number of retired people in the top few percentiles of the overall income distribution of the survey may vary from year to year.

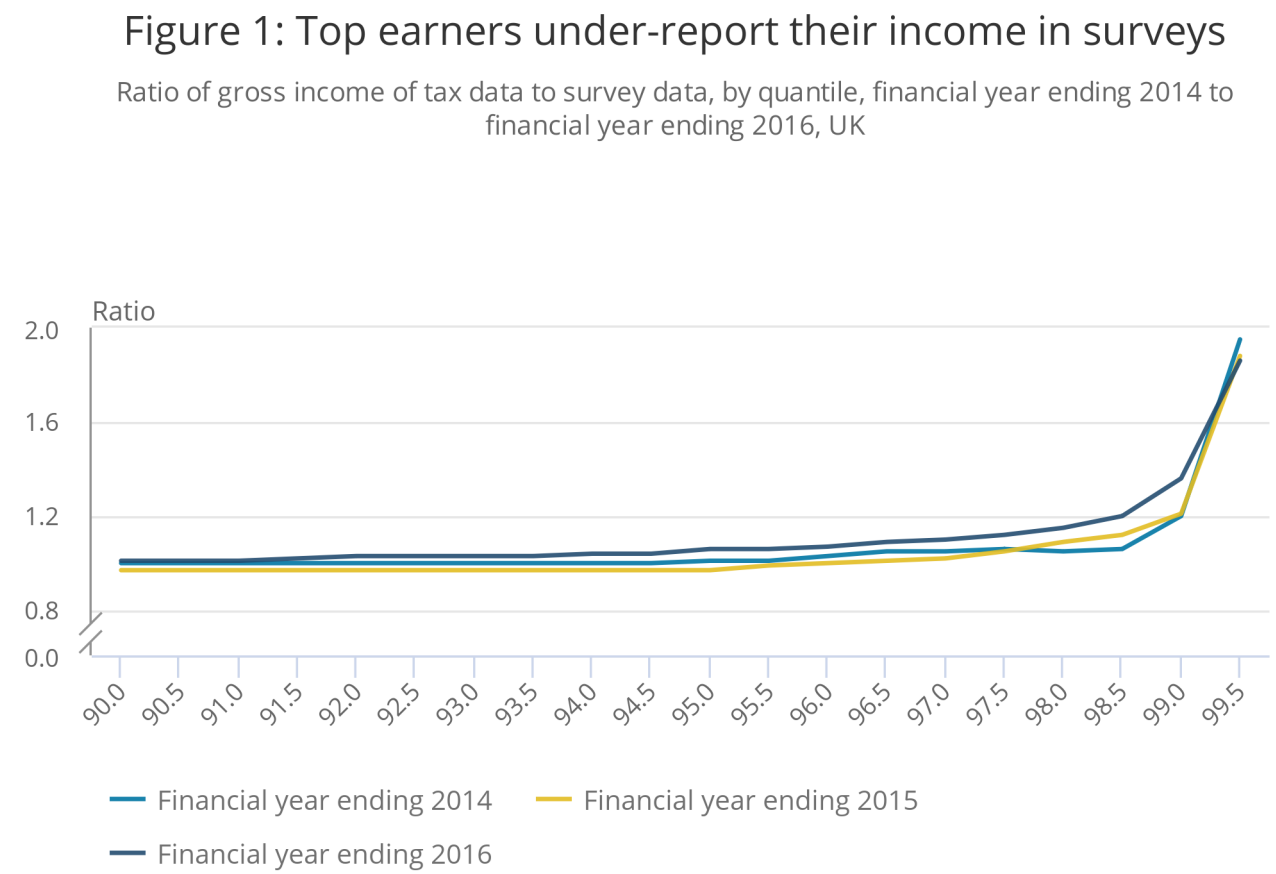
For most years, the SPI datasets used are full outturn datasets. However, for the most recent years, financial year ending (FYE) 2017 and FYE 2018, projected data, provided by HMRC has been used.

3 . How far down should the survey data be adjusted?

Figure 1 displays the ratio of the income of individuals in the tax dataset (Survey of Personal Incomes (SPI)) to the income of the individuals in the survey dataset (Effects of Taxes and Benefits) at different quantiles. This has been done for the three most recent years where full datasets are available for SPI. At the 99th percentile and above for all years, the income of individuals in SPI is more than 1.2 times higher than in the survey data. The ratio begins to rise above one noticeably at the 96th percentile and then more sharply increasing at the 98th percentile.

