Forecasting Child Poverty in Scotland

A report for the Scottish Government by

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Chapter 1. Introduction

Landman Economics and Virtual Worlds were commissioned by the Scottish Government to produce four sets of projections for child poverty in Scotland, required for the Child Poverty (Scotland) Act (Scottish Parliament 2017b), which includes a set of child poverty targets to be achieved by 2030. This report describes the methods we used to forecast child poverty and gives details of our results.

1.1 Outline of the report

This introductory chapter sets out the background to our work. We discuss the Child Poverty (Scotland) Act, and also recent developments in the UK Government's welfare reforms, as well as recent tax and social security measures announced by the Scottish Government which may have an impact on child poverty in Scotland. We then briefly discuss the key demographic and economic trends in Scotland and the UK.

Chapter 2 discusses our methods. We describe the four child poverty measures contained in the Child Poverty (Scotland) Act and explain how we model them using a microsimulation model (the Landman Economics/IPPR/Resolution Foundation tax-transfer model) and a large-sample dataset (the Family Resources Survey).

Chapter 3 presents our results. As we discuss below, the Act sets a number of ambitious targets for reducing measured child poverty. Even without the already announced UK-wide cuts to the social security system, relative child poverty in Scotland is forecast to increase from just under 31% in 2017/18 to 35.5% by 2030/31 (the last year which our projections cover). After the implementation of the planned cuts, child poverty in Scotland is forecast to increase further, to 38% by 2030/31. Despite acquiring additional powers over the social security system which are being operationalised in the Social Security (Scotland) Bill (Scottish Parliament 2017c), the Scottish Government has limited social security powers to offset the reductions in social security incomes which are driving our central forecast of a substantial increase in child poverty over the next five years. The tax and social security reforms recently announced by the Scottish Government will not fundamentally change the overall trajectory of child poverty in Scotland.

1.2 The Child Poverty (Scotland) Act 2017

The Child Poverty (Scotland) Act places a duty on the Scottish Government to ensure that four child poverty targets are met during the 2030/31 financial year[1]. The four targets are:

1. Less than 10% of children living in *relative poverty*;
2. Less than 5% of children living in *absolute poverty*;
3. Less than 5% of children living in combined low income and material deprivation; and
4. Less than 5% of children living in *persistent poverty*.

All four measures are based on After Housing Costs (AHC) disposable income.

The Act was passed unanimously by the Scottish Parliament on 8th November 2017 (Parliament 2017a; Southwick and Hutchison 2017).

Chapter 2 below discusses these four poverty measures more fully, and our approach to measuring and forecasting them.

1.3 The Welfare Reform and Work Act 2016

The Child Poverty (Scotland) Act was in part a response to the UK Government's repeal of significant parts of the Child Poverty Act 2010 (DWP 2010), which it replaced with the Welfare Reform and Work Act 2016 (DWP 2016a). That legislation replaced the four income-based targets of the Child Poverty Act with poverty measures based on worklessness and educational attainment[2]. The Scottish Government states in the policy memorandum accompanying the Child Poverty (Scotland) Act that it:

> *Fundamentally disagrees with this approach: in particular, the removal of income-based targets, and the use of alternative measures that do not take income into account. In the Scottish Government's view, this represents a shift towards characterising poverty as a lifestyle choice rather than addressing the social and economic drivers that cause people to fall into or remain in poverty[3].*

[1] Scottish Parliament 2017b, Explanatory Notes, page 2
[2] Scottish Parliament 2017b, Policy Memorandum, pages 1-2
[3] Scottish Parliament 2017b, Policy Memorandum, page 2

1.4 Reductions in the generosity of social security payments

The UK Government's July 2015 Budget also announced several changes to the social security system which are forecast to have a significant impact on child poverty in the UK (including Scotland). The most important of these in terms of the number of people affected and the overall size of the reduction in social security spending as a result of the reforms are:

- A freeze in the nominal level of most social security benefits and tax credits received by working age families for four years, starting in 2016-17. These include Child Benefit, Jobseekers Allowance, and most parameters of tax credits and Universal Credit.[4].
- The limiting of premia for children in Housing Benefit, tax credits and Universal Credit to a maximum of two children only for new claimants – with support also not available for most third and subsequent children born after April 2017 for existing claimants.
- The abolition of the Work-Related Activity Premium for Employment and Support Allowance claimants from 2017 onwards.

1.5 Universal Credit

A further important driver is the gradual introduction of Universal Credit (UC) (DWP 2013), which is intended to replace the current system of tax credits and most means-tested benefits with a single unified system. In most cases UC is less generous than the benefits and tax credits it replaces (Browne, Hood and Joyce 2016). The introduction of UC has been extremely fraught (Timmins 2016) and national roll-out of the policy is well behind the UK Government's original schedule, but has now been accelerated (Gauke, 2017).

1.6 Devolved Social Security Powers

Following the 2014 Independence Referendum, the Smith Commission:

> *Recommended that the Scottish Parliament be given autonomy to determine the structure and value of a range of powers over disability,*

[4] The freeze follows a three-year period under the previous Conservative-Liberal Democrat Coalition UK Government where most benefits and tax credits were uprated by only 1 per cent per year, below the rate of CPI inflation.

as well as the power to make administrative changes to Universal Credit and to vary the housing cost element. It also recommended that the Scottish Parliament be given powers to create new benefits in areas of devolved responsibility, and top-up reserved ones.

(Scottish Government 2016)

In the wake of the Scotland Act 2016, which devolved further powers over part of the social security system to Scotland, the measures that the Scottish Government has introduced, or is planning to introduce, include:

- Introducing a new Social Security Agency (Scottish Government 2017a);
- Increasing the weekly payment of Carers' Allowance to the level of Jobseekers' Allowance for a single adult – an increase from £62.70 to £73.10 at current (2017/18) rates (Scottish Government 2017b);
- A new Best Start Grant which replaces the Sure Start Maternity Grant (SSMG), which is a grant for new mothers in low income families. Since 2010 the SSMG has been paid only for the first child in a low-income family. The Best Start Grant pays qualifying families £600 on the birth of their first child (compared with £500 for the SSMG) and £300 on the birth of any subsequent children. Qualifying families also receive £250 when each child begins nursery, and a further £250 when they start school.

1.7 Devolved Income Tax Powers

The Scotland Act 2016 also enabled the Scottish Government to set its own income tax rates and bands on non-savings and non-dividend income. Table 1.1 shows the new rates which will apply for the 2018/19 tax year in Scotland and compares them with the rates which remain in place in the rest of the UK.

Table 1.1. Income tax marginal rates in Scotland and England/Wales: 2018-19

	Income tax marginal rate (%)	
Gross income level	Scotland	England/Wales
£11,850-£13,850	19	20
£13,850-£24,000	20	20
£24,000-£43,430	21	20
£43,430-£46,350	41	20
£46,350-£150,000	41	40
Above £150,000	46	45

The new Scottish rates of income tax result in a tax cut for people in Scotland earning between £11,850 and £26,000 per year compared to the system in place in the rest of the UK; this tax cut is worth a maximum of £20 per taxpayer annually. Above £26,000 annual gross income, the increase in marginal rates (and setting the higher rate threshold at £43,430 in Scotland rather than £46,350 in the rest of the UK) results in higher income tax payments, the extra revenue from which is being reinvested into public services to offset the impact of the UK Government's cuts to the Scottish Government's budget settlement (Scottish Government, 2018). It should be noted that the impacts of the reinvestment of additional tax revenues into public spending are not captured in the modelling used in this report (except where the additional revenue is being used to increase social security payments, as in the reforms to Carers Allowance and the introduction of the Best Start Grant).

Important as the Scottish Government's new tax and social security measures are, we show in Chapter 3 that their effects are relatively minor compared to the UK Government cuts that have already happened or are in the pipeline.

1.8 Trends in population and employment

Demographics

As well as changes to the tax and social security system, the extent of child poverty depends also on demographics and the state of the economy.

Appendix 1 below discuss how we use economic and demographic forecasts in our microsimulation work. Here we briefly note two things.

Firstly, political events, especially Brexit, mean that there is a higher than usual level of uncertainty about the path of the Scottish population and the Scottish economy. Figures 1.1 and 1.2 below illustrate this; they show the range of official population forecasts for Scotland, for all people (Figure 1.1) and children only (Figure 1.2)[5]. Differing assumptions about fertility, life expectancy and, in particular, inward migration mean that by the end of our forecast period there is a range of 700,000 between the highest and lowest official forecast for total population, and over a quarter of a million for children. The wide range of forecasts is reflected in the robustness analysis of the results in Section 3.5 of this report where using different sets of population forecasts produces a bigger variation in projected child poverty rates than for any of the other forecast parameters (for example earnings or employment).

[5] See Appendix 1 below for a discussion of the sources of these projections.

Figure 1.1. Population projection variants

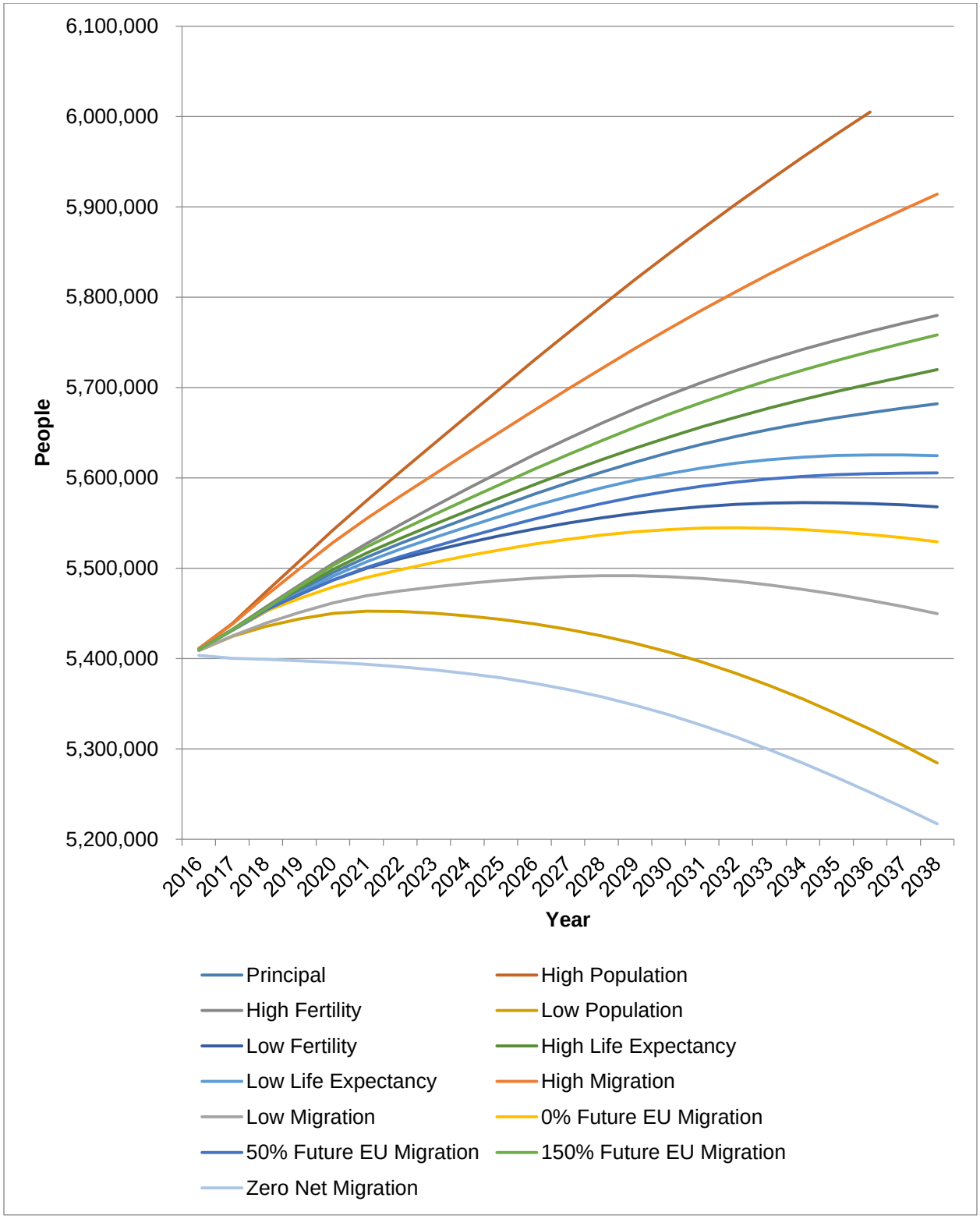
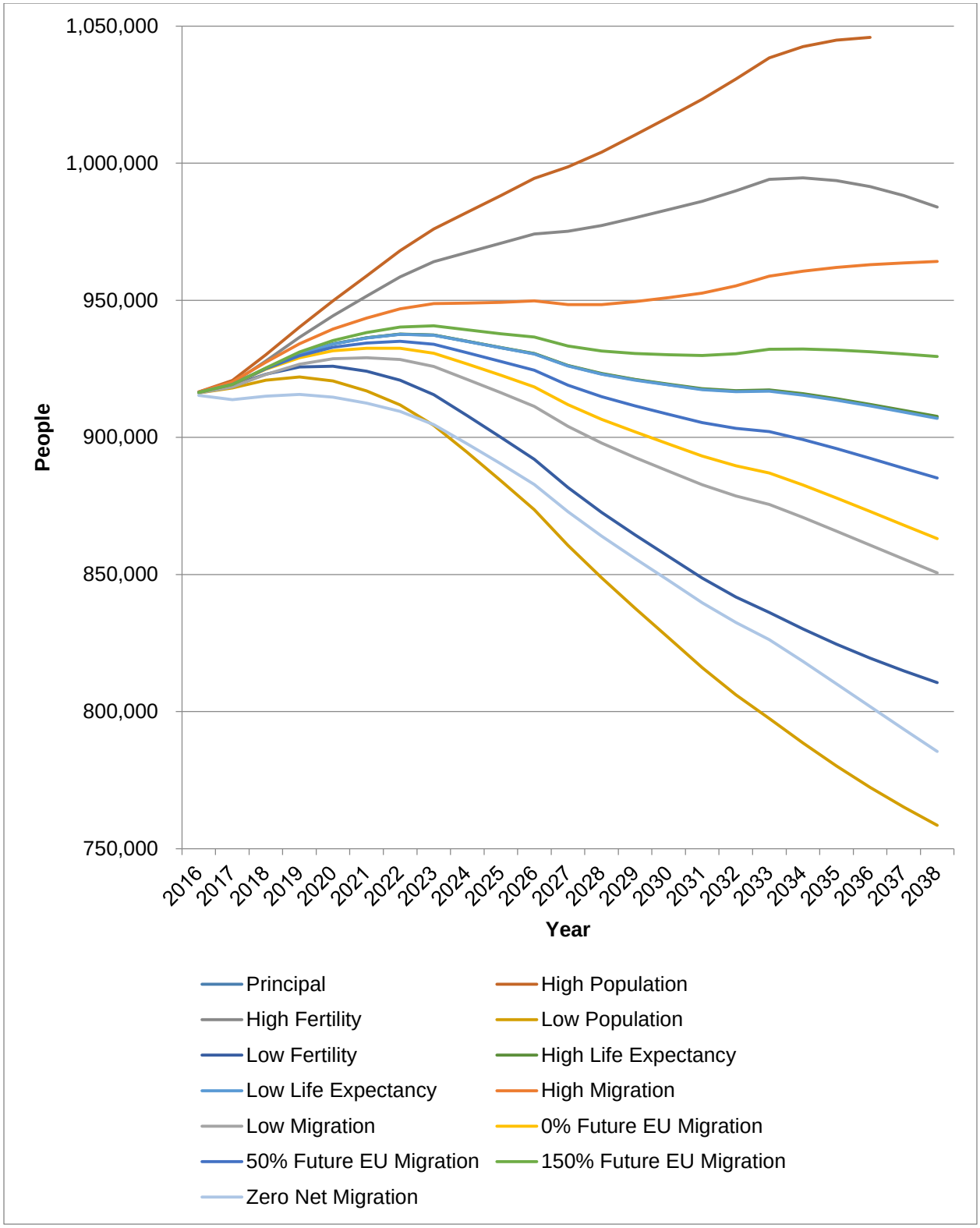


Figure 1.2 Forecast variants for number of children



Secondly, although we have put a lot of effort into capturing their effects accurately, in practice our results are not primarily driven by demographics or the projected state of the economy. Figures 1.3 and 1.4 below show projections for numbers of children (by age group and gender) and for employment and unemployment levels, for the baseline and one pessimistic projection (zero net migration from the EU post-Brexit).

Figure 1.3. Projected numbers of children, adults, and employment, baseline scenario

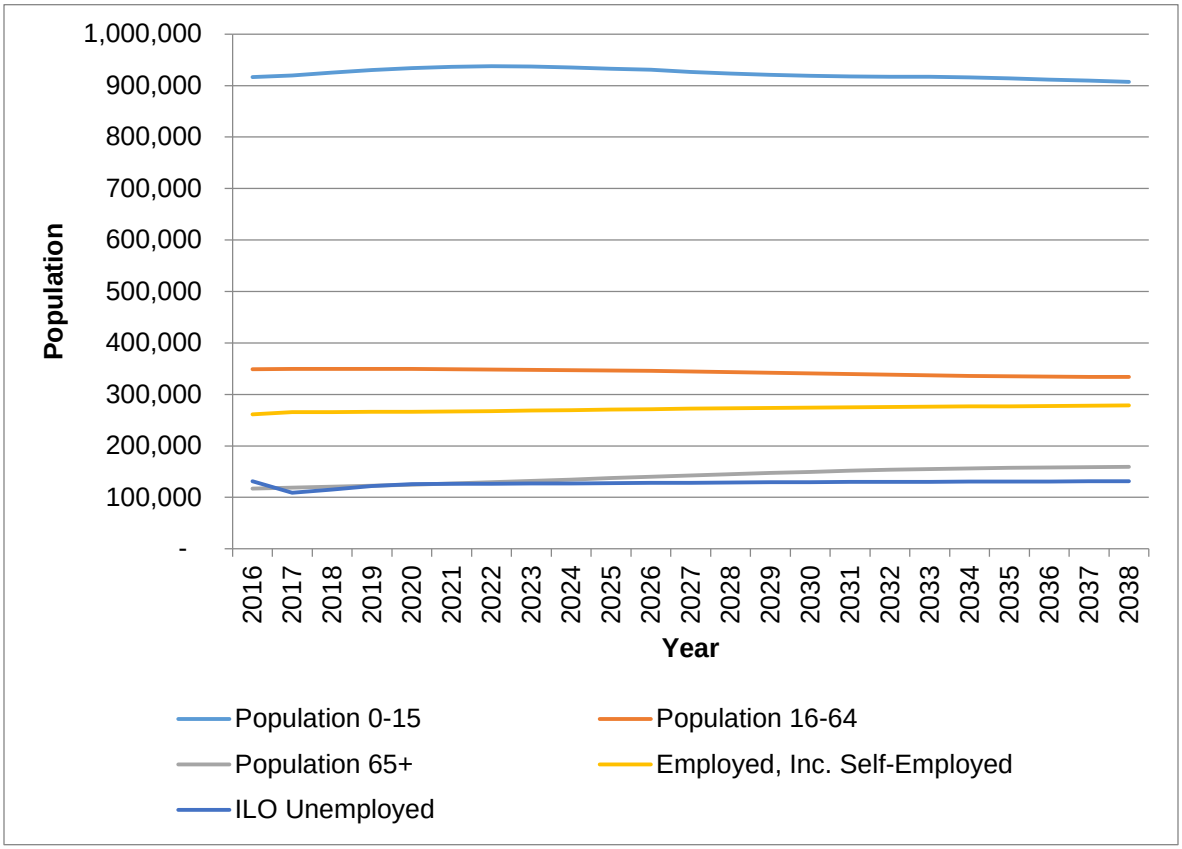
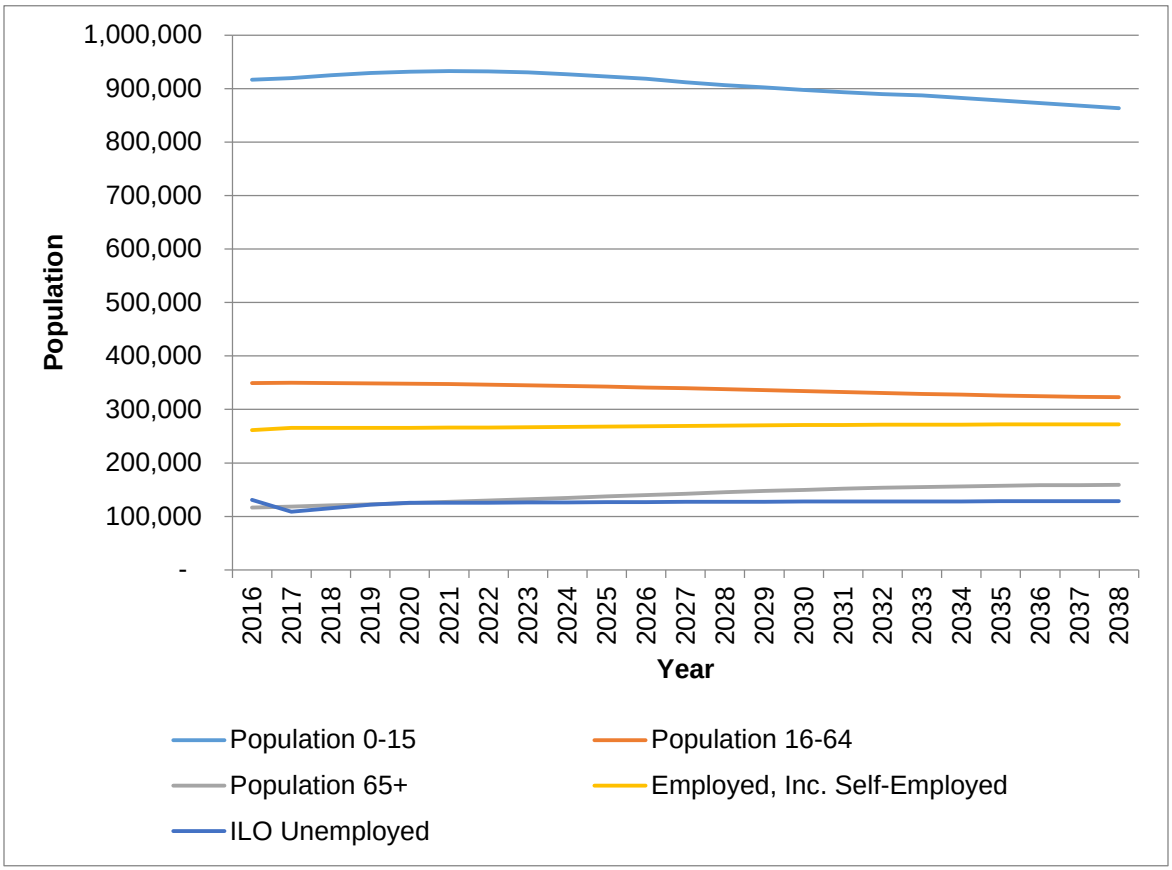


Figure 1.4. Projected numbers of children, adults and employment, pessimistic scenario



Although the Scottish population is clearly ageing (especially in the pessimistic scenario), the ratio of working-age adults to children is forecast to be reasonably stable even in the pessimistic case.