Figure 1: Top earners under-report their income in surveys

Ratio of gross income of tax data to survey data, by quantile, financial year ending 2014 to financial year ending 2016, UK



Source: Office for National Statistics - Living Costs and Food Survey, HM Revenue and Customs - Survey of Personal Incomes

This indicates that, in line with the findings of Burkhauser and others (2018a, 2018b), there is evidence to suggest that the largest challenge affecting top incomes in UK data is that of under-reporting by survey respondents rather than under-coverage. It further suggests that any adjustment should focus primarily on the top few percentiles of the distribution.

Based on the evidence provided in Figure 1, analysis has therefore been performed on adjustments with a range of thresholds from 95% to 99% for the financial years ending (FYE) 2003 to 2018 (FYE 2009 is excluded due to SPI data not being available for that year). The adjustments have kept a constant quantile group size of 0.5%, allowing the impact of changing the threshold to be isolated and clearly visualised.

The inclusion of a top-income adjustment has a similar effect on the average equivalised household disposable income of the richest 10% of people (income of the richest 10% from hereon in), as shown in Figure 2, and the Gini coefficient based on equivalised household disposable income of individuals (Figure 3), regardless of which threshold is used.

For both measures, the differences between adjustments are smaller than the differences between any adjusted data and the unadjusted data. There is an exception to this, which is FYE 2011, where there is little change of Gini coefficient between adjusted and unadjusted data. This is probably due to the introduction of a 50% top tax rate for FYE 2012, which resulted in people forestalling their income (see The Exchequer effect of the 50 per cent additional rate of income tax) and hence tax data for top earners is not as different to survey data in FYE 2012 as for other years.

For both measures, adjusted data using a 99% threshold follow a slightly different trend to the other four thresholds, which are all very similar. This implies, that once the threshold goes below 98% there is little effect in replacing survey data with tax data.

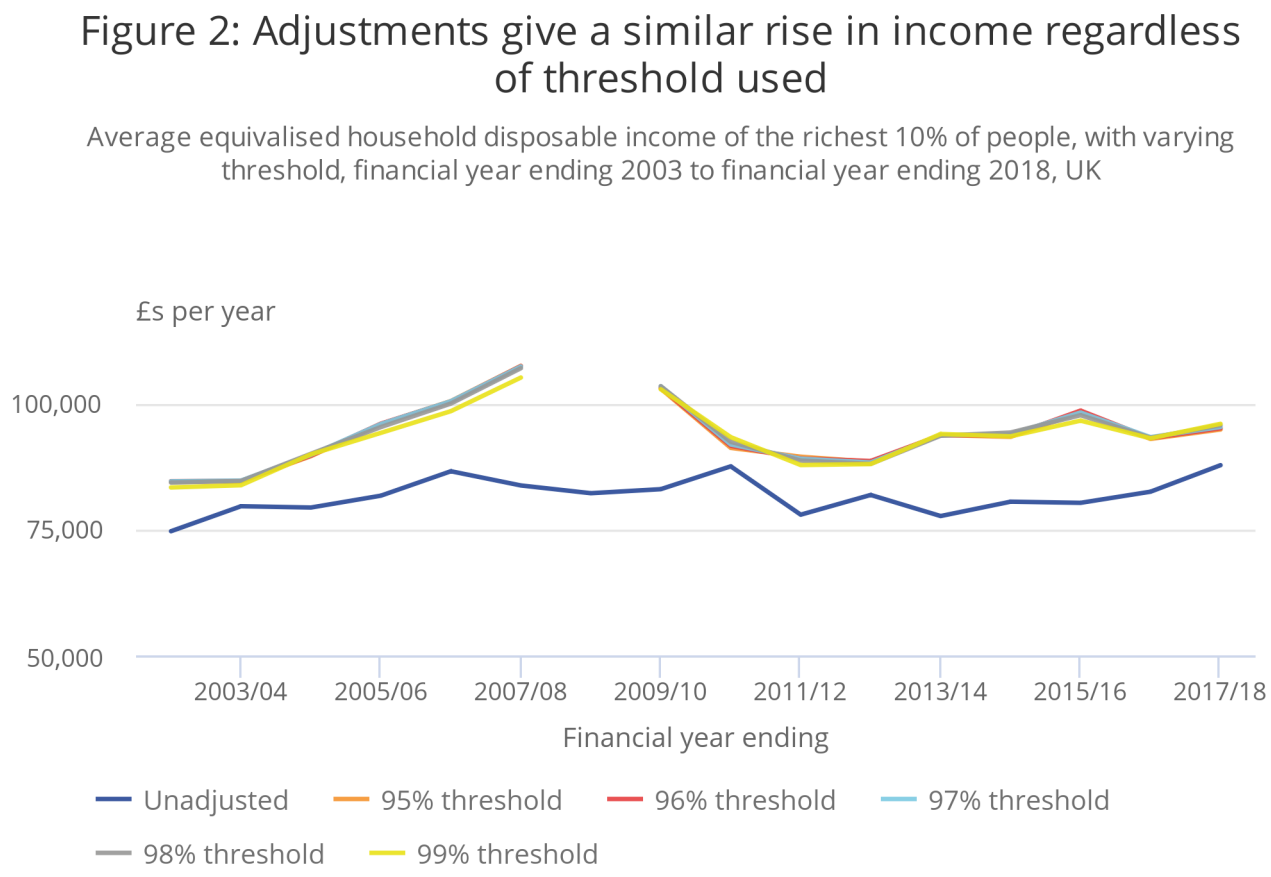
Across all years, the average percentage change of the income of the richest 10% is 14.9% when comparing adjusted data with unadjusted data. On average, there is 1.0% difference between the adjustment using a 99% threshold when compared with the average of the other four adjustments. When comparing any of the other thresholds, with the other four thresholds, the highest average difference is 0.5%.

The trends of adjusted data compared with unadjusted data over time are broadly similar, but there are some differences in the income of the richest 10%. In FYE 2008, the income of the richest 10% goes up in the adjusted data, but it goes down in the unadjusted data. The differences in FYE 2010 can be explained by forestalling as discussed previously.

From FYE 2013 to FYE 2017, the adjusted data have a much larger increase in income in comparison with the unadjusted data, which is offset by a sharper increase in income between FYE 2017 and FYE 2018 in the unadjusted data.

Figure 2: Adjustments give a similar rise in income regardless of threshold used

Average equivalised household disposable income of the richest 10% of people, with varying threshold, financial year ending 2003 to financial year ending 2018, UK



Source: Office for National Statistics - Living Costs and Food Survey, HM Revenue and Customs - Survey of Personal Incomes

Notes:

1. 2002/03 represents the financial year ending 2003, and similarly through to 2017/18, which represents the financial year ending 2018.

2. 2008/09 is missing due to there being no SPI dataset available for that year.

3. Incomes are adjusted for inflation using the Consumer Prices Index including owner occupiers' housing costs.

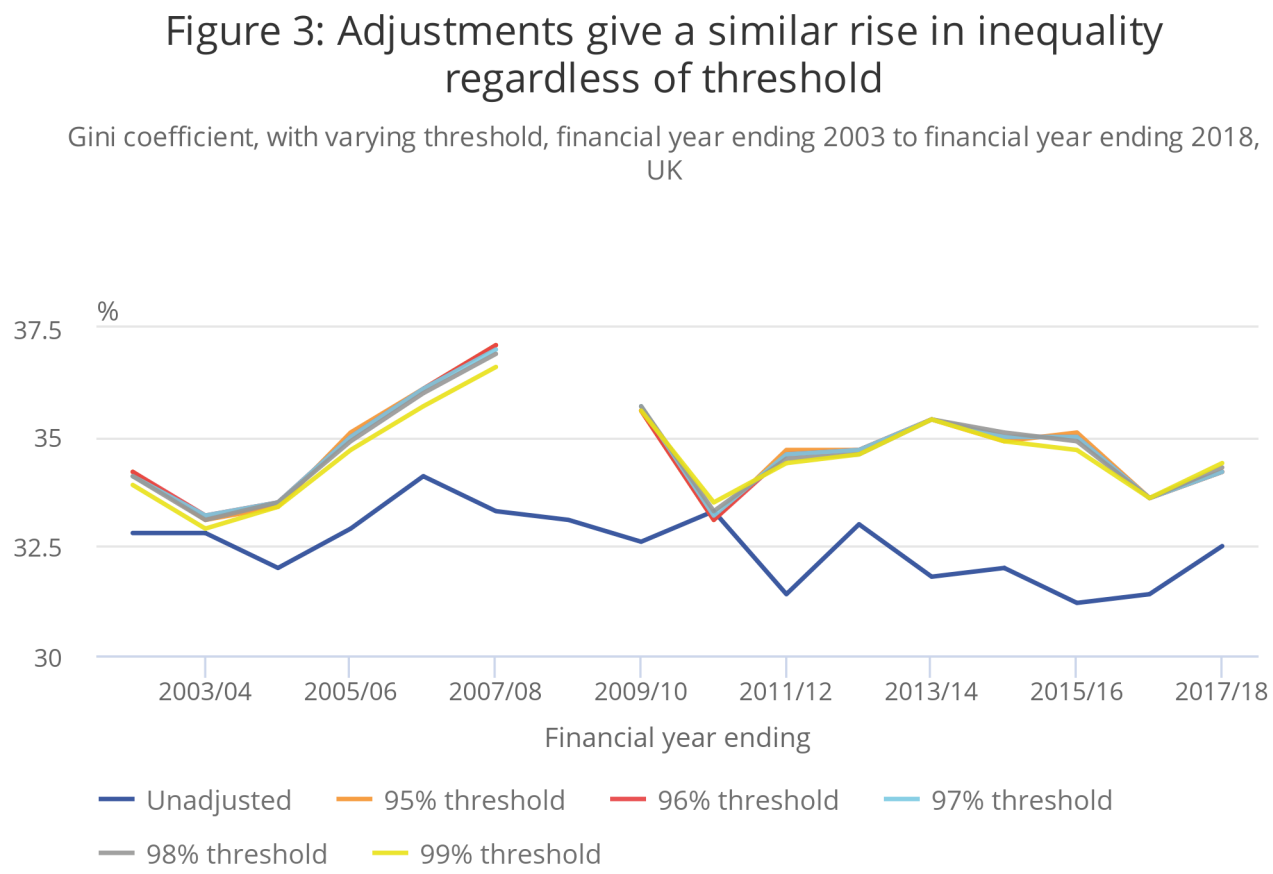
4. Individuals are ranked by their equivalised household disposable incomes, using the modified Organisation for Economic Co-operation and Development scale.

For all years, the average change in Gini coefficient comparing all adjusted data with unadjusted data is an increase of 2.2 percentage points. On average, there is a 0.2 percentage point difference between the adjustments using a 99% threshold when compared with the average of the other four adjustments.