The Economy

The Scottish Fiscal Commission (SFC) is now responsible for producing independent forecasts for Scotland. SFC produced their first forecast for the Scottish economy in December 2017 (SFC 2017), and we take our projections for the paths of earnings and employment from there. Since (as discussed below), our poverty lines are calculated using data for the UK as a whole, we also use UK-wide data from the corresponding Office for Budget Responsibility (OBR) forecast (OBR 2017) to provide projections for the paths of earnings and employment for the rest of the UK.

As shown in Table 1.2 below, the SFC forecast paints a picture of relatively sluggish growth in both output per head and employment.

Table 1.2. SFC Scottish Growth Predictions: Headline Numbers

	2017	2018	2022
Growth (%)	0.4	0.7	1.1
Productivity Growth (%)	0.2	0.5	1.0
Wage Growth (Nominal) (%)	2.0	2.3	3.1
Employment Growth(%)	1.3	0.6	0.1

Source: SFC (2017), p7

This is true also of the OBR forecast for the whole UK, as shown in Table 1.3 below, which compares the SFC Scottish forecast with the OBR UK-wide one for the early years of our simulation period. Both Scotland and the UK are forecast to have historically slow growth, but the forecast UK growth is slightly higher[6]. However, the forecast divergence in growth between Scotland and the rest of the UK could be significant for our study because the poverty lines used in our poverty measures[7] increase with UK income (DWP 2016b), and therefore slower growth in Scotland compared to the rest of the UK could cause measured relative poverty in Scotland to increase even if there was nothing else going on, due to slower real income growth causing more households to fall below a relative poverty line which is calculated based on UK-wide household incomes[8]. As discussed in Chapter 3, however, using OBR's and SFC's central projections, this effect appears to be small[9].

[6]Possible reasons for slow growth in the UK economy as a whole include the collapse in productivity growth following the 2008-09 recession, a forecast decline in immigration post Brexit, shocks from Brexit itself, and secular changes such as the increasing share of service industries and the rise of the 'gig economy'.

[7]Except absolute poverty (measure 2), since the poverty line there does not move as median income changes over our simulation period.

[8]One interesting reason for the divergence between the OBR and SFC forecasts that could be relevant to us is that OBR continue to use the ONS central population forecast, which does not assume any impact of Brexit, whereas the SFC one uses one of the NRS's pessimistic forecasts, which assumes a fall of 50% in EU net migration.

[9] The results in Chapter 3 contain a robustness check – running the child poverty projections using the OBR forecasts for the whole of the UK *including Scotland* – to check what difference it makes to the child poverty results if we use OBR forecasts for the Scottish economy as well as the rest of the UK. The results show that using OBR forecasts for Scotland makes almost no difference to our poverty forecasts.

Table 1.3. Comparison of SFC Scottish economy forecasts with OBR UK economy forecasts

		2016	2017	2018	2019	2020	2021	2022
GDP	OBR	1.8	1.5	1.4	1.3	1.3	1.5	1.6
	SFC	0.4	0.7	0.7	0.9	0.6	0.9	1.1
GDP per capita	OBR	1.0	0.9	0.8	0.7	0.7	0.9	1.0
	SFC	-0.1	0.3	0.3	0.6	0.3	0.6	0.9
Employment (millions)	OBR	31.7	32.1	32.3	32.4	32.5	32.6	32.7
	SFC	2.6	2.6	2.7	2.7	2.7	2.7	2.7
Real hourly wages	OBR	1.7	0.3	-0.1	0.7	0.6	1.0	1.0
	SFC	2.1	-0.3	0.1	0.5	0.6	0.8	1.1
Nominal annual earnings	OBR	2.8	2.3	2.3	2.3	2.6	3.0	3.1
	SFC	3.2	2.0	2.2	2.4	2.6	2.8	3.1

Source: SFC (2018) for Scottish economy forecasts, OBR (2017) for UK economy forecasts.[10]

[10]One interesting reason for the divergence between the OBR and SFC forecasts that could be relevant 1to us is that OBR continue to use the ONS central population forecast, which does not assume any impact of Brexit, whereas the SFC one uses one of the NRS's pessimistic forecasts, which assumes a fall of 50% in EU net migration.

Chapter 2. Methodology

2.1 Microsimulation of household net incomes

Our approach for forecasting child poverty over the years to 2030/31 relies on using a microsimulation model to estimate household net incomes under three different policy scenarios (as explained in Section 2.6 below). We use the **IPPR/Resolution Foundation/Landman Economics tax-transfer model**[11] (referred to hereafter in this report as the "tax-transfer model", or the abbreviation TTM) to model the effects of reforms to the tax and social security system in Scotland and the rest of the UK. Broadly, the following parts of the system are modelled:

- Income tax;
- National Insurance Contributions (NICs);
- Council Tax and Council Tax-related benefits (including the Council Tax Reduction scheme in Scotland);
- Means-tested and non-means tested benefits;
- Tax credits;
- Universal Credit, which is currently being rolled out to all families in the UK and replacing tax credits and most means-tested benefits.

In addition to this, the analysis also models the introduction of the National Living Wage (NLW) – an above-inflation increase in the minimum wage for employees aged 25 and over, introduced in 2015 and uprated every April since then, with the stated intention of increasing to 60 percent of median earnings by 2020.

The TTM is a *microsimulation* model which uses data from the UK Family Resources Survey (FRS) (discussed further in Section 2.2 below). It calculates net incomes for households (and benefit units within households, and individuals within benefit units) given a set of tax-transfer parameters, and for a given tax year (e.g. 2017-18). The parameters are held in files in spreadsheet format; a set of parameters can describe the

[11] The model was originally developed in 2008-09 by Landman Economics for the Institute for Public Policy Research (IPPR) and was subsequently shared with researchers at the Resolution Foundation which provided additional funding for improvements in the model functionality and performance. The model is now used by all three organisations. Other comparable models in use in the UK include the distributional analysis models used by HM Treasury and the Department for Work and Pensions; the Institute for Fiscal Studies (IFS)'s TAXBEN model; and the UK version of the Euromod model which is hosted at the University of Essex.

actual tax-transfer system in place at a given time, or a simulated system with one or more reforms implemented (for example, an increase in income tax rates).

The model takes account of all the reforms to the tax and social security system in Scotland and other countries of the UK that can be modelled using the information in the FRS data. The model also takes account of partial take-up of means-tested benefits, tax credits and Universal Credit. Not everybody who is eligible for particular means-tested social security payments based on their circumstances in the FRS data actually claims those payments, and it is important for the modelling to control for this where possible[12]. Appendix 2 contains more detail on these features of the TTM.

The model is fundamentally *static* in that it does not attempt to model the effect of reforms to taxes or transfer payments on people's behaviour; the analyses in this report assume that behaviour is unchanged in response to policy changes. However, the algorithm used to reweight the FRS data for years between 2017/18 and 2030/31 (discussed in more detail in Section 2.4 below) does take forecasts of increased employment in Scotland (and the rest of the UK) into account.

The TTM has been used for analysis of the impact of reforms to tax and social security on child poverty rates in the UK before – for example in an analysis of the impact of increased employment on child poverty by 2020 for the Social Mobility and Child Poverty Commission (Reed and Portes 2014a), cumulative impact assessments of Budget and Spending Review policy decisions by the UK Government for the Equality and Human Rights Commission (Reed and Portes, 2014b and 2018) and an analysis of the impact of various policy choices on the welfare state for inequality and poverty in 2030 (Harrop and Reed, 2015). It is a model with a proven track record for realistic poverty forecasts.

2.2 Survey data

The Family Resources Survey (FRS)

The FRS is an annual survey of around 20,000 households per year in the UK, collected on a tax-year basis[13]. The most recent release of FRS at the time of writing this report was 2015-16[14]; the 2015-16 dataset contains 2,704 households from Scotland, 13,840

[12] The impact of assuming 100% take-up of means-tested social security payments on the result is tested in Chapter 3 as a robustness check.
[13] The Family Resources Survey and the Living Costs and Food Survey are both 'repeated cross-sectional' surveys rather than panel surveys; they interview a new set of households each year rather than conducting repeat interviews with the same set of households over a number of years.
[14] The FRS data for 2016/17 are scheduled to be released on 22nd March 2018.

households from England, 1,930 households from Northern Ireland and 848 households from Wales.

The FRS is generally acknowledged to be the best source of data on individual, family and household gross incomes and disposable incomes (incomes after payment of direct taxes and transfer payments) in the UK. For this reason, the FRS is used for the UK Government's statistical publication on the income distribution *Households Below Average Income* (HBAI) (DWP 2017b) and also the Scottish Government's own publication *Poverty and Income Inequality in Scotland* (Scottish Government, 2017d).

The FRS is also suitable for microsimulation modelling of changes in taxes and transfer payments in response to policy reforms as it contains individual, family and household attribute variables which establish eligibility to many elements of the tax and transfer payment system (e.g. age, single/couple and/or marital status, number of children in the family, housing tenure type, and so on). The FRS also contains information on housing costs and childcare arrangements and expenditure (but not expenditure on other goods and services).

Because of the relatively small sample size for the FRS in Scotland, our calculations of child poverty for this project use a pooled dataset of four years (2012/13, 2013/14, 2014/15 and 2015/16). This gives a total sample size of 13,337 Scottish households out of 92,501 UK households (excluding a small number of households dropped from the dataset which the UK Government uses for HBAI because of incomplete or poor quality data).

Understanding Society

In order to forecast persistent poverty, it is necessary to use a panel dataset where the same households and individuals are interviewed repeatedly (e.g. on an annual basis). FRS is a cross-sectional dataset and so cannot be used in isolation to produce persistent poverty forecasts. The best source of panel data on household incomes is Understanding Society (USoc). This is a panel survey of around 25,000 households which has been running since 2009; 6 waves of data are now available, with the most recent interviews in 2015-16. The DWP and Scottish Government have both produced experimental statistics on persistent poverty using the USoc data (DWP 2017c; Scottish Government 2017e).

The USoc data on household disposable incomes for consecutive waves are used to produce estimates of persistent poverty (being in poverty in at least 3 of the 4 waves 3,4,5 and 6) which are then combined with the FRS data using techniques described in Section 2.4 below, to produce estimates of persistent poverty for the FRS sample.

2.3 Reweighting and uprating the data

The pooled FRS dataset for the four years 2012-13 through to 2015-16 needs to be adjusted for each of the forecast years (2016-17[15] through to 2030-31) so that, for each forecast year, the dataset better resembles forecasts of what the population and the distribution of earnings and other gross incomes in future years. This project uses two techniques[16] to adjust the FRS dataset so that it better resembles the population profile and earnings distribution in future years:

1. *Re-weighting*. Survey datasets such as the FRS contain weights that are inversely related to the probability of a given household being selected in a random sample; for example, if lone parent households are less likely than average to respond to the FRS questionnaire (or to be contacted by FRS interviewers in the first place), lone parent households will tend to have a higher-than-average weight in the survey. These weights 'gross up' to the totals of each type of household in the UK population. By varying the weights it is possible to transform the FRS data so that it more closely resembles forecasts of the demographic structure of the population in future years.
2. *Uprating*. If we expect earnings or other economic variables (such as housing costs) to rise or fall in real terms, the recorded values of these variables in the FRS data can be adjusted before carrying out the calculations in the TTM.

Appendix 1 gives a detailed account of the re-weighting and uprating methods used to adjust the FRS data to forecast the demographic structure and economic variables in Scotland (and the rest of the UK) over the forecast period.

2.4 Forecasting the child poverty measures

This section gives an overview of the methods required for forecasting each of the four child poverty measures specified in the Child Poverty (Scotland) Act 2017.

[15] Although the 2016-17 tax year is in the past, because the most recent FRS data currently available is 2015-16, for the purposes of the empirical analysis in this report, 2016-17 (and 2017-18) are forecast years rather than historical years.
[16] A third technique – artificial ageing – was considered for use in this project but rejected as too time-consuming given the available time and budget to complete the project.

Measure 1: relative child poverty

The forecast for this measure in each target year (between 2016/17 and 2030/31) is calculated as follows:

i. The pooled FRS data for the years 2012/13 to 2015/16 are reweighted and uprated to the target year according to economic projections for employment and earnings growth, and growth of gross incomes from other sources (e.g. investment, property etc). More detail on the reweighting and uprating procedures is given in Appendix 1;

ii. The relevant tax-benefit parameters for the target year are applied (see Section 2.5 on 'policy scenarios' below);

iii. Median household AHC (equivalised) net incomes are calculated at a UK-wide level, taking simulated weights for the target year into account;

iv. The child poverty rate is calculated based on 60% of the AHC poverty line.

Measure 2: absolute child poverty

The method for Measure 2 is exactly the same as for Measure 1 except that the poverty line in step (iii) is the 2010-11 median income level, uprated for inflation[17] to the target year.

Measure 3: combined low income and material deprivation

The forecasting of poverty measure 3 requires additional assumptions compared to measures 1 and 2 because measure 3 depends in part on material deprivation and this cannot be forecast directly using the tax-transfer model in the way that disposable income can. Instead, we estimate a simulated deprivation score for the FRS subsample of households with children in the target year.

The following procedure is used to estimate a simulated material deprivation score for each household with children in the FRS:

[17] The uprating index used for the absolute poverty measure in the UK Department for Work and Pensions' Households Below Average Income statistics is now a version of the Consumer Prices Index (CPI), and the Scottish Government also uses CPI in the Child Poverty (Scotland) Act. See Levell and Skingle (2016) for details.

1) Pooling data from the FRS for 2010-11[18] through to 2015-16;
2) A regression of household deprivation score against variables including:
    i. household demographics (e.g. number of children in various age groups, number of single and couple adults);
    ii. region;
    iii. housing tenure;
    iv. household earned income;
    v. household investment income;
    vi. household income from transfer payments (e.g. benefits, tax credits);
    vii. employment status.
3) Based on the regression coefficients (plus a randomly generated error term for each household) and the forecast values of the explanatory variables for the target year (some are time invariant such as household demographics, whereas others change between the base year and the target year, such as household incomes), a simulated deprivation score is predicted for each household in the target year.
4) The proportion of households with a deprivation score of over 25 is calculated (based on the simulated sample weights for the target year) – this is the forecast of material deprivation in the FRS for the target year.
5) Forecast material deprivation is combined with a variant of the forecast of low income from Measure 1 above (using a higher poverty line, of 70% of median equivalised AHC income) to produce the forecast of combined low income and material deprivation which is Measure 3.

Note that this procedure can be repeated a larger number of times with differently randomly generated errors to build up a distribution of simulated forecasts. In Chapter 3 we use this technique to produce statistical confidence intervals for the estimates of Measure 3 over the forecast period.

[18] Although material deprivation indicators were introduced in the 2007-08 FRS survey, the questions were changed in 2010-11 so 2010-11 to 2015-16 is the longest run of data that we have on a consistent basis.

Measure 4: persistent child poverty

The method for estimating persistent child poverty is similar to the method for forecasting material deprivation used for measure 3 above, but there is an additional complication because the persistent child poverty measure uses Understanding Society (USoc) data rather than FRS.

Bearing this in mind, the forecast of persistent poverty proceeds as follows:

1. A pooled USoc dataset from waves 3 to 6 is used;
2. For households in waves 3 to 6, a (probit) regression of persistent child poverty is estimated (defined as child poverty in at least 3 of the last 4 years) against variables including:
    i. household demographics (e.g. number of children in various age groups, number of single and couple adults);
    ii. region;
    iii. housing tenure;
    iv. household earned income;
    v. household investment income;
    vi. household income from transfer payments (e.g. benefits, tax credits);
    vii. employment status.
3. The probability of being in persistent poverty is predicted using the FRS sample for the target year, based on the regression coefficients from the USoc regression (plus a randomly generated error term for each household) and the forecast values of the explanatory variables for the target year
4. The proportion of households in persistent poverty in the FRS is calculated (based on the simulated sample weights for the target year). This is our estimate of measure 4.

As with measure 3 above, we perform a robustness analysis of the confidence intervals on the persistent child poverty results derived using this approach by replicating steps (iii) and (iv) a large number of times with different sets of random errors.

2.5 Policy scenarios

The four child poverty measures are estimated for three different policy scenarios. Each of these scenarios uses the actual tax and social security systems in place in Scotland and the rest of the UK for years up to and including the current tax year (2017/18). After 2017/18, the three scenarios make different assumptions about the future parameters of the tax and social security system, as follows:

Scenario (a): uprating only

Scenario (a) assumes that the 2017-18 tax and social security system is kept in place and simply uprated for future years using the default uprating assumptions ('triple lock' uprating for the state pension and Consumer Prices Index uprating for other benefits, tax credits, and tax and National Insurance thresholds). None of the further reforms or changes scheduled to take effect after 2017/18 – for example the roll-out of Universal Credit, and the continuation of the working-age social security uprating freeze for two more years – are implemented.

Scenario (b): Westminster reforms

Scenario (b) includes reforms announced by the UK Government which are scheduled to come into effect after 2017/18, but does not include reforms announced by the Scottish Government (the changes to income tax rates in Scotland scheduled for 2018/19, the increase in Carers' Allowance to the level of Jobseekers' Allowance, and the Best Start Grant).

Scenario (c): Westminster plus Scotland reforms

Scenario (c) includes the reforms announced by the UK Government *plus* the reforms announced by the Scottish Government detailed above.

By comparing between the three scenarios it is possible to establish the projected impact of future announced reforms from the UK Government, and the forthcoming changes to the Scottish tax and social security system, on the projected path of child poverty.