The change in Gini coefficient over time is broadly similar between adjusted and unadjusted data with some differences, which are similar to the differences shown looking at income of the richest 10% (Figure 2). Between FYE 2013 and FYE 2016, there is a larger rise in inequality in the adjusted data compared with the unadjusted data. However, between FYE 2016 and FYE 2018, there is a larger rise in inequality in the unadjusted data.

Figure 3: Adjustments give a similar rise in inequality regardless of threshold

Gini coefficient, with varying threshold, financial year ending 2003 to financial year ending 2018, UK



Source: Office for National Statistics - Living Costs and Food Survey, HM Revenue and Customs - Survey of Personal Incomes

Notes:

1. 2002/03 represents the financial year ending 2003, and similarly through to 2017/18, which represents the financial year ending 2018.

2. 2008/09 is missing due to there being no SPI dataset available for that year.

In deciding what threshold to use for the top-income adjustment, there is a trade-off to be found between adjusting far enough down the distribution to sufficiently address issues of under-reporting and not going too far down such that we are unnecessarily discarding survey data and the individual detail that provides.

Also, for financial years ending 2017 and 2018, projected SPI data are used rather than a full SPI dataset. Burkhauser and others (2018b) demonstrate that there are notable differences between the projected data and the later published outturn data, which makes survey data more desirable for these years. When comparing adjustments of a threshold below 98%, to an adjustment with a 98% threshold, there are very few differences. Therefore, it seems sensible that a threshold of 98% or above should be used.

4 . What size should the quantile groups be?

In addition to the threshold for the adjustment, it is important to also consider the size of the quantile groups, and again there is a potential trade-off to be made.