2.6 Robustness analysis

Variant scenarios

It is useful and instructive to re-calculate the child poverty measures using variations to many of the assumptions on the macroeconomy, demographic structure, and some of the key assumptions underlying the microsimulation modelling of household net incomes using the TTM. With this in mind, Chapter 3 of the report includes some analysis of variants to the child poverty estimates produced using the following variants to the modelling methodology:

- Varying the population forecasts for the Scottish economy;
- Varying the forecasts for employment growth in the Scottish economy;
  Zero real wage growth;
- Wage growth lower than forecast (e.g. 0.5 percentage points per year lower);
- Wage growth higher than forecast (e.g. 0.5 percentage points per year lower);
- No reweighting (essentially stripping out all the reweighting assumptions after 2017-18);
- Using OBR forecasts across the whole UK economy (including Scotland);
- Using a longer transition period for the roll-out of Universal Credit;
- Assuming 100% take-up of means-tested social security payments.

Comparison with IFS results

In October 2017 the Institute for Fiscal Studies published forecasts for child poverty going up to the 2022/23 tax year which included a subset of results for Scotland (Hood and Waters, 2017). We compare our results with the IFS results and attempt to explain any differences between the two sets of results.

Chapter 3. Results

3.1 Headline child poverty measures

Figure 3.1 shows the results for the proportion of children in poverty under each of the four featured measures, starting with 2015/16 (the most recent year for which published child poverty statistics were available at the time or writing) and ending in 2030/31. Note that these headline measures are based on scenario (c) (where all the planned UK Government and Scottish Government tax and social security reforms are implemented over the forecast period). Measure 1 (relative child poverty) is shown in blue, Measure 2 (absolute child poverty) in red, Measure 3 (combined material deprivation and below 70% of median AHC income) in grey, and Measure 4 (persistent poverty) in yellow.

Figure 3.1 shows that the relative child poverty rate (Measure 1) is forecast to rise sharply between 2015/16 and the current tax year, 2017/18 (from 26.5 per cent to just under 31 per cent). A further sharp increase is forecast between 2017/18 and 2020/21, to 34.5 per cent. After this, during the 2020s, relative child poverty is forecast to continue increasing, but at a slower rate, before levelling out at just under 38 per cent from 2027/28 onwards.

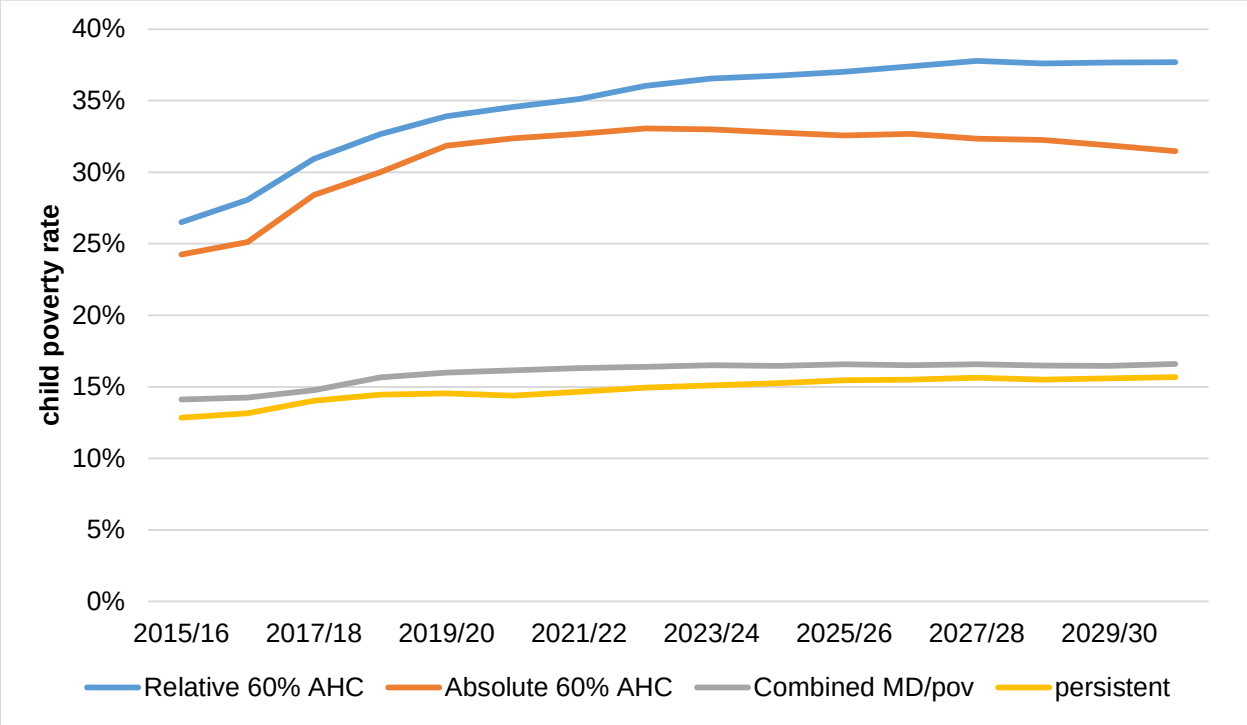
The absolute child poverty measure (Measure 2) begins to rise sharply after 2016/17, rising from just over 25 per cent in 2016/17 to just under 32 per cent in 2019/20. After this, absolute poverty rises more slowly before levelling off at just over 33 per cent in 2021/22, and then gradually falling over the rest of the 2020s before reaching 31.6 per cent in 2030/31 – around the same level it is forecast to be at in 2019/20.

Measure 3 (combined material deprivation and low income) is forecast to rise from just over 14 per cent in 2016/17 to 16 per cent in 2019/20, and then rises less quickly over the early 2020s before levelling off at around 16.5 per cent in 2023/24. It is then forecast to stay at around this level for the rest of the 2020s.

Measure 4 (persistent poverty) is projected to rise from just under 13 per cent in 2015/16 to 15.5 per cent in 2026/27 before levelling off at around this level for the rest of the forecast period.

A key driver of the sharp increase in all four measures of child poverty (but particularly measures 1 and 2) is the reduction in the real-terms generosity of the social security system between 2016/17 and 2020/21 as a result of planned reforms by the UK Government. This is explained and analysed in more detail in the next section, which looks at the differences between trends in child poverty under the three featured policy scenarios.

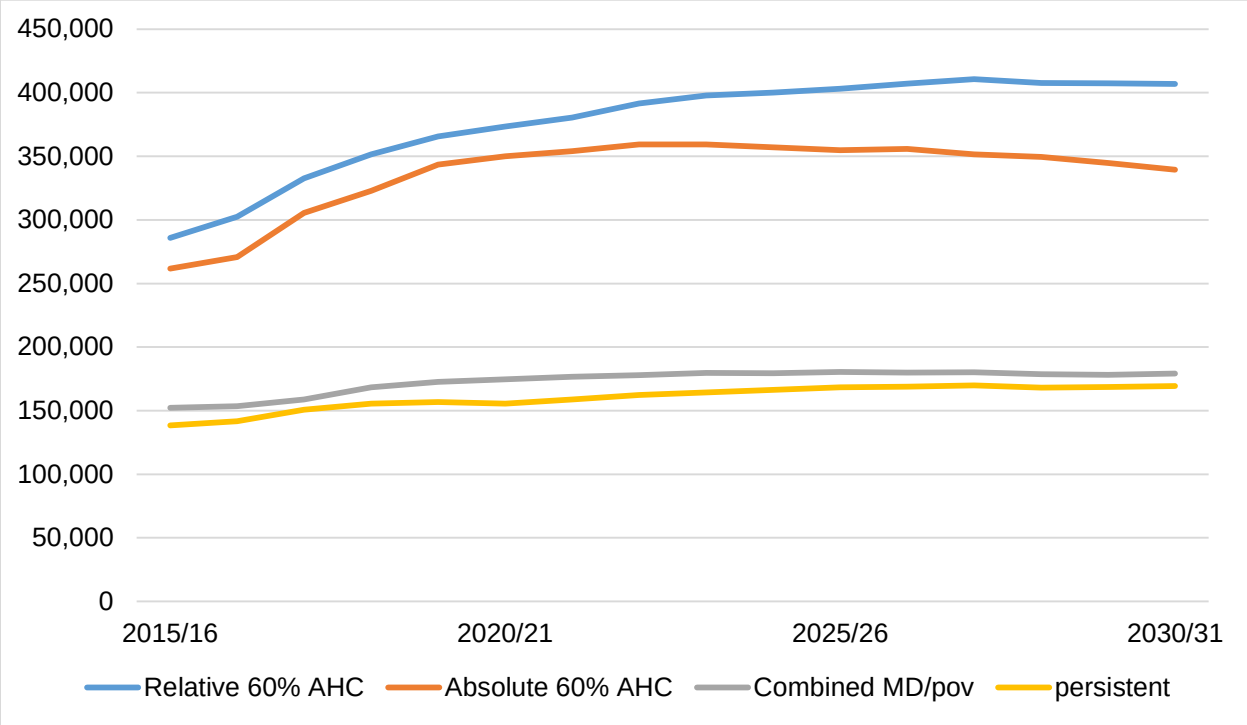
Figure 3.1. Headline child poverty rate forecasts, Scotland, scenario (c), 2015/16 to 2030/31



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Figure 3.2 shows the same headline results as Figure 3.1 but expressed in terms of the forecast number of children in poverty rather than the forecast poverty rate. Because projections for the growth of population of children in Scotland show almost no increase over the forecast period as a whole (a projected population of 1.079 million in both 2015/16 and 2030/31, with a maximum population of 1.089 million in the mid-2020s), the pattern of increases in child poverty looks almost identical in Figure 3.2 compared to Figure 3.1. For this reason, all subsequent graphs in this report use child poverty rates rather than absolute numbers in poverty.

Figure 3.2. Headline forecast numbers of children in poverty, Scotland, scenario (c), 2015/16 to 2030/31



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

3.2 The impact of UK and Scottish Government policies on child poverty: scenario comparisons

Analysing the difference between forecast child poverty rates under the scenarios (a), (b) and (c) outlined in Section 2.6 is useful for providing more information about what the drivers of the forecast increase in poverty are. Figure 3.3 shows a comparison of the forecasts for child poverty measure 1 (relative poverty) under the three scenarios;

a) The 2017-18 system with no further reforms, uprated for inflation;
b) Scenario (a) plus subsequent announced UK Government tax and social security reforms;
c) Scenario (b) plus subsequent announced Scottish Government tax and social security reforms.

Figure 3.3 shows that the announced UK government reforms after 2017-18 (the orange line) result in a substantial further increase in relative child poverty compared to scenario (a) where the subsequent UK reforms are not implemented (the blue dashed line). This reflects the impact of the freeze on the uprating of working age social security

benefits, in particular. One of the reasons that relative poverty starts to increase at a faster rate after 2016/17 is the impact of the social security uprating freeze, combined with relatively high inflation in the wake of the EU referendum vote in June 2016 (for example CPI was running at 2.7% in January 2018, compared to a Bank of England target of 2 per cent) (ONS 2018). Other policies, such as the introduction of the two-child limit for Housing Benefit, tax credits and Universal Credit in April 2017, are also contributing factors to the measured increase in Scenario (b). When UK Government-mandated reforms for 2018/19 and subsequent years are stripped out, relative poverty still increases, but does so at a much slower rate; by 2020/21, relative poverty is forecast to be just under 32 per cent in scenario (a), compared to 34.5 per cent in scenario (b).

The role of the Scottish tax and social security reforms in explaining trends in forecast child poverty

Comparing scenario (b) with scenario (c), we see that the Scottish Government's planned tax and social security reforms have a very limited impact on relative child poverty. Across the whole forecast period, the divergence between forecast child poverty in scenario (b) and scenario (c) is always within the statistical margin of error for the forecast. In other words, there is no statistically significant impact of the Scottish Government's reforms. This section analyses why the forecast impacts of the reforms are so small.

In the case of the increase in Carers' Allowance, the smallness of the effect is because the measure does not affect enough households with children to cause any measurable impact on child poverty[19]. And while the Best Start Grant is received by a far higher proportion of families with children – and low-income families with children, in particular – than Carers' Allowance, the additional payments from the grant – expressed in weekly terms – are not large enough to make an appreciable difference to the poverty rate.

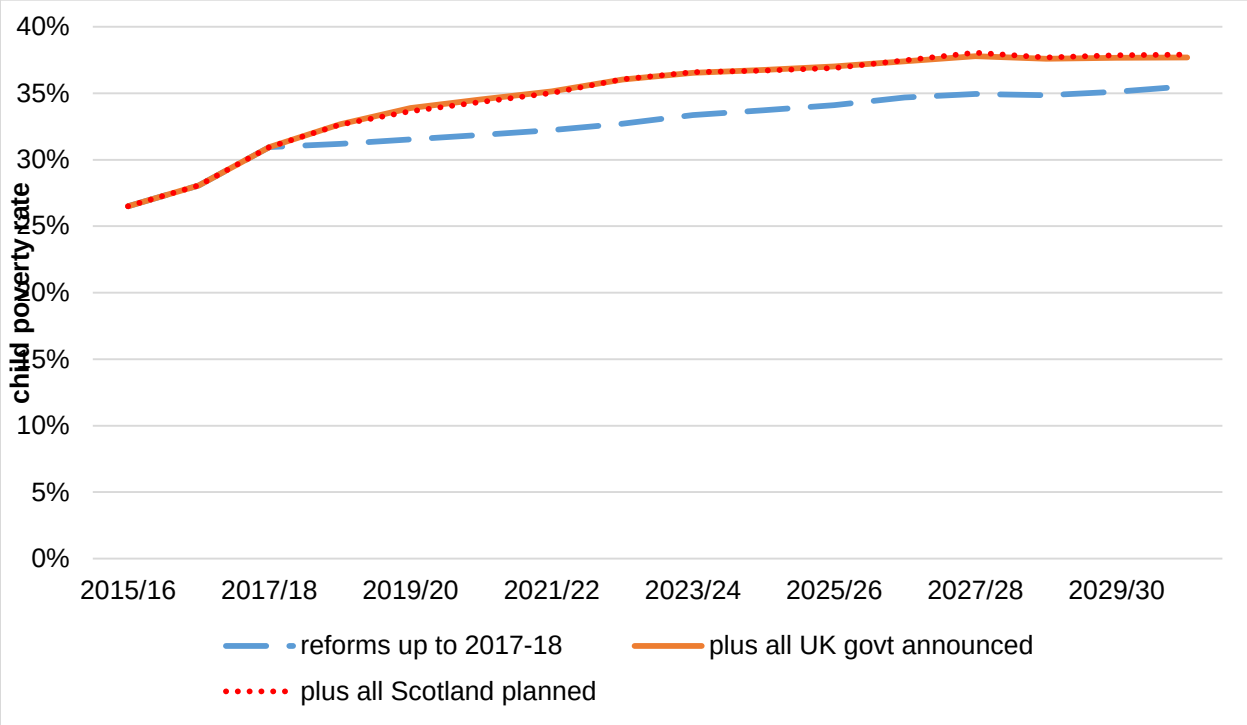
The changes to income tax from 2018/19 onwards affect a much larger proportion of the Scottish population than either the increase in Carers' Allowance or the introduction of the Best Start Grant. However, the maximum gain from the reduction in the rate of income tax to 19% on the first £2,000 of taxable income is £20 per year, or just under 40 pence per week. Even in a household with two earners in the relevant gross income bracket, this is not a large enough sum by itself to result in a statistically significant reduction in child poverty. Meanwhile, the increase of 1% in marginal income tax rates above £24,000 per year gross income results in additional tax payments for people earning above £26,000 per year, but in most cases households with one or more

[19] Analysis of the Scottish Family Resources Survey data for 2015/16 suggests that only around 3 per cent of households with children receive Carers' Allowance.

earners in this income bracket are above the relative (and absolute) poverty lines and so the increase in tax does not have any impact on poverty.

Appendix 3 presents results from an analysis of the number of children in households in the 4-year pooled Scottish FRS sample who move out of, or into, relative AHC poverty as a result of the Scottish reforms. The results show that the number of children moving into or out of poverty is extremely small in any given part of the forecast period.

Figure 3.3. Policy scenario comparison: Child poverty measure 1 (Relative 60% AHC)

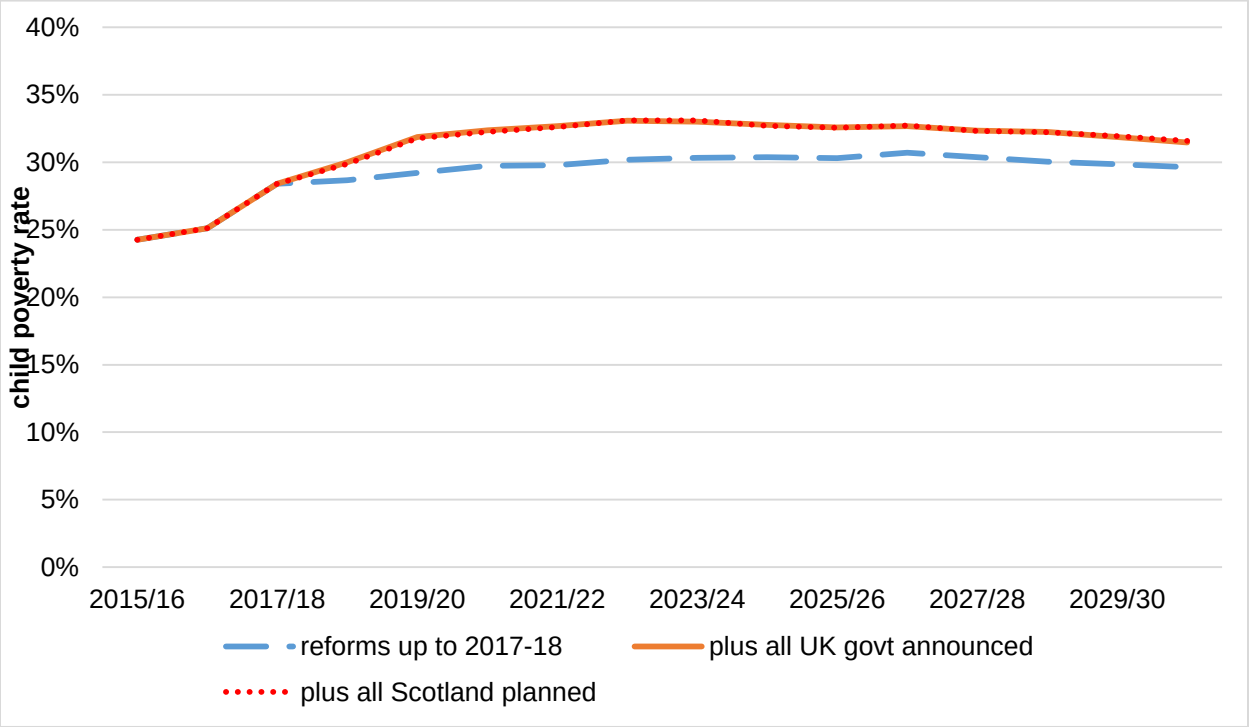


Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Figure 3.4 shows the comparison of policy scenarios for child poverty measure 2 (absolute poverty). Once again, comparing scenarios (a) and (b) shows major differences in the forecast path for child poverty in Scotland. In scenario (a), where the effects of future planned UK Government reforms are not included, absolute child poverty rises fairly slowly, to just over 30 per cent by 2022/23, then begins to fall from 2026/27 onwards. By contrast, in scenario (b) there is a much faster increase in absolute poverty after 2017/18, to 33 per cent by 2022/23. As with the relative poverty measure, the additional impact of the Scottish Government's planned reforms on

absolute child poverty in scenario (c) compared to (b) is very minor; they result in no statistically significant change in child poverty rates over the forecast period.

Figure 3.4. Policy scenario comparison: Child poverty measure 2 (Absolute 60% AHC)

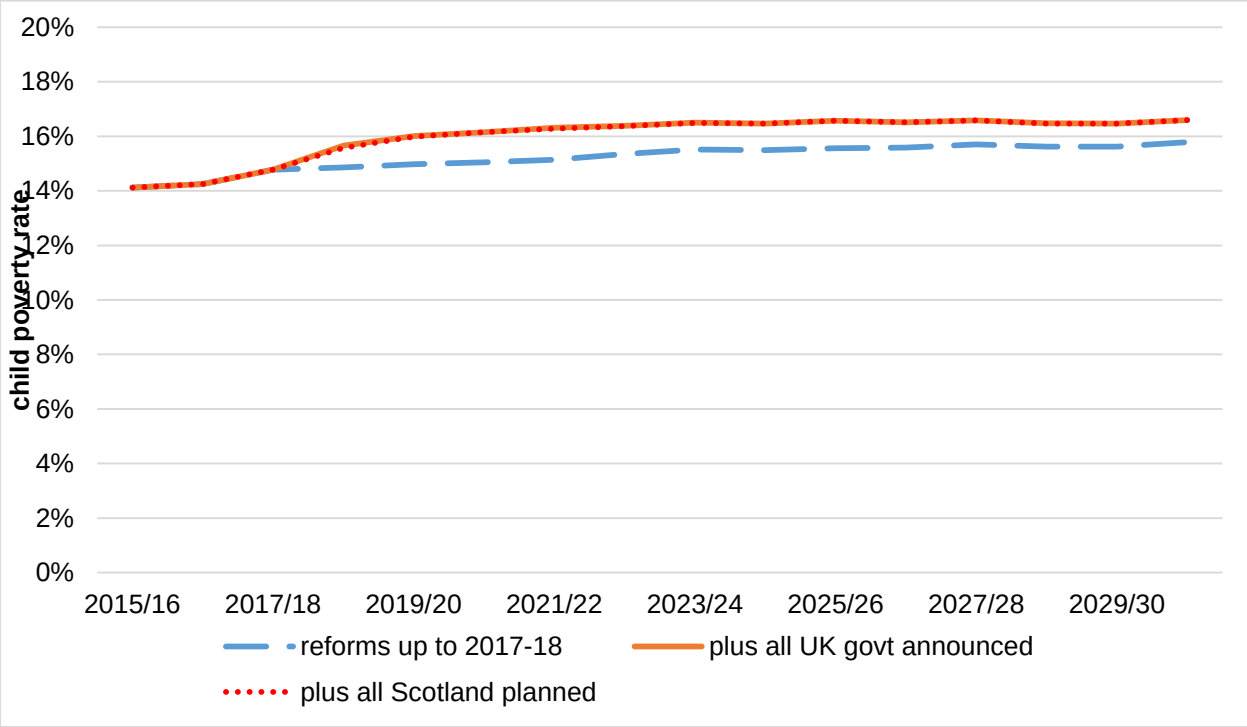


Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Figure 3.5 shows the policy scenario comparison for measure 3 (combined material deprivation and low income). The inclusion of UK Government planned reforms relative to a scenario of no further reforms after 2017-18 (scenario (b) compared to scenario (a)) shows a smaller percentage difference for measure 3 than either measure 1 or 2, but this is not surprising given that measure 3 starts from a lower percentage of children in poverty in 2015/16 (around 14 per cent compared to 24 per cent for measure 2 and 26 per cent for measure 1). A scenario of 'no further reforms' here leads to a gradual increase in the combined material deprivation and low income rate, from just under 15 per cent in 2017/18 to just over 15.5 percent by 2025/26. By comparison, when planned UK Government reforms are included, the poverty rate under measure 3 is around 1 percentage point higher. Including the Scottish Government's planned tax and social

security reforms makes almost no difference to measured child poverty under this measure[20].

Figure 3.5. Policy scenario comparison: Child poverty measure 3 (Combined material deprivation and low income)



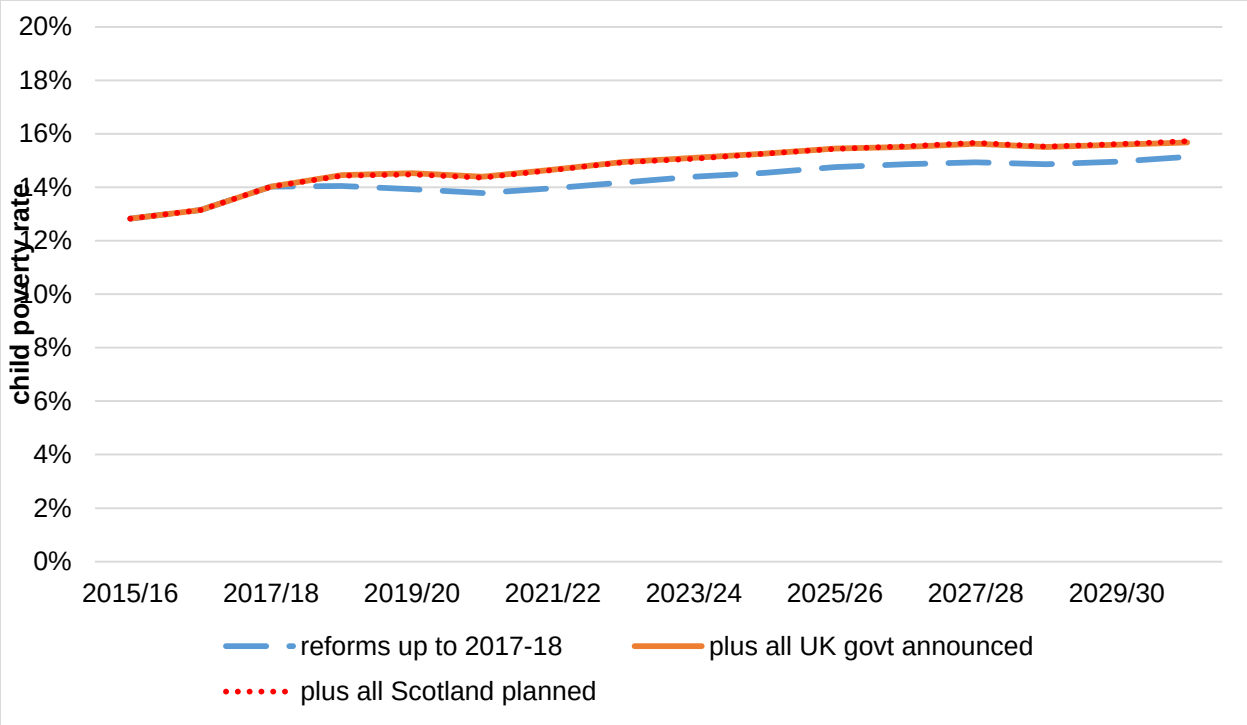
Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Finally in this section, Figure 3.6 shows the comparison of policy scenarios under measure 4 (the persistent poverty measure). Interestingly the planned UK Government reforms make slightly less difference to the child poverty rate using measure 4 than they do using measure 3, at least in the early years of the forecast. The forecast persistent poverty rate rises from 14 per cent in 2017/18 to 15 per cent by 2029/30 in scenario (a), compared to just over 15.5 per cent in scenario (b). This may be because low income in any given year of the FRS is less strongly related to the probability of being in *persistent* poverty (based on the regression coefficients from the Understanding Society data) than

[20] It should be noted that one of the objectives of the Best Start Grant is to incentivise families to spend on certain child-related items, some of which are part of the questions used in the FRS to measure material deprivation. Thus, it is possible that the introduction of the Best Start Grant could result in reduced poverty under Measure 3 due to a decrease in measured material deprivation. The modelling used in this report is unable to capture this effect, however.

it is to the probability of being in material deprivation (based on the coefficients from the FRS regression on the determinants of material deprivation). Comparison of the results for scenario (b) and (c) show that the Scotland-specific reforms to tax and social security have essentially no impact on forecast poverty rates under this measure.

Figure 3.6. Policy scenario comparison: Child poverty measure 4 (persistent poverty)



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16 and regression modelling using Understanding Society data Waves 3 to 6

3.3 Confidence intervals for measures 3 and 4

As explained in Section 2.3 above, the estimates for poverty measures 3 and 4 are subject to greater uncertainty than measures 1 and 2 because material deprivation and persistent poverty cannot be calculated directly using the output from the tax-transfer microsimulation model but have to be estimated using regression predictions based on the net income estimates from the model combined with coefficients from an FRS regression of the likelihood of material deprivation based on observable characteristics (for measure 3) and a USoc regression of the likelihood of persistent poverty based on

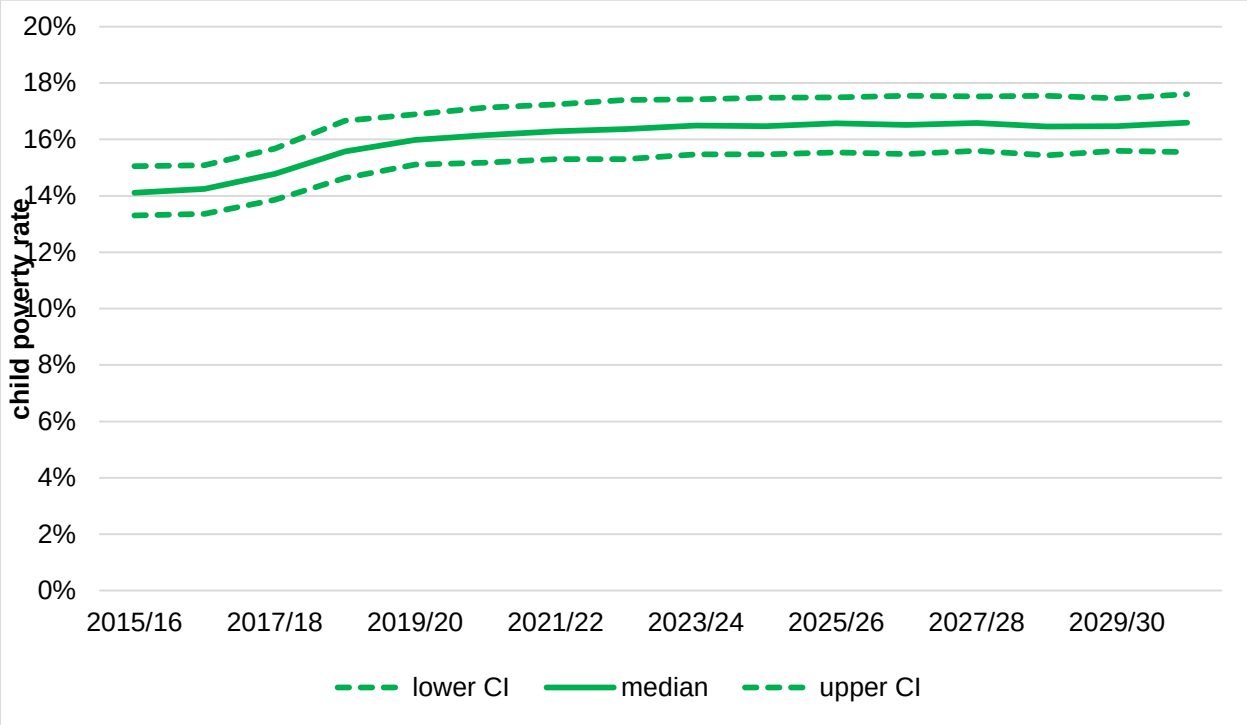
observable characteristics (for measure 4). Each set of regression predictions uses a set of randomly drawn error terms for the FRS data when predicting the likelihood of each FRS household being in material deprivation or persistent poverty. By using a large number of random draws and recalculating poverty measures 3 and 4 for each draw it is possible to build up a distribution of estimated poverty rates for each year.

Figure 3.7 shows the upper and lower 95% confidence intervals[21] for poverty measure 3 based on this repeated random draw process (sometimes known as “Monte Carlo simulation”). Roughly speaking, the upper and lower confidence intervals are around 1 percentage point above and below the central estimate, respectively. Thus, measure 3 is relatively tightly estimated, despite the inherent uncertainty in forecasting material deprivation given that it cannot be modelled directly using standard microsimulation techniques. The forecast increase in the central estimate of combined poverty and material deprivation from around 13.5 per cent in 2015/16 to around 15.5 percent by 2024/25 is statistically significant[22] even taking into account the uncertainties introduced by the estimation procedure.

[21] Intuitively, this means that there is a 95% chance that the true value is somewhere between our upper and lower limits. See Giles (2011) for more detail on this.

[22] The statistical significance of the increase in poverty measure 3 over the forecast period (at the 95% level) arises because the upper confidence interval for 2015/16 is below the lower confidence interval for 2030/31.

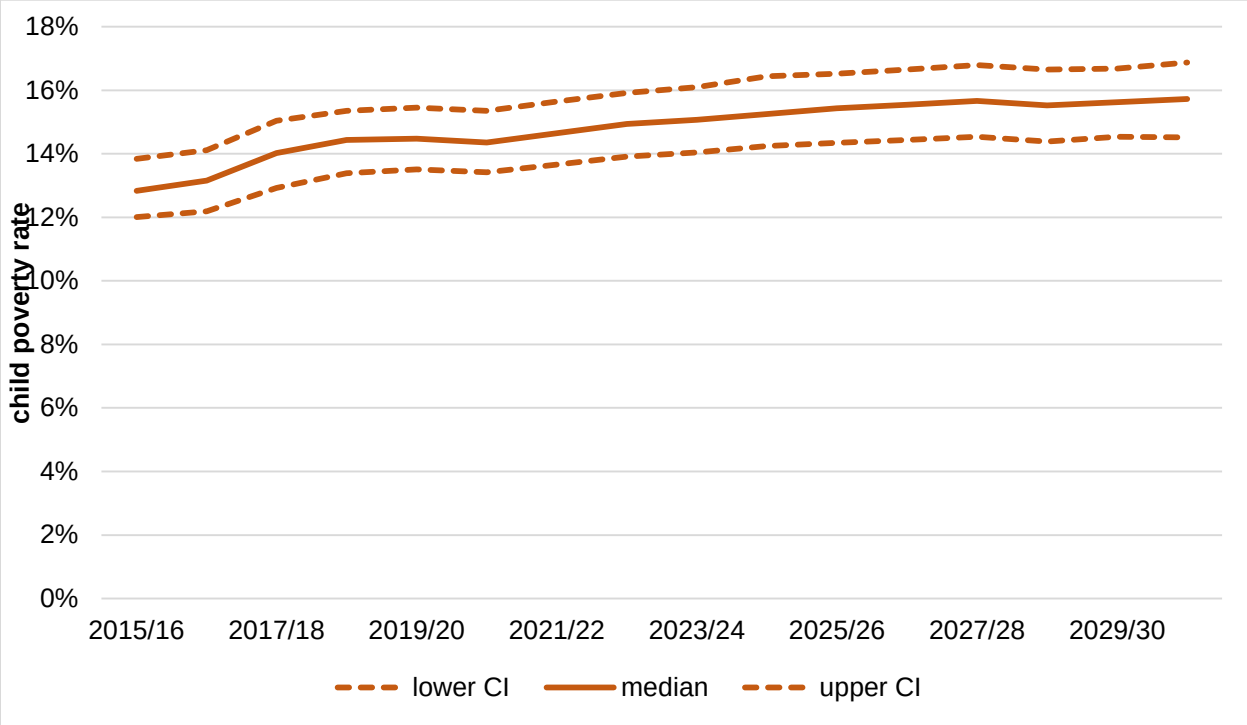
Figure 3.7. Confidence intervals, estimates of poverty measure 3 (combined material deprivation and relative poverty)



Source: Monte Carlo simulations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Figure 3.8 shows upper and lower confidence intervals for poverty measure 4 in the same way. The confidence intervals are slightly wider than for measure 3 on average, perhaps reflecting the additional uncertainty introduced by using two datasets – Understanding Society and the FRS – for the estimate of persistent poverty. However, the increase in measure 4 is still statistically significant even after taking uncertainties based on the regression prediction into account.

Figure 3.8. Confidence intervals, estimates of poverty measure 4 (persistent poverty)



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16 and regression results from Understanding Society Waves 3 to 6

3.4 Child poverty by family composition, number of children and employment status

This section breaks the results for the whole population of Scottish households with children (shown in Section 3.1 above) down into different household types to show trends for lone parent families compared to couples with children, households with different numbers of children, and the number of adults in work in the family (and whether they are in part-time or full-time work).

Lone parents and couples with children

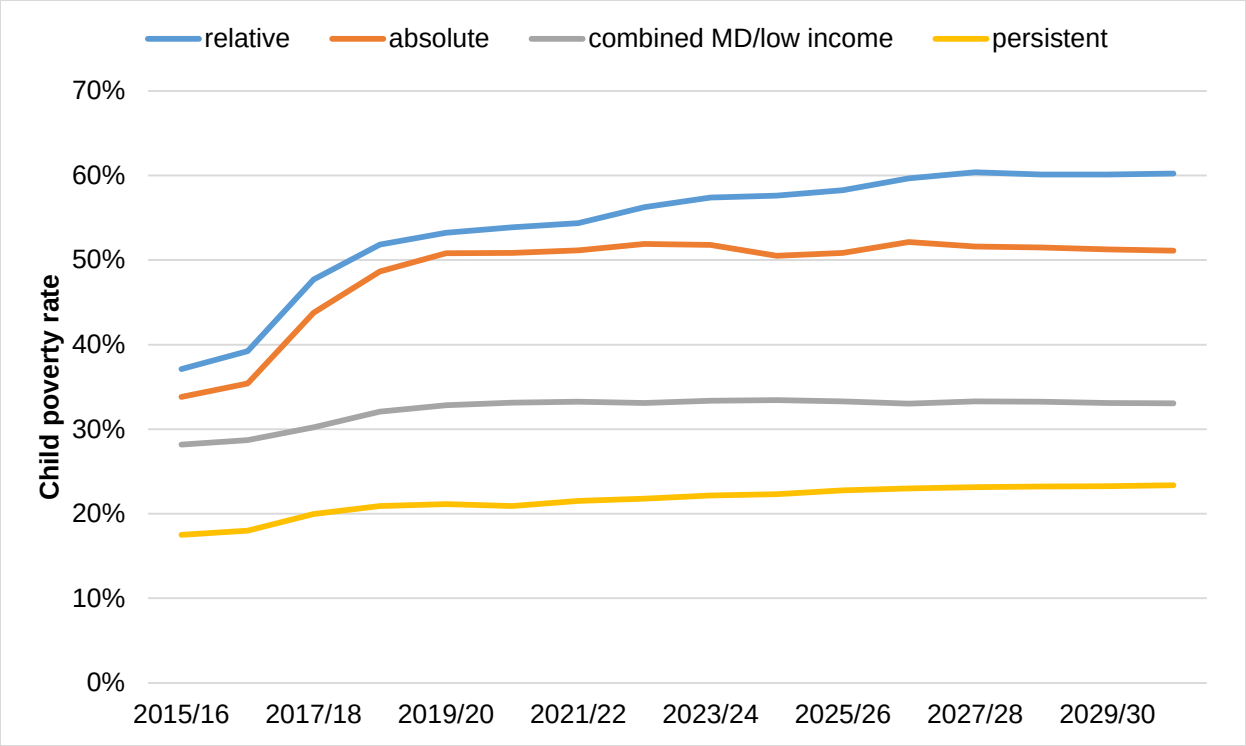
Figure 3.9 shows trends in the four child poverty measures for children in lone parent families, while Figure 3.10 shows the equivalent trends for children in two-parent families. The two Figures are drawn on the same scale to allow an easy comparison of

the results. Figure 3.9 shows very substantial projected increases for lone parents in relative poverty (measure 1) and absolute poverty (measure 2) between 2016/17 and 2021/22. In just one year – 2016/17 to 2017/18 – relative child poverty for lone parents jumps by over 8 percentage points (from just over 39 per cent to just under 48 per cent). Reaching just over 56 per cent by 2022/23, it is then forecast to carry on rising through most of the 2020s before levelling off at around 60 per cent in 202/28. Over the total forecast period relative poverty for lone parents grows by around 23 percentage points, while absolute poverty grows by around 17 percentage points. Absolute poverty for lone parents peaks just above 52 per cent in 2026/27, falling slightly after that. Combined material deprivation and low income poverty and persistent poverty show smaller (but still substantial rises) over the forecast period – the former goes from just over 28 per cent in 2015/16 to around 33.5 per cent by 2023/24, while the latter increases from 17.5 per cent in 2015/16 to around 23.5 per cent by 2030/31.

For children in couple families, the increases in relative and absolute poverty are not as large as for children in lone parent families, although still substantial. Relative poverty increases by just 6 percentage points between 2015/16 and 2023/24, peaking at 29.3 per cent in 2027/28. Absolute poverty increases by just over 5 percentage points to 26 per cent by 2022/23 before falling back under 24 per cent by the end of the forecast period. Interestingly, the increase in poverty under both these measures is smoother for children in couple families, whereas the trends for children in lone parents show a much sharper increase between 2016/17 and 2019/20 – driven by the cuts to social security benefits and tax credits, and the introduction of Universal Credit, over this period.