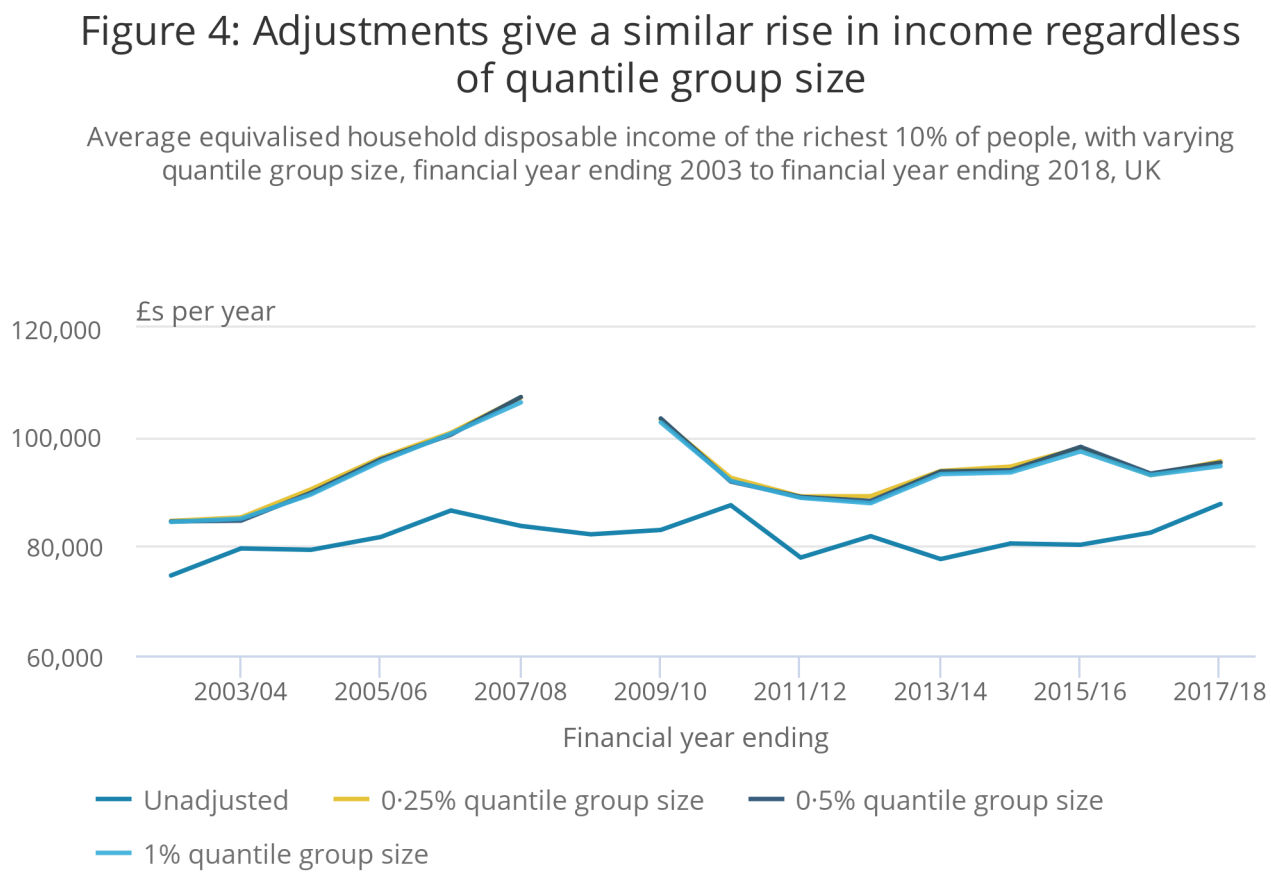
A smaller quantile group size allows more granularity to the adjusted data; however, a smaller sized quantile group will result in there being fewer individuals in each band, which could be problematic. The adjustment uses a threshold that has been kept constant at 97%, allowing the impact of changing the quantile group size between 0.25%, 0.5% and 1% to be seen. The analysis has been performed from financial year ending (FYE) 2003 to FYE 2018 (excluding FYE 2009, due to missing Survey of Personal Incomes (SPI) dataset).

Whichever quantile group size is used, the top-income adjustment has a similar effect on both the average income of the richest 10% (Figure 4) and the Gini coefficient (Figure 5). In both cases, the differences between adjustments are smaller than any differences between adjusted and unadjusted data (excluding FYE 2011 as discussed in Section 3).

Across all years, the average percentage change of income of the richest 10% for the adjustments is 15.1% when compared with the unadjusted data. The different trends in the adjusted and unadjusted data, in the income of the richest 10% over time, are broadly similar to those discussed in Section 3.

Figure 4: Adjustments give a similar rise in income regardless of quantile group size

Average equivalised household disposable income of the richest 10% of people, with varying quantile group size, financial year ending 2003 to financial year ending 2018, UK



Source: Office for National Statistics - Living Costs and Food Survey, HM Revenue and Customs - Survey of Personal Incomes

Notes:

1. 2002/03 represents the financial year ending 2003, and similarly through to 2017/18, which represents the financial year ending 2018.

2. 2008/09 is missing due to there being no SPI dataset available for that year.

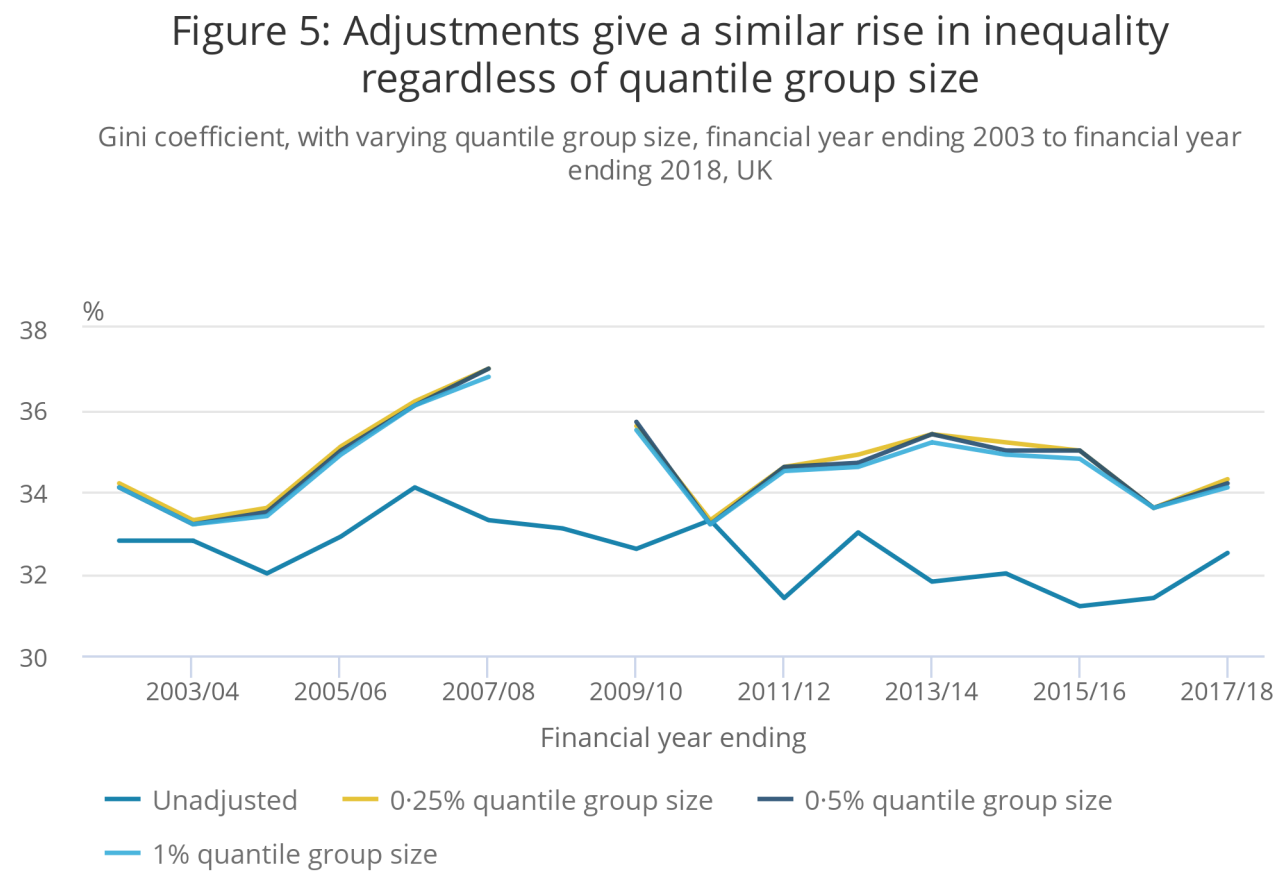
3. Incomes are adjusted for inflation using the Consumer Prices Index including owner occupiers' housing costs (CPIH).