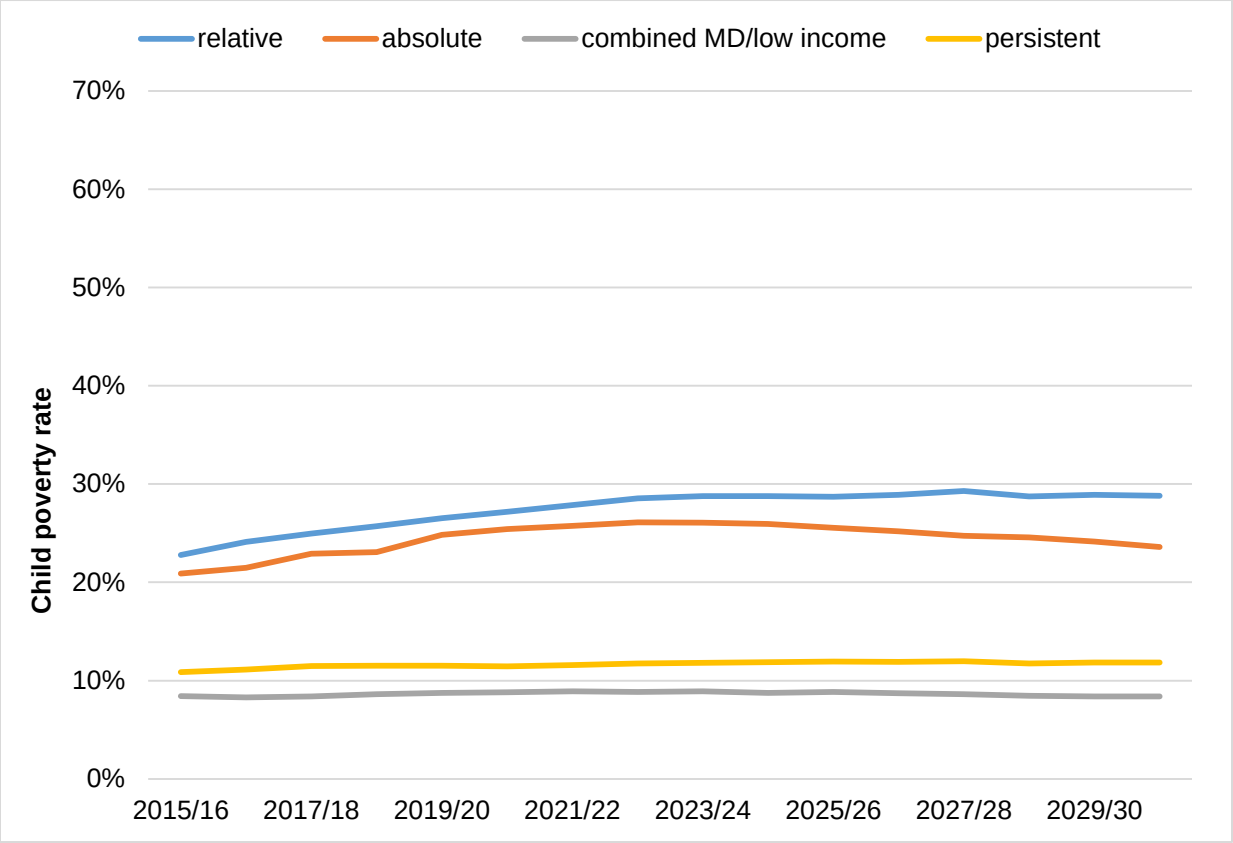
Trends in measure 3 (combined material deprivation and low income) and measure 4 (persistent poverty) show less of an increase for children in couple families than for lone parents. In fact, for measure 3 there is only a slight increase – by half of one percentage point between 2016/17 and 2021/22 – and by 2030/31 poverty on this measure is forecast to return to its level at the start of the forecast period. Persistent poverty is projected to increase by just over one percentage point, reaching 12 percent by 2027/28.

Figure 3.9. Child poverty rate forecasts: lone parent families



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Figure 3.10. Child poverty rate forecasts: couples with children



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

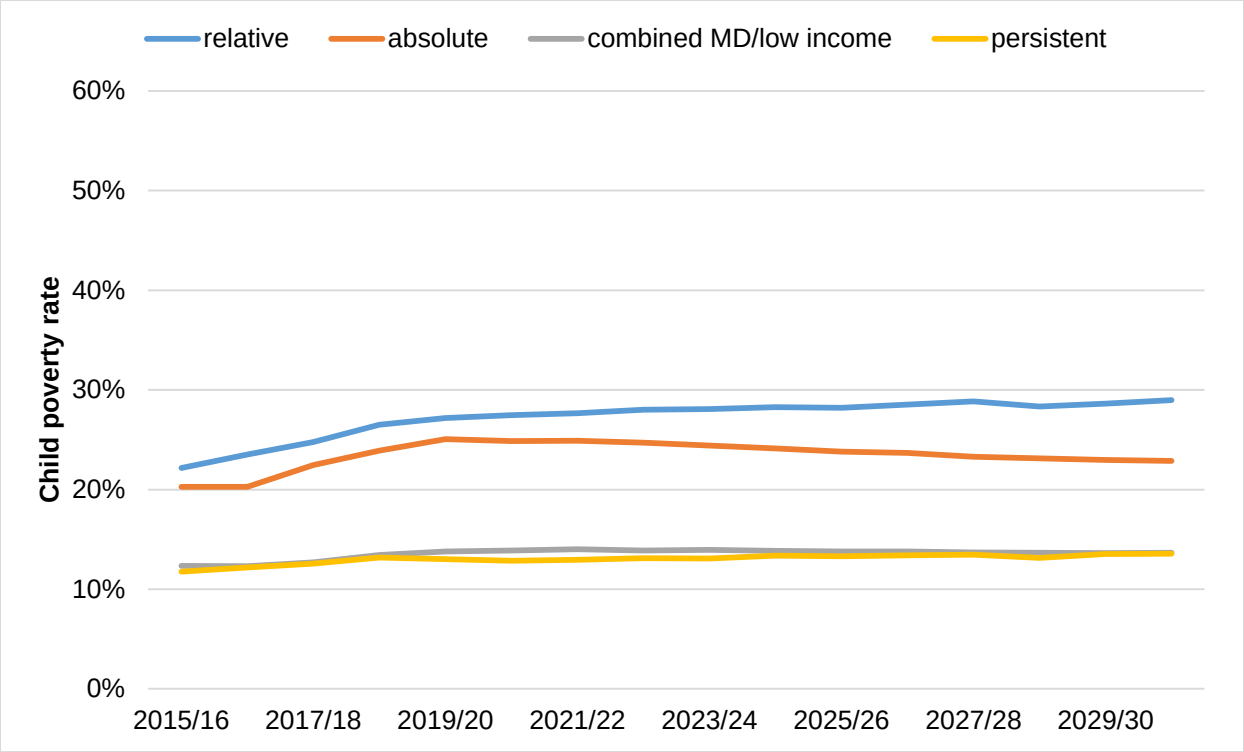
Number of children in household

Figures 3.11, 3.12 and 3.13 show trends in child poverty rates for children in families with one child, two children and three children respectively. The results for children in families with one child and two children show a reasonably similar pattern. Relative poverty increases from around 25 per cent to just under 31 per cent for children in families with one child, and from just over 22 per cent to 29 per cent for children in families with two children, over the forecast period. Meanwhile, absolute poverty rises by 3.5 percentage points before peaking at just under 27 per cent in 2020/21 for children in families with one child, and rises by just under 5 percentage points before peaking at 25 per cent in 2019/20 for children in families with two children. Absolute poverty falls by just over 2 percentage points over the 2020s for both groups. Meanwhile, combined poverty and material deprivation, and persistent poverty, both increase slightly for both groups over the forecast period.

The pattern for children in families with three or more children looks very different, with much more striking increases in poverty on all four measures. Relative poverty is forecast to increase very quickly from 33 per cent in 2015/16 to over 50 percent by 2022/23, with a further increase to 53 percent by 2027/28. Absolute poverty is forecast to increase from around 30 percent in 2015/16 to peak at over 47 percent in 2023/24, falling back only slightly to 46 percent by 2030/31. Combined material deprivation and low income is forecast to rise from around 22.5 percent in 2016/17 to 26 per cent by 2022/23, while persistent poverty is forecast to rise from just under 20 per cent at the start of the forecast period to 28 per cent by 2027/18.

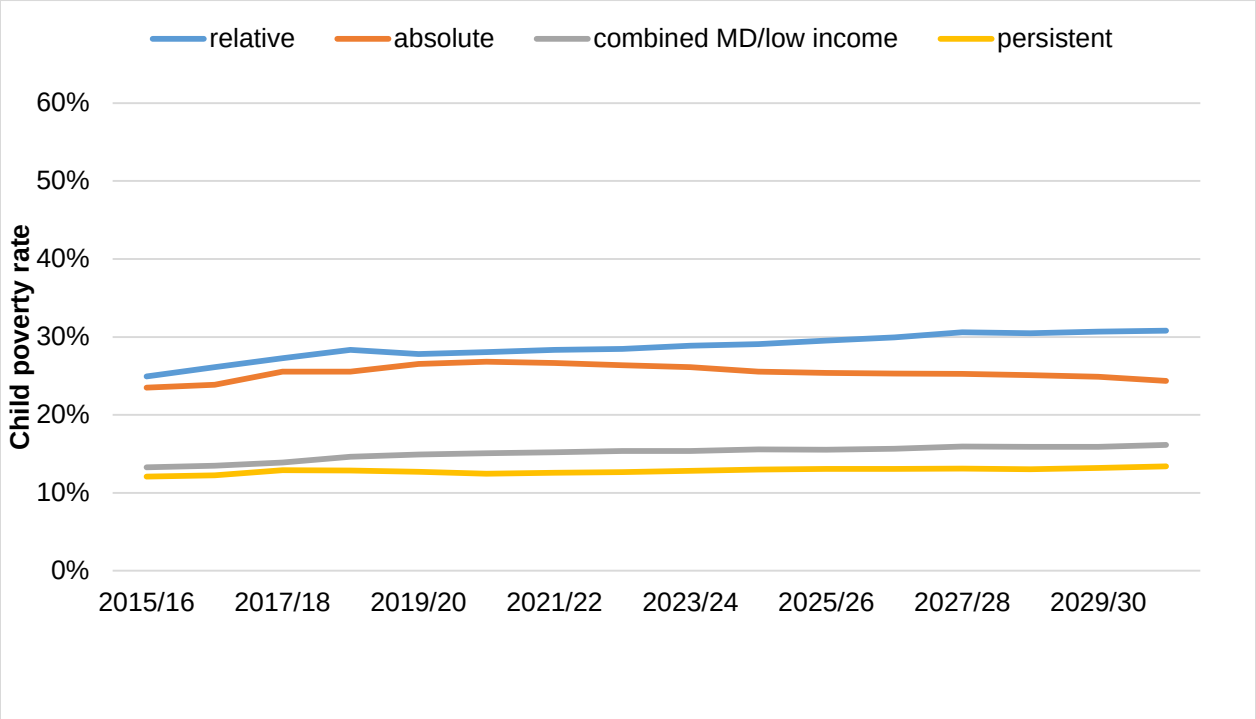
The main reason why child poverty is forecast to rise so much more for children in families with three or more children is because of the social security reforms coming into force from 2016/17 onwards. The restriction of financial assistance in Housing Benefit, tax credits and Universal Credit to the first two children only for new claims – and many existing claims – from 2017 onwards, leads to a substantial fall in net income for families with three or more children, as shown by Reed and Portes (2018). The four-year freeze on uprating for most family social security benefits also has a very substantial impact on larger families who claim larger amounts of means-tested benefits, tax credits and Universal Credit (where rolled out) than families with one or two children on average.

Figure 3.11. Child poverty rate forecasts: families with one child



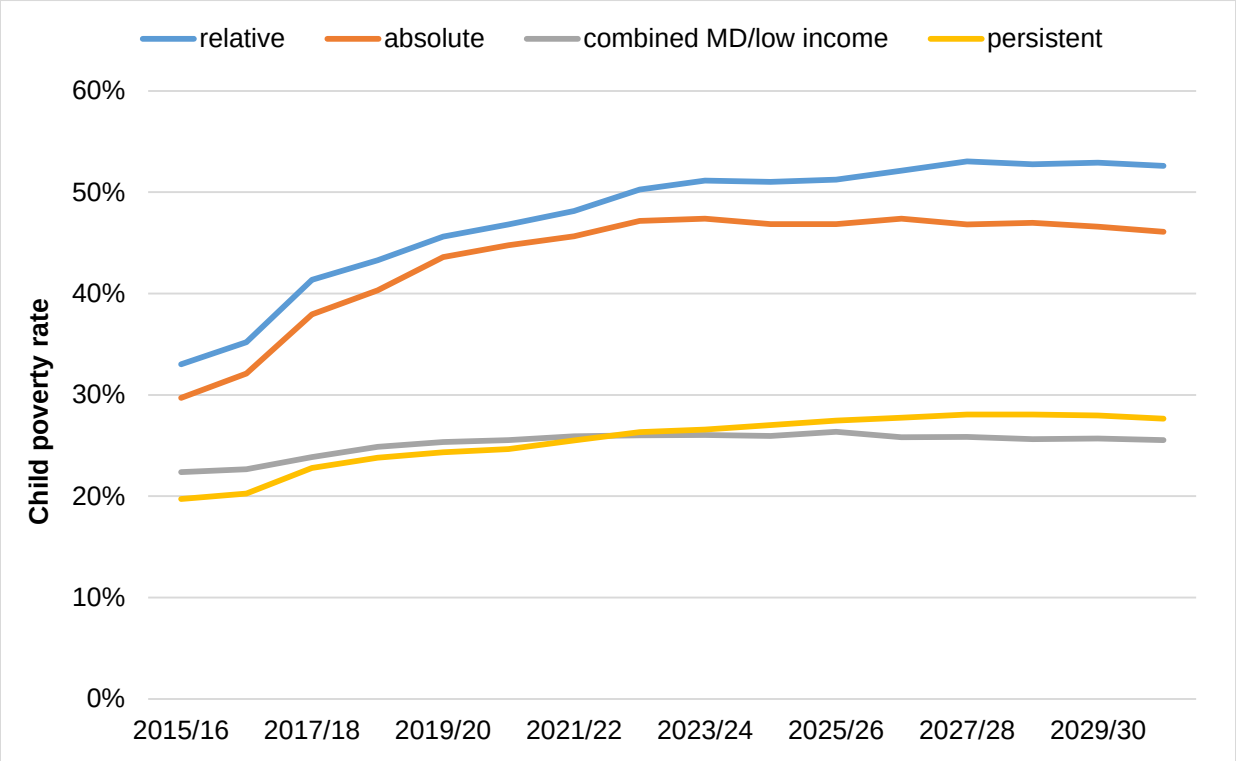
Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Figure 3.12. Child poverty rate forecasts: families with two children



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Figure 3.13. Child poverty rate forecasts: families with three or more children



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Employment Status

Figure 3.14 shows child poverty rate forecasts (for measure 1, the relative AHC poverty rate, only) for families disaggregated by the employment status of the adult(s) in the family. There is a substantial variation both in the measured poverty rates for children in families with different employment status and in the forecast growth of poverty in the years up to 2030/31.

Starting at the top of the Figure, the poverty rate for children in families where no adult is in paid work is already high (at 56 per cent) in 2015/16. Between 2016/17 and 2018/19 in particular, there is a very substantial increase in child poverty for children in this group, up to over 79 per cent by 2018/19 – an increase of 23 percentage points in two years. This is driven by the substantial cuts to social security benefits and tax credits and the introduction of Universal Credit which is rolled out by 2018/19 under our default assumptions. After 2018/19, child poverty for children in households where no adult is in paid work continues to increase (albeit more slowly), reaching over 91 per cent by 2027/28. This is a striking result – by the late 2020s, over nine in every ten

children in families where no adult is in paid work is forecast to be in relative poverty, compared with just over half in 2015/16.

The blue line shows trends in child poverty for children in families where there is no adult in full-time paid work , but one or two adults in part-time paid work. Many of these families are lone parent families with the lone parent in part-time paid work. In 2015/16 the relative child poverty rate for children in this group is just over 39 per cent. The rate rises to 46 per cent by 2017/18 and then more slowly over the rest of the forecast period, reaching 57 per cent by 2028/29.

The yellow line shows child poverty for children in couple families where one partner is working full time and the other partner is not in paid work. Child poverty for children in this group initially rises from just over 29 per cent in 2015/16 to 36 per cent in 2017/18 before falling back to 31 per cent in 2018/19 (a fall which seems to be related to the roll-out of Universal Credit, which is relatively generous for low-income single earner families[23]). However, poverty then rises relatively steeply for children in this group from 2019/20 onwards, reaching 48 per cent by 2030/31.

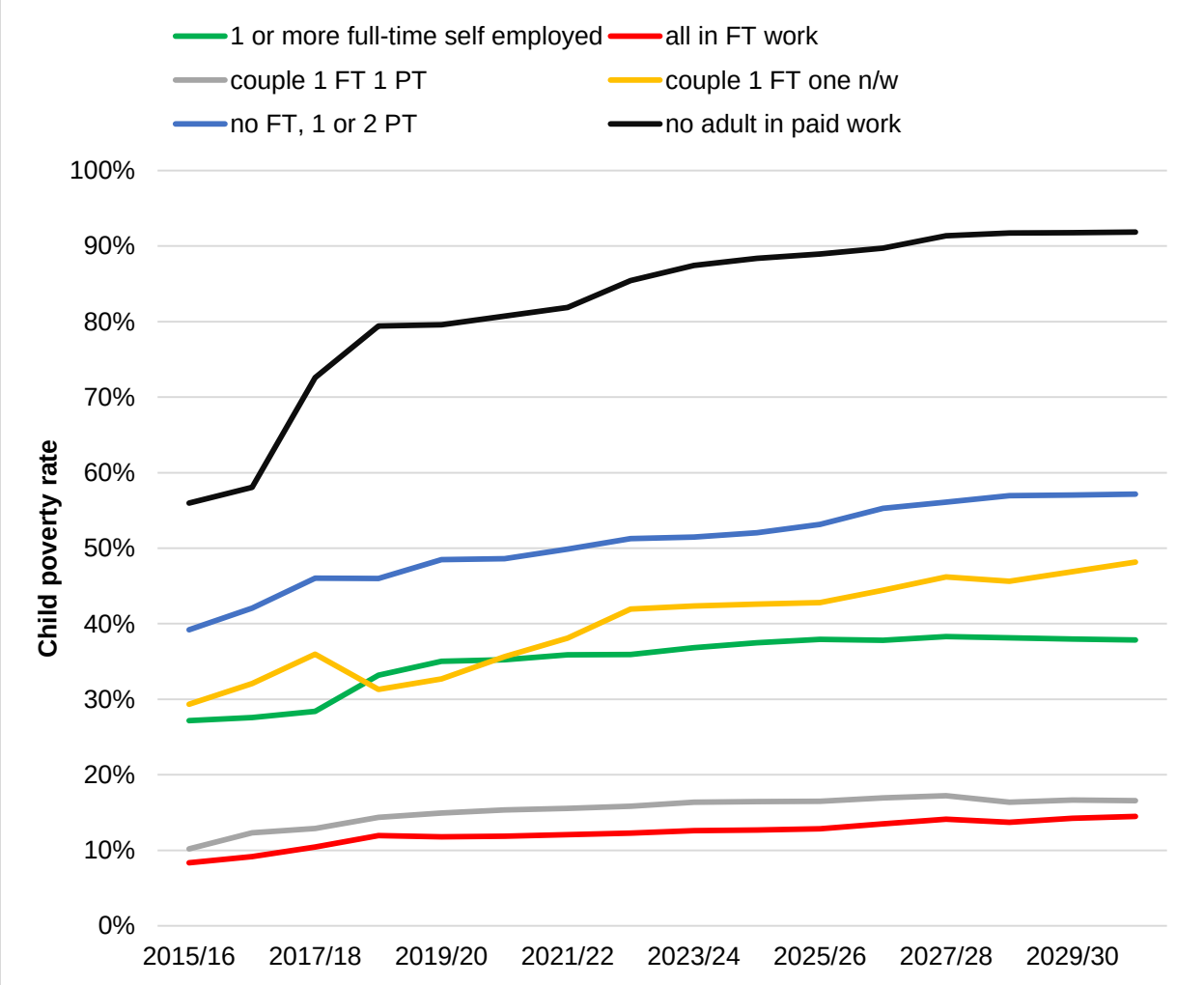
The green line shows relative poverty for children in families where one or more of the adults is full-time self-employed. Poverty for this group is just over 28 per cent in 2017/18, with a substantial jump in forecast child poverty to 33 per cent in 2018/19 followed by a shallower increase over the 2020s, reaching 38 per cent by 2027/28. The jump in forecast child poverty between 2017/18 and 2018/19 for this group appears to be caused by the introduction of Universal Credit, which is considerably less generous for low-income self-employed people due to the “minimum income floor” used in the income assessment, which treats most self-employed people as having gross earnings equivalent to 30 hours’ work per week at the minimum wage even if their earnings are less than this (Dellot, 2017).

Finally, trends in relative child poverty for couples with one adult in full-time paid work and one in part-time paid work (the grey line) and families where all the adults are in full-time paid work (the red line) look similar. There is a rise in forecast child poverty of around 6 percentage points for children in families where all adults work full-time and 7 percentage points for children in couples with one adult working part-time and one full-time. The rise in child poverty for these groups is relatively smooth, and they have the lowest forecast increase (in percentage points) of any of the groups analysed by employment status in this graph. To a large extent this reflects the fact that families in this group are less reliant on social security benefits, tax credits and Universal Credit than any of the other groups. Also, with a relatively high proportion of their net income from earnings, they are able largely to keep pace with upward trends in the relative

[23] Reed and Portes (2018), Chapter 9, shows that the roll-out of Universal Credit leads to an average gain for one-earner couples with children compared to the previous benefit and tax credit system which UC replaces.

poverty line (as a result of forecast real earnings growth over the 2020s) and so poverty is not forecast to increase that much for these groups.

Figure 3.14. Child poverty rate forecasts: families by employment status



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

3.5 Robustness analysis

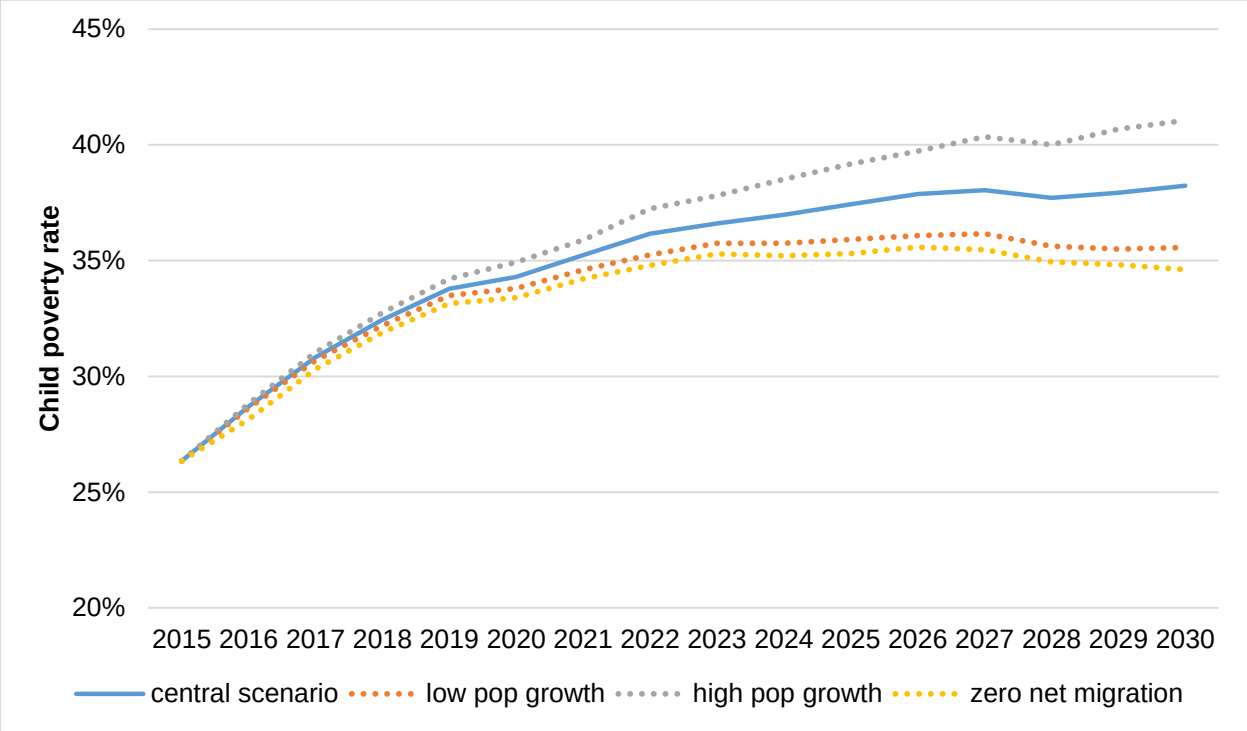
This section presents the results of our robustness analysis of the results in this report. We vary some of the key parameters in the simulations and show how these variations affect the headline poverty results. The results in this section refer to child poverty measure 1 (relative poverty); we also present results in Appendix 4 for child poverty measure 2 (absolute poverty).

Varying population growth assumptions

Figure 3.15 presents our headline poverty forecast (as shown in Figure 3.1 above) under the heading ‘central scenario’. The green dotted line ‘low pop growth’ shows the impact on the forecast poverty rate of using population forecasts from the Scottish Government which use lower projections for fertility, life expectancy and migration, whereas the red dotted ‘high pop’ growth line uses higher projections for fertility, life expectancy and migration. Meanwhile, the yellow dotted ‘zero net migration’ line uses a forecast where fertility and life expectancy are in line with the central scenario but net migration is set to zero.

The results show that higher population growth leads to an increase in the forecast poverty rate, with the gap between the central scenario and the high population scenario increasing in later forecast years. By 2030/31 forecast poverty is estimated to be around 3 percentage points higher in the high population scenario than in the central scenario. For the low population growth scenario, the effects go in the other direction, with forecast child poverty growth being lower. By 2030/31, poverty is forecast to be around 3 percentage points lower in the low population growth scenario than the central scenario. The impact of assuming zero net migration, with no other changes to the central scenario population forecast, is that child poverty is forecast to be slightly lower than in the low population growth scenario (around another 1 percentage point lower).

Figure 3.15. Impact of different population growth assumptions on child poverty measure 1



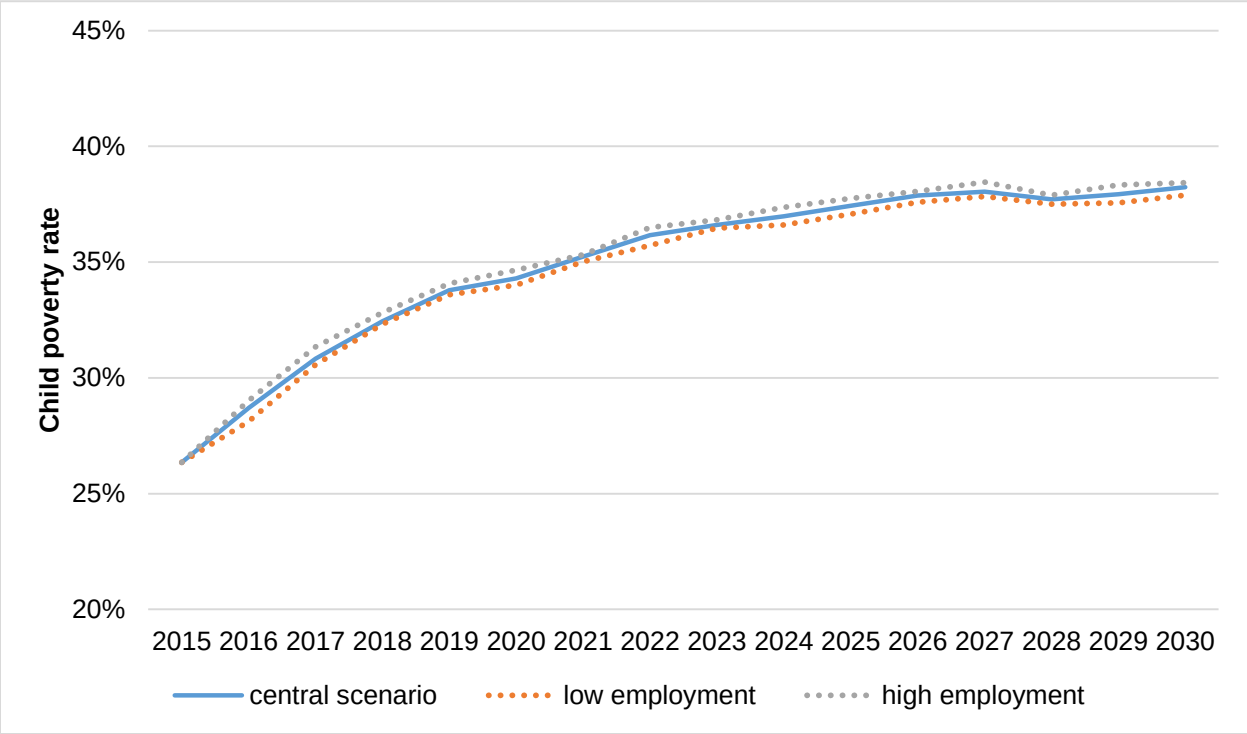
Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Varying employment growth assumptions

Figure 3.16 shows the impact of assuming that employment growth in the Scottish economy will be higher or lower than in the central forecast. The green dotted line labelled 'high employment' shows results for a scenario where employment is 10% higher than in the central scenario with all other simulation parameters unchanged, while the red dotted line labelled 'low employment' shows results for a scenario where employment is 10% lower than in the central scenario. The results show that varying the employment rate has only a minor impact on measured poverty rates; the effect is a maximum of about 0.5 percentage points in either direction. It should be noted that these forecasts assume that the composition of additional employment (in terms of the demographic characteristics of the additional people entering employment in the high employment scenario, or leaving employment in the low employment scenario) is similar to the overall profile of employment in the Scottish economy. Varying this assumption might lead to larger shifts in child poverty as a result of increased or decreased employment (for example, research by Reed and Portes, 2014, for the Social Mobility and Child Poverty Commission found that forecasts of the UK child poverty rate in 2020

were fairly sensitive to assumptions about increased employment for subgroups of the household population with relatively high child poverty rates, such as lone parents).

Figure 3.16. Impact of different employment growth assumptions on child poverty measure 1



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

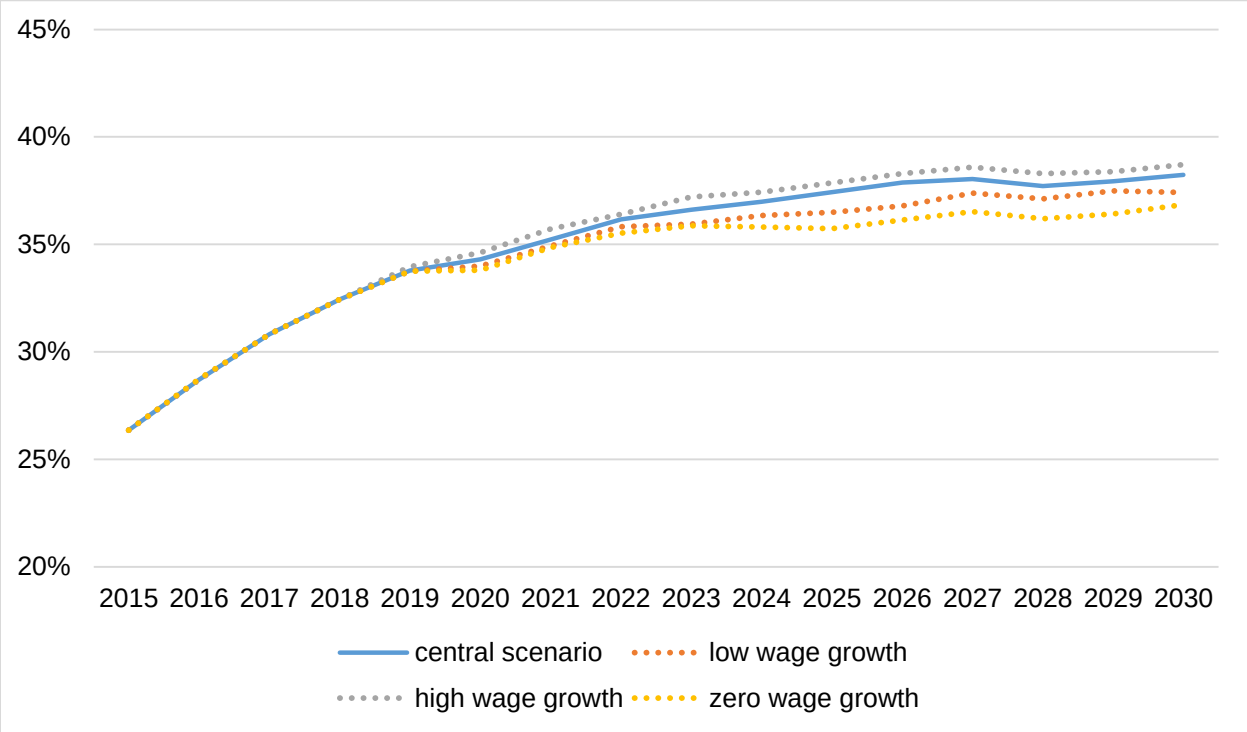
Varying wage growth assumptions

Figure 3.17 shows the impact of assuming higher or wages across the UK economy (including Scotland) compared to the central scenario. The green dotted line labelled 'high wage growth' shows results for a scenario where wage growth is 0.5 percentage points per year above the central forecast, while the red dotted line 'low wage growth' shows results for a scenario where wage growth is 0.5 percentage points per year below the central forecast. The yellow dotted line 'zero wage growth' shows a scenario where there is no average wage growth (in real terms) for the rest of the forecast period after 2017-18.

Figure 3.17 shows that assuming lower wage growth leads to a *decrease* in forecast child poverty while assuming higher wage growth leads to an increase. This is a well-

known finding from previous analysis of child poverty statistics; given that social security benefits and tax credits normally increase in line with price inflation (although at the moment most working-age social security uprating is frozen until 2020-21), higher real wage growth tends to increase the relative poverty line relative to the value of means-tested benefits and tax credits, pushing more households with children into poverty. Figure 3.17 shows that in the 'high wage growth' scenario, measured child poverty is just under 1 percentage point higher by 2030/31 than in the central scenario, whereas in the 'low wage growth' scenario measured child poverty is around 1 percentage point lower than in the central scenario. In the 'zero real wage growth' scenario, measured child poverty by 2030/31 is around 2 percentage points lower than the central scenario.

Figure 3.17. Impact of different wage growth assumptions on child poverty measure 1



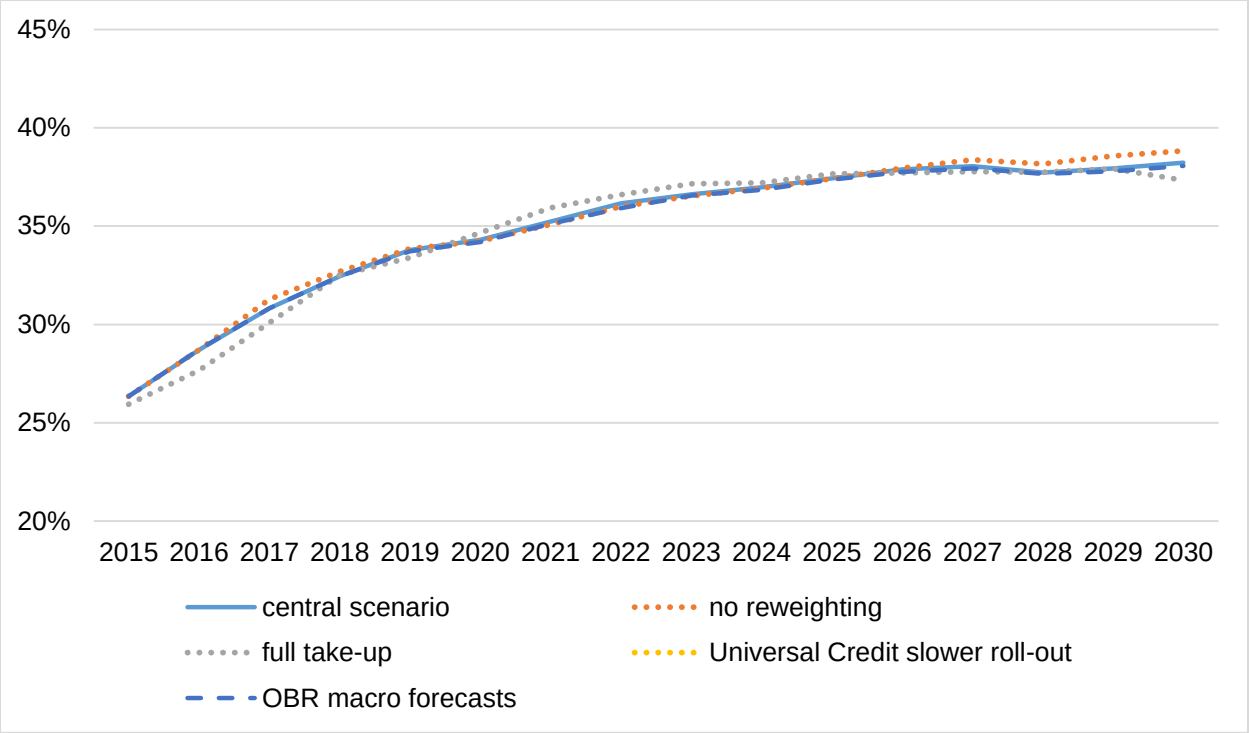
Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Other robustness checks

Figure 3.18 shows the impact of a range of other variant scenarios that we ran as robustness checks on the main results, which did not fit into any of the categories above. To summarise the main findings:

- When **no reweighting** is used on the FRS sample from 2016/17 onwards (i.e. stripping out all the effects of forecast demographic and employment changes) there is very little change to the poverty rate until the final five years of the forecast, where forecast poverty is slightly higher than the central scenario (about 1 percentage point by 2030/31.
- Assuming **full take-up of means-tested benefits, tax credits and Universal Credit** leads to a slightly higher forecast increase in measured child poverty between 2015/16 and 2023/24 but then a slower rate of increase in subsequent years.
- Assuming a **slower roll-out of Universal Credit** (over four years between 2017/18 and 2020/21) makes almost no difference to forecast poverty rates.
- Using the **OBR macro forecast for Scotland as well as the rest of the UK** makes almost no difference to forecast poverty rates.

Figure 3.18. Impact of other robustness checks on child poverty measure 1



Source: calculations based on outputs from tax-transfer model using FRS pooled dataset 2012/13 to 2015/16

Comparison with IFS findings

This section presents a comparison of our headline estimates of the child poverty rate with recent simulation results published by the Institute for Fiscal Studies (Hood and Waters 2017). The IFS study forecast poverty rates for the whole UK but also provided a regional breakdown. The IFS reports poverty rates averaged over the years 2019-21. We have compared these with our averaged forecasts from the same time period for Measure 1 (relative poverty) and Measure 2 (absolute poverty)[24]. The results show that our estimated poverty rates for 2019-21 are somewhat higher than the IFS estimates; around 4.5 percentage points higher for measure 1 and over 6 percentage points for measure 2. There are several possible reasons for the discrepancy between the two sets of forecasts:

- The roll-out of Universal Credit is generally assumed to increase take-up as a share of total possible expenditure on social security relative to the 'legacy'

[24] The IFS study does not present forecasts for combined material deprivation and relative poverty, or for persistent poverty.

benefits and tax credits which it replaces, because it is a single payment which replaces a range of benefits and tax credits and the FRS data shows that many households who are entitled to (for example) tax credits and Housing Benefit under the legacy system claim only one or the other, whereas by claiming Universal Credit they become eligible for a single payment which replaces both. However, we make a downward adjustment to Universal Credit take-up of around five percentage points (as a proportion of eligible claimants) to reflect recent data showing that the rate of sanctioning for UC claimants is higher than for the benefits which preceded it (Webster, 2017). This results in an increase in the forecast poverty rate for 2018/19 and subsequent years in our analysis.