4. Individuals are ranked by their equivalised household disposable incomes, using the modified Organisation for Economic Co-operation and Development scale.

Across all years, the average increase in Gini coefficient for all adjustments is 2.2 percentage points when compared with unadjusted data. There is not a quantile size that has a significantly different effect on the adjustments when compared with the other adjustments. The different changes in inequality over time between adjusted and unadjusted data have been discussed in Section 3.

Figure 5: Adjustments give a similar rise in inequality regardless of quantile group size

Gini coefficient, with varying quantile group size, financial year ending 2003 to financial year ending 2018, UK



Source: Office for National Statistics - Living Costs and Food Survey, HM Revenue and Customs - Survey of Personal Incomes

Notes:

1. 2002/03 represents the financial year ending 2003, and similarly through to 2017/18, which represents the financial year ending 2018.

2. 2008/09 is missing due to there being no SPI dataset available for that year.

It is unclear which quantile group size is best going forward. Principally, the more granular the data of the top earners can be, the better. However, once the quantile group size gets too small, there will be very few cases in the survey data within that quantile group. This is less of a problem for the current adjustment type but may be problematic in future, when exploring an adjustment based on reweighting (for more information, see Section 6).

Table 1 shows the number of individuals in quantile groups depending on size. The table is an average of FYE 2016 to FYE 2018 and it is broken down by retired status as individuals are split by this during the adjustment process. Across these years, the average number of households in the survey is 5,213 and the average number of individuals is 12,100. When using a quantile group size of 0.25%, there are six retired individuals in the survey data for each of the top four quantile groups. Therefore, a balance is needed between a small enough level of granularity but a large enough quantile group size that the numbers in each band are not too small.

Table 1: Smaller quantile group sizes give very few cases per quantile group
Number of cases in quantile groups in the survey data by quantile group size, average of financial year ending 2016 to financial year ending 2018

Quantile group size (%)	Quantile group	Number of non-retired individuals	Number of retired individuals
0.25	98	16	7
	98.25	18	6
	98.5	16	7
	98.75	19	6
	99	18	6
	99.25	15	6
	99.5	18	6
	99.75	19	6
0.5	98	34	13
	98.5	35	13
	99	33	12
	99.5	36	13
1	98	69	26
	99	69	24

Source: Office for National Statistics - Living Costs and Food Survey, HM Revenue and Customs - Survey of Personal Incomes