- There may be other differences in the algorithms which the IFS's TAXBEN model uses to model aspects of the tax and social security system and the algorithms used in our TTM model. In correspondence with the IFS authors we were unable to identify any really major discrepancies between the two models, although we lacked the time or funding for a detailed comparison at the level of underlying programming code.
- Because the IFS study only forecast poverty forward to 2020/21 whereas our study produces forecasts to 2030/31, IFS were able to use a more complex set of weights than we have used, including regional household projections, the number of people aged 65 or over with private pensions, and employment rates by 10 year age brackets, for men and women. However, re-estimating our child poverty measures using a more complex set of "IFS-style" weights up to 2020/21 produced very little change in our headline forecasts.
- The particularly large discrepancy for the absolute poverty measure may be partially explained by the fact that we used the November 2017 forecasts from the Office for Budget Responsibility for the macroeconomic variables (for countries other than Scotland) whereas IFS used the March 2017 OBR forecasts (because the November 2017 forecasts had not come out at the time their research was completed). In the November 2017 OBR forecasts (and the December 2017 Scottish Fiscal Commission forecasts which we use for Scotland) projected growth in real wages is significantly lower than in the March 2017 OBR forecasts. This means that absolute poverty for households with at least one person in paid employment is higher using the November and December 2017 forecasts than the March 2017 forecast.

Table 3.1. Comparison of our 2019-21 estimates with recent IFS estimates

	Child poverty rate (%)	
Study	Measure 1 (relative)	Measure 2 (absolute)
Hood and Waters (2017)	29.0	25.0
Our results	33.5	31.3
Discrepancy (ppts)	4.5	6.3

Summary of results of robustness analysis

Our analysis of the robustness of the headline results in this report suggests that varying most of the parameters for the analysis – wages, overall employment rates, the speed of roll-out of Universal Credit and the use of OBR or SFC forecast variables – makes only a minor difference to the results. The only parameter tested here which does make a more substantial difference to the forecast poverty measures is the population projections. As discussed in the Section 1.x, this may reflect the heightened uncertainty over key population parameters in the wake of the EU referendum vote in 2016. However, even in this case, our key finding of a substantial increase in relative and absolute child poverty remains robust to different assumptions on population growth.

As documented in the DWP's *Households Below Average Income* and the Scottish Government's *Poverty and Inequality in Scotland* publications, the equivalised household disposable income distribution is particularly dense around the relative and absolute poverty lines, and minor differences in methodology can make a substantial difference to forecast poverty rates. This is shown in the comparison between our results and the IFS results. A more in-depth analysis of the reasons why we forecast a bigger increase in child poverty in Scotland than the IFS would be a useful subject for future research.

Chapter 4. Conclusions

This project has produced forecasts for the four poverty measures contained in the Child Poverty (Scotland) Act, for a fifteen-year period starting in 2016/17 (the year following the most recent year of FRS data currently available) and 2030/31. The headline results from the analysis are striking. Relative AHC child poverty in Scotland (poverty measure 1) is forecast to rise from 26.5 per cent in 2015/16 to 34.5 per cent by 2020/21, a rise of 9 percentage points. A rise of this magnitude in such a short space of time would be without historical precedent since 1994/95 (the first year for which data from the Family Resources Survey are available). For the most part, the forecast increase in poverty is driven by the substantial cuts to social security for families with children legislated for in the previous UK Government's July 2015 Budget – in particular the four-year freeze on social security uprating and the two-child limit for Housing Benefit, tax credit and Universal Credit claims. In the 2020s, relative child poverty is forecast to continue to increase, albeit at a slower rate, reaching around 38 per cent by 2027/28.

Absolute child poverty (measure 2) also rises sharply in the early years of the forecast, from just over 25 per cent in 2016/17 to just under 33 percent in 2021/22 before falling slightly over the rest of the 2020s. Combined material deprivation and relative income poverty (measure 3) and persistent income poverty (measure 4) also rise in the early years of the forecast, but to a more limited extent – from 14 per cent in 2016/17 to 16 per cent in 2019/20 for measure 3, and from just under 13 per cent in 2015/16 to 15.5 per cent in 2026/27 for measure 4.

Whereas the policies enacted by the UK government after 2017/18 – including the remaining years of the working age social security uprating freeze and the roll-out of Universal Credit – are forecast to increase child poverty significantly under all four poverty measures (but especially measures 1 and 2), the reforms to tax and social security introduced by the Scottish Government do not have a statistically significant impact on child poverty.

Our analysis of the robustness of the headline results in this report suggests that varying most of the parameters for the analysis – wages, overall employment rates, the speed of roll-out of Universal Credit and the use of OBR or SFC forecast variables – makes only a minor difference to the results. Varying the population growth assumptions makes a somewhat bigger difference to the results but does not alter the key finding of a substantial increase in relative and absolute child poverty between 2015/16 and 2020/21.

The fact that the Scottish Government's planned increase in Carers' Allowance and the introduction of the Best Start Grant do not have a significant impact on poverty rates does not mean, in any sense, that the reforms are ill-advised. On the contrary, there are good policy rationales for both reforms. Rather, the conclusion should be that the impact

of a policy on a particular child poverty measure, or measures, is only one aspect of policy evaluation, and in many cases it may not be the most important aspect. Other measures – such as distributional impacts on eligible recipients of a particular benefit – may be more appropriate. This is particularly important for a benefit such as Carers' Allowance, where the number of recipients as a proportion of households with children in Scotland is very small (around 3 per cent).

Looking at the changes to Scottish income tax, much of the rationale for these is to provide badly-needed additional funding for public services in the face of real-terms cuts to the UK Government's budget allocation for Scotland. The changes to rates have been made in such a way as to provide a small reduction in income tax payments for taxpayers on low-to-middle incomes while raising more from those earning over £26,000 per year. However, the policy was not designed as a means of reducing child poverty *per se*. One limitation of the child poverty measures featured in this report is that they do not take account of benefits-in-kind to families from improved funding for public services.

Finally, the results of breaking down our child poverty projections to look at subsamples of the population show particularly large forecast increases in child poverty for lone parents, families with three or more children and families with no adults in paid work. As with the overall headline results, these large forecast increases for particular subgroups of the population are largely a consequence of reductions in social security entitlements.

In order to reverse these trends in child poverty by 2030/31 and hit the child poverty targets in the Child Poverty (Scotland) Act, it will be necessary either to increase support for low-income families through the social security system substantially, or to find another mechanism for increasing net income for families in poverty (e.g. higher earnings and employment (Reed and Portes, 2014), or some other source of financial assistance such as a Citizens Income scheme (Reed and Lansley, 2014). Certainly, the forecasts contained in this report suggest that the child poverty targets are challenging.

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Appendix 1. Reweighting the Family Resources Survey: Sources and Methods

Our modelling uses data from the Family Resources Survey (FRS) (DWP 2017a) and (for child poverty measure 4) Understanding Society (USoc) (Social and Economic Research 2018). An important task for this project is to take these datasets and adjust them so that they better resemble forecasts of what the population will look like in future years.

There are three techniques we can use in producing the forecast datasets:

1. *re-weighting*. In most microsimulation work, some units (households, family units or individuals) are given a higher weight in final outputs than others. The typical starting point for a single-period model is to use weights that are inversely related to the probability of selecting the individual in a random sample, with some adjustment for non-response. In our case, we go further, using weights to simulate the populations in future years. If we believe there will be more pensioners 10 years from now, for example, we can capture this by giving each pensioner in the dataset a higher weighting for that year;
2. *uprating*. If we expect incomes or housing costs to rise, we increase the values recorded for these things in the dataset;
3. *artificial ageing*. An alternative technique to reweighting is to progressively rewrite the data: for each simulated year, you increment the ages of the individuals in the dataset, and then impute a new state by applying statistical models giving the probability of events such as death, illness, unemployment, etc. Artificial ageing is most useful when we want to track individuals or households over many years, for example to model pension contributions or cumulative payments for social care. However, the technique is hard to implement and extremely data-intensive, requiring modelling of such varied items as spells of employment, childbirth, education choices, improvement and deterioration of health and much else; each these could be a major research project in itself. Given the inherent difficulties in this technique we decided not to use it in this project, and we are not aware of any other UK-based poverty forecasting research which has used it.

Our forecasting therefore uses a combination of weighting and uprating. However, both weighting and uprating still pose considerable challenges, which we now turn to.

Reweighting

There are well-established techniques for reweighting micro datasets.[25] If we wish to reweight to match just one characteristic, for example age, we can just weight by the target population totals divided by the sample totals; for example, if we expect there to be 100,000 five-year olds in 2030, and there are 100 five-year-olds in the data, we can weight each sample unit by 1,000. For this project, however, we want to capture a population evolving in multiple dimensions; for example the current HBAI grossing regime for Great Britain as specifies private household population by region, age and sex, number of benefit units with children, number of lone parents, households by tenure type, households by council tax band and number of households containing "very rich" people (DWP 2014).

Reweighting for multiple characteristics involves finding a set of weights that allow the weighted sample to sum to all the target totals, with the weights being as close to uniform as possible, on some measure of closeness. (Creedy 2003).

Forecast Data Sources

The Scottish and UK Government produce forecasts of population, employment, numbers of households, and the wider economy. These are used in planning housing, education, transport and much else. It is important that our forecasts are are as far as possible consistent with the official ones. This is not absolutely straightforward, however: creating a forecast dataset that is sufficiently rich requires merging together data from different sources, produced at different dates, and additional data processing is needed to make everything internally consistent. Further, since we can only use things that are officially forecast, our set of population targets are necessarily somewhat less rich than would be possible when weighting to hit current targets, as in the HBAI exercise. We also need UK-wide forecasts since our poverty lines are calculated for the whole UK.

Our final set of forecasts run annually[26] from 2017 to 2038, and has data on

- population (by age and sex);
- household composition; and
- employment and unemployment.

See the final section of this appendix for the full list.

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[25] See (Creedy 2003) for a very good, largely non-technical discussion of the techniques involved, (Creedy and Tuckwell 2003) for a discussion of an application similar to ours, and (Deville and Sarndal 1992) for the statistical background.

[26] consistent with the Child Poverty bill, we use financial years (April-March) throughout. Our forecasts for population and household composition, however, use calendar years, which we interpolate. The differences are minor, however.

Population Forecasts

Projections of the Scottish Population are available from National Records for Scotland (NRS) (NRS 2017), and for the UK from the Office for National Statistics (ONS) (ONS 2017). We use the latest 2016-based projections, since these are used in the Scottish Fiscal Commission's macroeconomic forecast (Commission 2018).

As we discussed in section 1, NRS and ONS produce population forecasts on a variety of assumptions - high fertility, low migration, as well as some variants that attempt to capture various post-Brexit scenarios[27]. We have constructed sets of weights consistent with all of them.

Household Composition

Household composition is also important. In particular, there is a strong association between single parenthood and poverty[28]. NRS produces projections for household composition (Scotland 2017). However, at the time of writing these are based on earlier, 2014-based population projections, and for some but not all the population projection variants. We make a correction for the differing base year by weighting the household projections by changes in the population projections between our 2016 edition and the 2014 edition.

For our UK-wide forecasts there is an additional issue to address. Household forecasts are produced by the four devolved governments (ONS 2016b; Government 2017; Agency 2016). Each uses a different set of household compositions, and the Northern Irish series is based on earlier (2012) population projections. The different breakdowns unfortunately have little overlap: the only consistent breakdown common to all four is simply:

- one adult households;
- two adult households;
- all other households, including all households with children.

In constructing our weights we have focused on hitting the correct household composition totals for Scotland (e.g. the correct numbers of single parents in Scotland). This does imply that we are not guaranteed to hit the equivalent totals for the UK, but given that our focus is on producing accurate child poverty forecasts for Scotland, we decided that this was an acceptable trade-off.

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[27](see Appendix 1.1 for the full list)

[28]Over the period 2012/13 to 2015/16, 37% of lone parents in Scotland were in AHC relative poverty, as against 18% of all adults (Scottish Government 2017f, Table 2a).

Employment and Unemployment

The SFC produces projections of labour force participation, employment and unemployment, as a percentage of the over 16s (SFC 2017, Table S2.3). We apply the percentages in that table to each of the NRS's population forecasts discussed above[29]. The forecasts run till 2022/23; we hold the end period percentages constant for all later periods. OBR produce comparable data for the UK as a whole (Responsibility 2017 Supplementary Economy Tables 1.6) which we apply similarly to the ONS UK population forecasts.

An Example

Table A.1 below gives an example of how our reweighting algorithm performs on the FRS data.

The second and fourth columns show our forecast numbers for each of our targets for the years 2017 and 2031 respectively. The third and fifth column show how far our away from this our pooled FRS dataset is, when we weight each FRS household equally[30]. Cases that are underrepresented by more than 10% are coloured red, and those overrepresented are coloured green.

[29]Note this implies participation and unemployment rates are independent of migration and fertility levels.
[30]The initial weight is the ratio of the total number of households forecast for the year to the count of FRS households.

Table A.1. Performance of weighting algorithm on the pooled Scottish FRS dataset

	2017		2031	
	Target	% Diff	Target	% Diff
One Adult Male	431,785	-12.9	534,877	-24.2
One Adult Female	478,178	-0.1	530,710	-2.9
Two Adults	775,857	10.1	854,687	7.9
One Adult One Child	93,630	-2.8	106,488	-7.8
One Adult Two Plus Children	67,544	11.4	74,554	8.9
Two Plus Adult One Plus Childre	434,119	9.3	403,017	27.1
Three Plus Person All Adult	203,554	-33.3	176,643	-17.1
Employed	2,654,740	-12.8	2,751,900	-9.3
Employee	2,239,490	-8.6	2,318,730	-4.8
Ilo Unemployed	108,747	21.3	129,860	9.6
0-4 Male	144,804	10.4	143,716	20.0
5-10 Male	183,986	0.9	178,286	12.4
11-15 Male	141,556	4.3	147,495	8.1
16-19 Male	119,165	-8.1	124,010	-4.7
20-24 Male	179,329	-35.1	168,853	-25.6
25-29 Male	190,894	-33.3	158,897	-13.6
30-34 Male	175,581	-16.8	170,006	-7.3
35-39 Male	167,032	-14.0	191,015	-18.8
40-44 Male	158,508	7.3	192,553	-4.7
45-49 Male	184,358	1.2	174,505	15.3
50-54 Male	196,939	-12.0	160,380	16.6
55-59 Male	185,400	-10.2	158,682	13.2
60-64 Male	160,753	11.2	178,551	8.1
65-69 Male	146,754	17.8	179,078	4.2
70-74 Male	123,658	6.9	152,252	-6.3
75-79 Male	84,000	16.5	116,043	-9.0
80+ Male	99,586	6.8	160,942	-28.7
0-4 Female	137,331	16.6	137,100	26.0
5-10 Female	176,601	3.3	170,428	15.5
11-15 Female	135,038	4.8	140,582	8.6
16-19 Female	114,050	-12.9	118,448	-9.5
20-24 Female	179,007	-24.9	168,783	-14.0
25-29 Female	192,384	-17.8	157,347	8.5
30-34 Female	181,625	-3.1	169,312	12.2
35-39 Female	174,049	-11.2	192,572	-13.4
40-44 Female	164,562	10.6	196,585	-0.1
45-49 Female	198,130	4.9	184,039	21.8
50-54 Female	209,425	-10.0	168,700	20.5
55-59 Female	195,259	-2.5	168,725	21.7
60-64 Female	170,060	15.7	195,408	8.6
65-69 Female	157,102	22.4	196,167	5.8
70-74 Female	138,530	11.7	169,253	-1.3
75-79 Female	105,185	6.8	133,852	-9.4
80+ Female	161,132	-13.4	214,700	-29.8

We see three main potential weaknesses of our approach. None of these invalidates the results but they are worth mentioning in the interests of full disclosure.

First, although our reweighting algorithm ensures that we can weight our data to hit our target set, there is no guarantee that we thereby get the distribution right of other characteristics that might be important but for which we have no forecast. We don't weight by disability status, for instance, and there's no *a priori* reason that the weights we use will move our numbers of disabled in the right direction, especially in the longer run. However, without additional forecast data on the other population characteristics (e.g. disability) this approach is the best that can be achieved with the data we have.

Second, we don't explicitly try to capture changes in the distribution of income. This could be important as the poverty measures are highly sensitive to small changes in the income distribution around the poverty lines, even if mean and median incomes are unchanged. The combination of our weighting and uprating *do* change the income distribution in the model somewhat, however (if we have a higher proportion of employed people in future, for instance), but is not something we are explicitly modelling.

Third, as we push out further into the future, the weights get increasingly dispersed, so some households have a very high weight, and others a very low one. Figures A1.1 and A1.2 illustrate this: they show the distribution of the weights needed to gross up our pooled 2012-15 FRS Scottish subsample so as to meet our target set in 2016/17 and 2031/32.

Figure A1.1. Distribution of weights required to meet population targets for pooled FRS Scotland sample in 2016/17

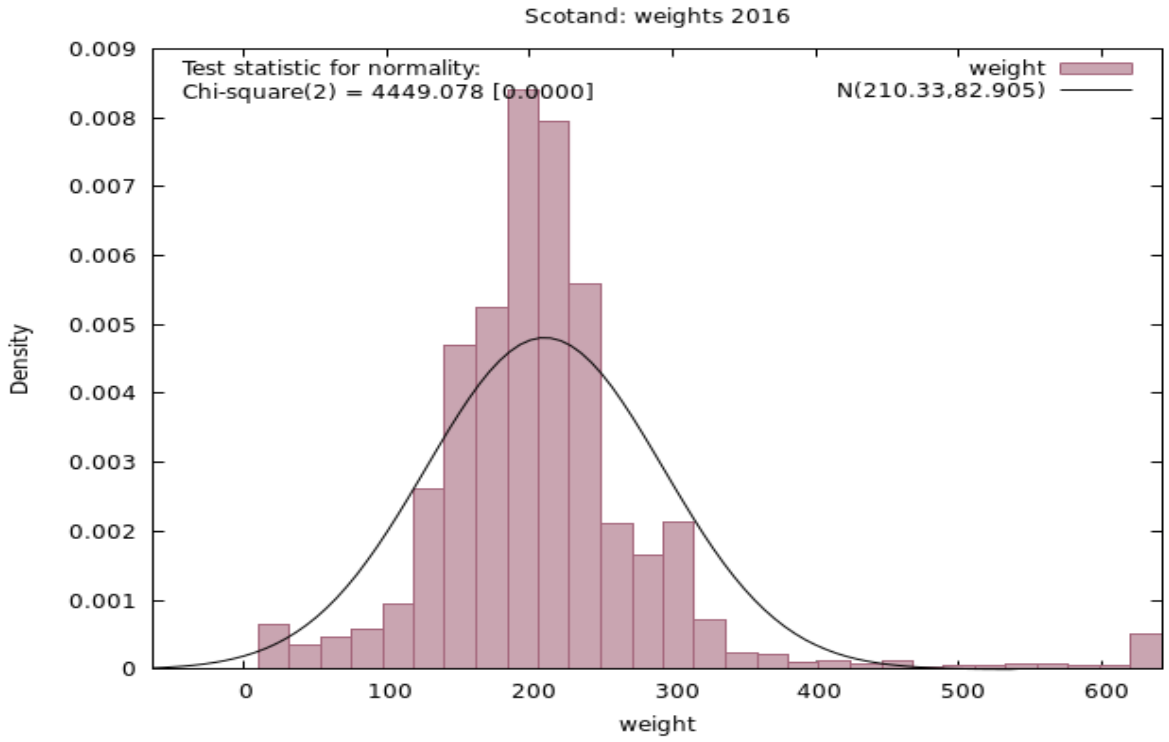
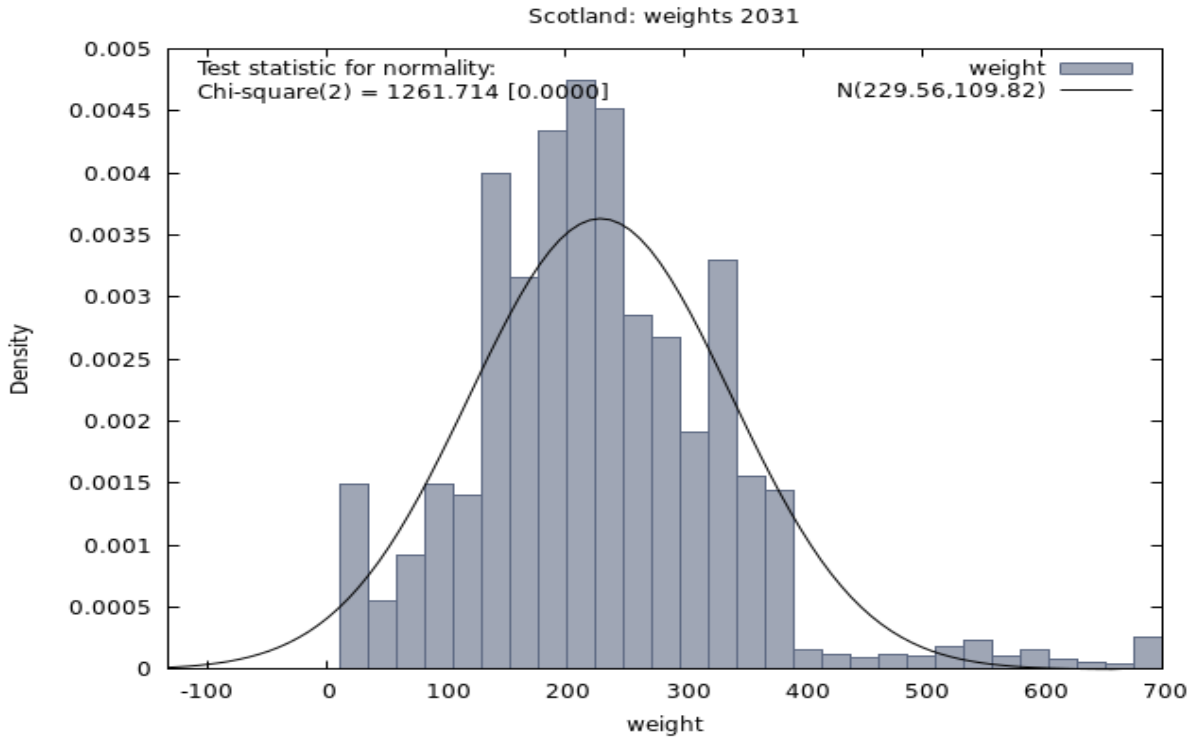


Figure A1.2. Distribution of weights required to meet population targets for pooled FRS Scotland sample in 2031/32



It is clear that the dispersion is increasing with time. This is an additional source of uncertainty in our forecasts, but one that is difficult to quantify.