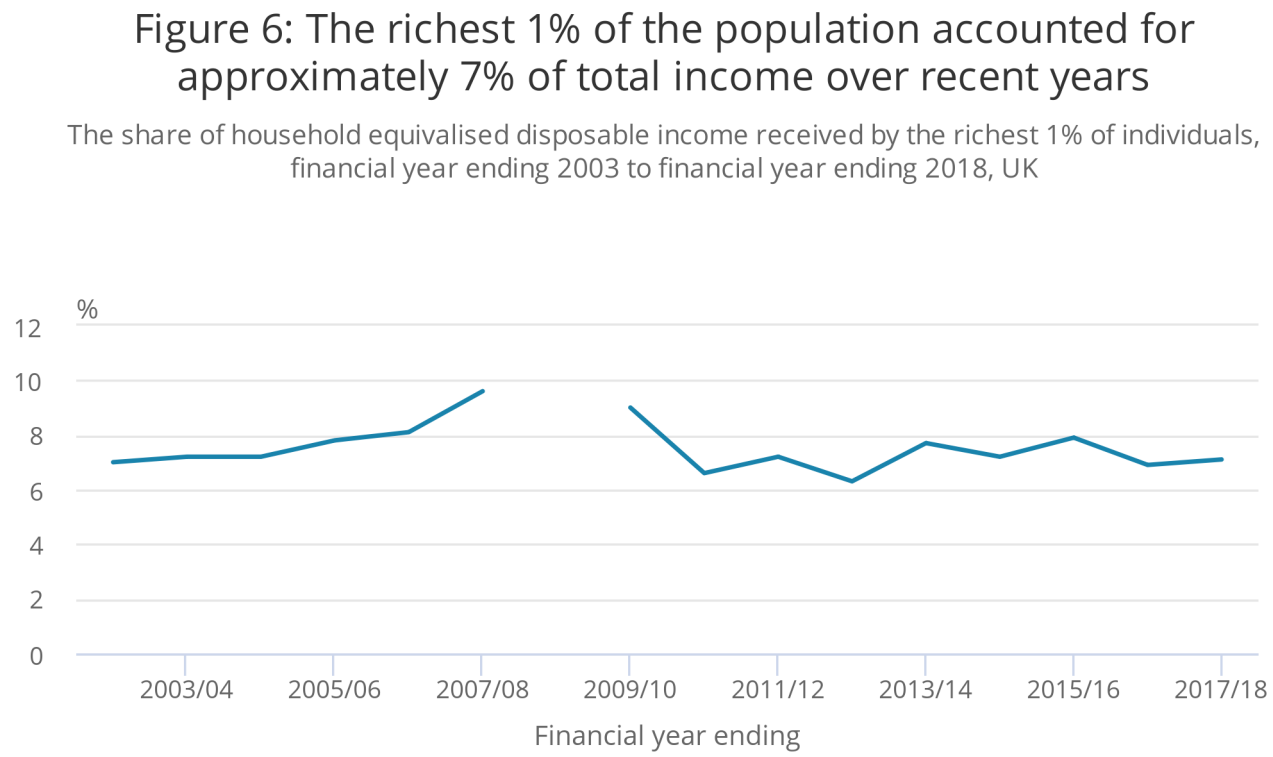
5 . The income share of the top 1%

The income of the so-called top 1% is a topic of considerate focus that has not historically been reported in Office for National Statistics's (ONS) household income releases due to the reported issues with the top end of survey data. The adjustments presented within this paper provide experimental data allowing analysis of the top 1% share on ONS's survey data for the first time, which has been performed using a top-income adjustment with a threshold of 98% and a quantile group size of 0.5%.

Figure 6 highlights that the household equivalised disposable income share of the top 1% of individuals accounted for 7.1% of the total household disposable income in financial year ending 2018. The top 1% share has remained steady since financial year ending 2011, following increases and subsequent fall before and during the economic downturn.

Figure 6: The richest 1% of the population accounted for approximately 7% of total income over recent years

The share of household equivalised disposable income received by the richest 1% of individuals, financial year ending 2003 to financial year ending 2018, UK



Source: Office for National Statistics - Living Costs and Food Survey, HM Revenue and Customs - Survey of Personal Incomes

Notes:

1. 2002/03 represents the financial year ending 2003, and similarly through to 2017/18, which represents the financial year ending 2018.

2. 2008/09 is missing due to there being no SPI dataset available for that year.

3. This chart uses a top-income adjustment with a threshold of 98% and quantile group size of 0.5%.

6 . Next steps

This release has been published to share progress on this work and get feedback from those with an interest and expertise in these issues. This release will be followed by a more detailed paper later this year, setting out the research in more detail. This will include work to be undertaken with the Department for Work and Pensions (DWP) to look at the impact of applying this adjustment to their Households Below Average Income (HBAI) series, derived from the Family Resources Survey.

This future paper will also include work on a different method of adjusting involving reweighting. In this method, upper and lower boundaries of quantile groups are calculated from the tax data. Individuals in the survey data within these income boundaries are then allocated to bands based on corresponding tax quantile groups. They are then given the incomes of the corresponding quantile group, and the number of individuals in bands in the survey data are reweighted so that they reflect the weight of the corresponding tax data quantile group. The whole dataset is then reweighted to reflect population totals.

This future paper will also look at further issues that it has not been possible to undertake analysis for, such as observing the impact of using projected Survey of Personal Incomes (SPI) data when compared with full outturn SPI datasets published later.

It is anticipated that, following this process, a top-income adjustment method can be finalised and included in regular Office for National Statistics (ONS) releases from 2020 onwards.

In future, there may also be work to expand the analysis of historical series further back in time and potentially apply the chosen top-income adjustment on household income datasets going back to 1977.

7 . Quality and methodology

For all quality and methodology information, please see The effects of taxes and benefits on household income, financial year ending 2017: technical report.

8 . Authors and acknowledgements

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