2016 - Based Scottish Projections

- principal projection;
- high population;
- high fertility;
- low population;
- low fertility;
- high life expectancy;
- moderately high life expectancy;
- moderately low life expectancy;
- low life expectancy;
- high migration;

- low migration;
- 0% future EU migration (not National Statistics);
- 50% future EU migration (not National Statistics);
- 150% future EU migration (not National Statistics);
- zero net migration (natural change only).

Final Weighting Target List

- One Adult Male Household
- One Adult Female Household
- Two Adults Household
- One Adult, One Child Household
- One Adult Two Plus Children Household
- 2+ Adults with Children Household
- Three+ Adults, no children Household
- Employed, Inc. Self-Employed
- Employees
- ILO Unemployed
- 0-4 Male
- 5-10 Male
- 11-15 Male
- 16-19 Male
- 20-24 Male
- 25-29 Male
- 30-34 Male
- 35-39 Male
- 40-44 Male
- 45-49 Male

- 50-54 Male
- 55-59 Male
- 60-64 Male
- 65-69 Male
- 70-74 Male
- 75-79 Male
- 80+ Male
- 0-4 Female
- 5-10 Female
- 11-15 Female
- 16-19 Female
- 20-24 Female
- 25-29 Female
- 30-34 Female
- 35-39 Female
- 40-44 Female
- 45-49 Female
- 50-54 Female
- 55-59 Female
- 60-64 Female
- 65-69 Female
- 70-74 Female
- 75-79 Female
- 80+ Female

Note: for UK-wide weighting, the households targets are simplified to:

- One Adult Household
- 2 Adult Household
- All other households, including all households with children.

Appendix 2: The IPPR/Resolution Foundation/Landman Economics tax-transfer model

Overview

The calculations of the distributional effects of tax and transfer (benefit, tax credit and Universal Credit) policies is in this report were made using a tax-benefit microsimulation model (the tax-transfer model, or TTM) which was originally written by Landman Economics, and which is maintained jointly by Landman Economics, the Resolution Foundation and the Institute for Public Policy Research. This appendix gives a technical overview of the model.

Data and Outputs

The tax-benefit model uses data from the Family Resources Survey (FRS) to analyse the impact of direct taxes, benefits, tax credits and Universal Credit, and the Living Costs and Food Survey (LCF) to analyse the impact of indirect taxes. The information in the FRS and LCF allows payments of direct taxes and receipts of benefits and tax credits to be modelled with a reasonable degree of precision for each family in the surveys using either the current tax/benefit system which is in place at the moment, or an alternative system of the users' choice. For example, the user can look at what the impact of an increase in the income tax personal allowance would be. Using a 'base' system (this is often the actual current tax and benefit system, although the model can use any system as the base) and one or more 'reform' systems, the model can produce several types of outputs, for example:

- Aggregate costings of each system (i.e. amount received in direct and indirect personal taxes, and amount paid out in benefits and tax credits);
- Distributional impacts of reform system compared with base system (e.g. change in incomes in cash terms and as a percentage of weekly income in the base system). The distributional effects can be broken down according to several different variables, as shown in the section "individual and household identifier variables" below.
- Proportions of exchequer savings/costs due to a particular reform or set of reforms paid for by/going to particular family types
- Average impact of reforms on the household incomes of particular types of individuals, eg children, working age adults and pensioners;

- Winners and losers from a particular reform or set of reforms (grouped according to size of cash gain or size of percentage gain);
- Impact of reforms on overall inequality of disposable incomes (Gini coefficient);
- Impact of reforms on household and child poverty rates (using various definitions, e.g. proportion of children below 60% of median income);
- Changes in Marginal Deduction Rates (MDRs), i.e. the net gain to people in employment from an extra pound of earned income (which, for many individuals, will depend on income tax and National Insurance Contribution rates as well as the taper rates on means-tested benefits and tax credits).

Note that only the FRS data was used for this report because the child poverty measures contained in the Child Poverty (Scotland) Act do not take into account the effect of indirect taxes on household incomes. Therefore, the remainder of this Appendix only discusses the FRS component of the model.

Reforms modelled

The TTM is able to model most, but not all, of the features of the tax and social security systems in Scotland and the rest of the UK. For the purposes of modelling, the tax and social security system can be classified into three categories as follows

1. Features modelled with **high accuracy.** These include the following:
    - Income-based taxation, e.g. income tax, National Insurance Contributions;
    - Most parts of the benefit, tax credit and Universal Credit systems.
2. Reforms modelled with **lower accuracy**. Some aspects of the tax and social security reforms are modellable but with lower accuracy because the relevant information necessary to model the reforms with high accuracy is not available in the FRS dataset. The main examples of these are as follows:
    - Council Tax payments and Council Tax support payments can only be approximated because the FRS data do not contain local authority information. This is less of a problem in Scotland where the Scottish Government's Council Tax Reduction Scheme operates on a nationwide basis, and can be modelled with higher accuracy.
    - The Local Housing Allowance for Housing Benefit claimants can only be approximated, again because of the lack of local authority data in the FRS.

- Assessment and re-assessment for disability-related benefits (in particular Employment and Support Allowance, and the replacement of Disability Living Allowance with Personal Independence Payment) cannot be modelled with full accuracy because the FRS does not have enough detail on the type and severity of disabilities which affect each claimant.

3. Reforms which **can't be modelled**. Some aspects of the tax and welfare reforms cannot be included in the analysis because the FRS data doesn't contain enough information to model them at all. The main examples of these are:

    - Changes to the rules on income thresholds for repayment of tax credits when family income increases from one year to the next; these can't be modelled because the FRS doesn't contain information on the previous year's incomes for each household.

    - Sanctions for JSA and ESA claimants as well as Universal Credit; the FRS doesn't contain information on whether claimants are being sanctioned or not.

It is important to note that the TTM is able to model the following Scotland-specific tax and benefit policies with high accuracy:

- Additional funding from the Scottish Government to mitigate the impact of the “bedroom tax”.
- Recent increases to multipliers for the four top Council Tax bands (E,F,G and H).
- The Council Tax Reduction Scheme for low-income households.
- The increase in Carers’ Allowance to the level of JSA from 2018/19 onwards.
- The introduction of the Best Start Grant, replacing the Sure Start Maternity Grant.
- The changes to income tax rates in Scotland from 2018/19 onwards.

Modelling partial take-up

The take-up algorithm

Previous forecasts of child poverty using the TTM (for example Reed and Portes, 2014) assumed full take-up of means-tested benefits, tax credits and UC. In 2017 a new partial take-up algorithm was developed for the TTM. For a range of means-tested benefits (Housing Benefit, Income Support, income-based Employment and Support Allowance, income-based Jobseeker’s Allowance and Pension Credit) and for tax credits, the algorithm operates as follows:

First, actual benefit or tax credit receipt is compared with modelled receipt of the benefit or tax credit.

Second, the benefit unit is assigned to a quadrant based on the decision matrix in Table A1.1 below, and action is taken (or not taken) based on the assignment.

Table A1.1 Decision matrix for partial take-up algorithm: actual receipt vs modelled receipt

Benefit unit status:	Modelled as receiving benefit/tax credit	Not modelled as receiving benefit/tax credit
Actually receiving benefit/tax credit	Award benefit	Don't award benefit
Not actually receiving benefit/tax credit	Award benefit based on take-up algorithm	Don't award benefit

The next course of action for each benefit unit depends on which box of the decision matrix the benefit unit is assigned to, based on a comparison of actual and modelled receipt. Four options are possible:

1. If the benefit unit is **actually receiving** the benefit (or tax credit), and is also **modelled as receiving** the benefit in the TTM, the benefit is paid.
2. If the benefit unit is **not receiving** the benefit, and is **modelled as not receiving** the benefit, the benefit is not paid.
3. If the benefit unit is **actually receiving** the benefit, but is **modelled as not receiving** the benefit, the benefit is not paid.
4. If the benefit unit is **not actually receiving** the benefit, but is **modelled as receiving** the benefit, the partial take-up algorithm is applied.

All the remaining explanation in this section relates to option 4) – benefit units who are modelled as receiving a benefit (or tax credit) but do not actually receive that benefit or tax credit.

The partial take-up algorithm for each benefit works as follows:

For benefit units who are modelled as receiving a benefit or tax credit, a take-up regression is estimated. The regression is a probit regression with the dependent variable being actual take-up of the benefit or tax credit in question and the regressor variables being as follows:

- Ethnicity
- Disability (core group, wider group)

- Family demographic status (couple with children, couple without children, lone parent, single person with no children)
- Region
- Employment
- Housing tenure type (social tenant, private tenant, owner-occupier[31]

The predictions from this regression (plus a random error term for each benefit unit) are used to create a ranking (from 0 to 100) which is used to calibrate take-up of each benefit and tax credit in the FRS so that the grossed-up percentage of benefit units claiming each benefit in the model matches published DWP and HMRC statistics.

Table A1.2 compares estimated take-up rates from the pooled FRS data in the tax-transfer model – calculated as number of benefit units actually taking up each benefit, divided by number of benefit units modelled as receiving each benefit – with published take-up statistics from DWP (2017c) and HMRC (2017)– calculated in the same way, but using administrative data combined with FRS-based modelling. The table shows that estimates from the TTM for take-up proportions of each featured benefit and tax credit are below DWP and HMRC's published statistics. This means that the estimated take-up rate in the FRS data needs to be adjusted upwards in the TTM so that estimated take-up matches published take-up rates. For example, our 'raw' estimate of take-up in the TTM is 42%; this needs to be adjusted upwards by 20 percentage points to match DWP's Pension Credit take-up statistics.

Table A1.2. Comparison of estimated take-up rates for FRS data in tax-transfer model with published take-up statistics from DWP and HMRC, by caseload

Benefit/tax credit	TTM estimate (%)	DWP or HMRC estimate (%)	Difference, DWP/HMRC minus TTM (ppts)
Pension Credit	42	62	20
JSA	46	50	4
IS/ESA	65	82	17
Working Tax Credit	48	68	20
Child Tax Credit	75	87	-12

Source: comparison of TTM estimates with DWP (2017c) and HMRC (2017)

[31] The take-up regression for Housing Benefit does not include an owner occupier dummy variable because Housing Benefit can only be claimed by tenants.

Using the prediction ranking from the take-up regressions (as explained above), it is possible to adjust the simulated take-up rate for each benefit or tax credit in the TTM to match any percentage total between zero and 100%. The parameter files provide the flexibility to do this separately for each of the benefits and tax credits in Table A1.2. In the simulations presented in this report we assume that the take-up rates for each benefit and tax credit match DWP and HMRC's latest published statistics.

Take-up of Universal Credit

Universal Credit (UC) presents an additional problem because there are, as yet, no official statistics from DWP on the take-up rate. However, it is generally assumed that the take-up rate for UC will be higher than the take-up rate for the benefits and tax credits it replaces, for one particular reason: there are currently many benefit units who are eligible for more than one of the benefits or tax credits which are being replaced by UC, but who do not claim the whole package of benefits. For example, there are benefit units who are eligible for tax credits and Housing Benefit but whom claim only one or the other. Because UC is a single payment replacing several different benefits, when a claim is processed, it is equivalent to a situation in which the benefit unit applied for all the 'legacy' benefits and tax credits, and this should result in a boost in take-up rates.

To estimate the extent to which UC might be expected to boost take-up rates, all other things being equal, we used the TTM to calculate the number of benefit units who claimed any of the benefits being replaced by UC (Income Support, income-based JSA, income-based ESA, Housing Benefit, Working Tax Credit and Child Tax Credit) as a proportion of the number of benefit units modelled as eligible to receive any of those benefits in the TTM. The calculation (adjusted for the gap between TTM estimates of take-up rates for the individual benefits and DWP/HMRC estimates) was a UC take-up rate of 87%. This is a relatively high take-up rate compared to the DWP/HMRC estimates for most of the individual benefits and tax credits. However, we adjust this assumption slightly downwards, by 5 percentage points, to take account of recent evidence from UC sanctions statistics that the sanction rate for claimants of UC is substantially higher than the average sanctions rate for the benefits and tax credits it replaces (Webster, 2017). Thus, **82%** is our headline take-up rate assumption for Universal Credit in the reform scenario.

Simulating changes in child poverty rates

Modelling of the impact of reforms to direct taxes and transfer payments on the number of children in poverty proceeds in six stages as follows.

Firstly, the FRS data from the pooled 2012-13, 2013-14, 2014-15 and 2015-16 Households Below Average Income (HBAI) dataset is analysed to identify households who are below 60% of equivalised median household disposable income on the relative and absolute After Housing Costs (AHC) measure.

Next, the pooled FRS data for 2012-13 through to 2015-16 are run through the TTM using the relevant parameter files for the data year and for 2015-16 (the starting year for the simulations). For each household, we also calculate a 'calibration factor' equal to the difference between modelled income and actual HBAI income for each household in the data base year (2012/13, 2013/14, 2014/15 or 2015/16 depending on which year of the FRS data the household is from). This calibration factor is added back into the modelled income estimate for each year. The objective of this procedure is to ensure that the starting child poverty rates in 2015/16 match the published statistics from *Poverty and Inequality in Scotland.*

For each of our scenarios (a), (b) and (c) (explained in Section 2.5 in the main report), the pooled FRS data are run through the TTM for all tax years between 2016/17 and 2030/31 inclusive. The earnings and other gross incomes in the model are uprated to the relevant tax year in each case. This produces a total of (4 data years) x (3 scenarios) x (15 forecast years) = 180 model runs.

New simulated child poverty rates for each data year, each scenario and each forecast year are calculated based on modelled net incomes (after applying the calibration factor).

This procedure is used for all poverty measures 1 and 2 (relative AHC and absolute AHC). The only difference between the relative and absolute poverty calculation procedures is that for the relative poverty measures, the poverty line is recalculated based on the modelled distribution of incomes in the baseline and reform scenarios, whereas for the absolute poverty measures, the AHC poverty line in the 2010-11 tax year are used (uprated by the Consumer Price Index).

For poverty measure 3 (combined low income and material deprivation), relative AHC poverty using a higher threshold (70% of median equivalised household income) is calculated and this is then combined with regression-based prediction of material deprivation as outlined in Section 2.4 in the main report.

For poverty measure 4 (persistent poverty), household net income in each scenario (a), (b) and (c) is calculated using the TTM and this is combined with the results from the regression for the probability of persistent poverty in the USoc data to produce a predicted probability of being in persistent poverty for each household in the pooled Scottish FRS sample.

Appendix 3. Movements into and out of poverty as a result of the planned Scottish reforms

Table A3.1 shows the average number of children in households in the 4-year pooled Scottish FRS sample moving out of relative poverty as a result of the forthcoming Scottish reforms to the tax and social security systems, and the number of children moving into relative poverty as a result of the Scottish reforms. The figures are presented as annual averages for three time periods: (a) 2018/19 to 2021/22, (b) 2022/23 to 2025/26 and (c) 2026/27 to 2030/31. The results show that the number of children moving into poverty or out of poverty as a result of the Scottish income tax reforms is extremely small – only a maximum of 13 children moving out of poverty in period (a) and a maximum of 7 people moving into poverty in period (c). These effects are well below the reporting threshold for statistically significant results based on the FRS data (which should normally be based on at least 30-50 household observations).

Table A3.1.

Forecast period	Number of children moving out of poverty	Number of children moving into poverty	Net balance (increase in poverty)
2018/19 to 2021/22	13	1	-12
2022/23 to 2025/26	8	2	-2
2026/27 to 2030/31	3	7	+4

Appendix 4. Robustness analysis results for child poverty measure 2 (absolute poverty)

This appendix presents the graphs from a robustness analysis of child poverty measure 2 (absolute poverty). These are equivalent to Figures 3.15, 3.16, 3.17 and 3.18 for child poverty measure 1 in the main report.

Figure A4.1. Impact of different population growth assumptions on child poverty measure 2

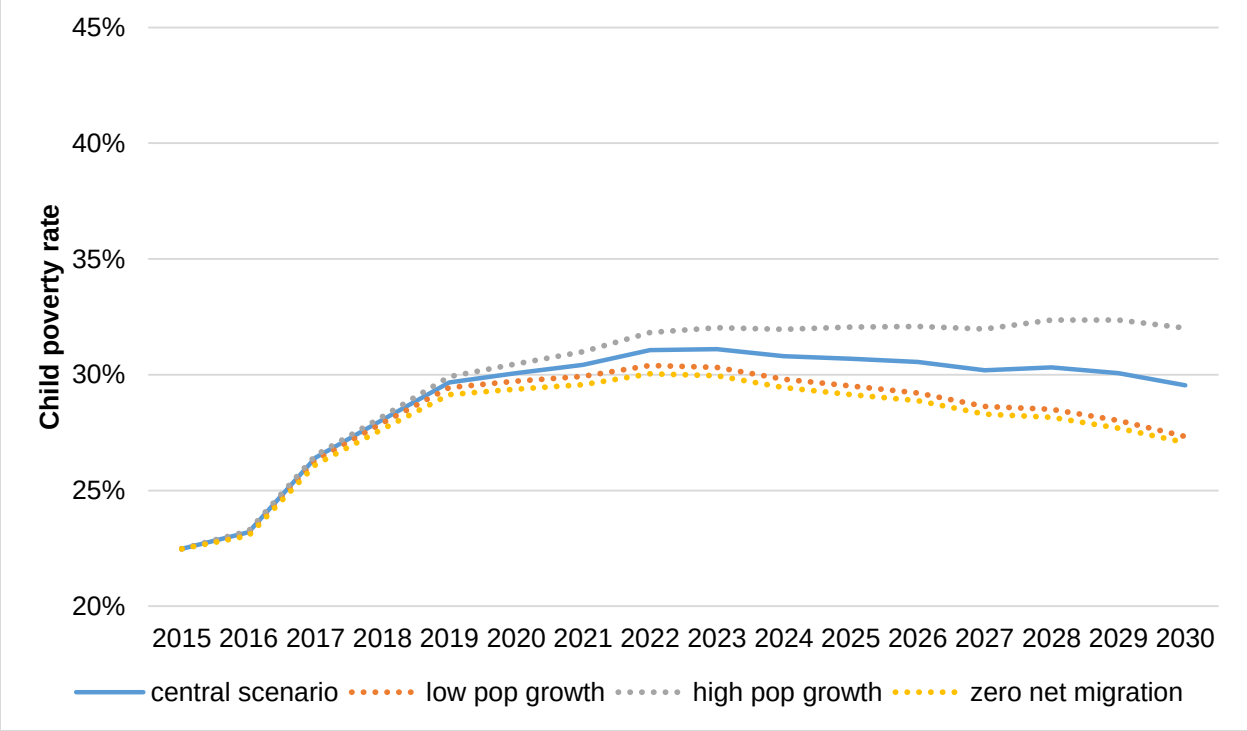


Figure A4.2. Impact of different employment growth assumptions on child poverty measure 2

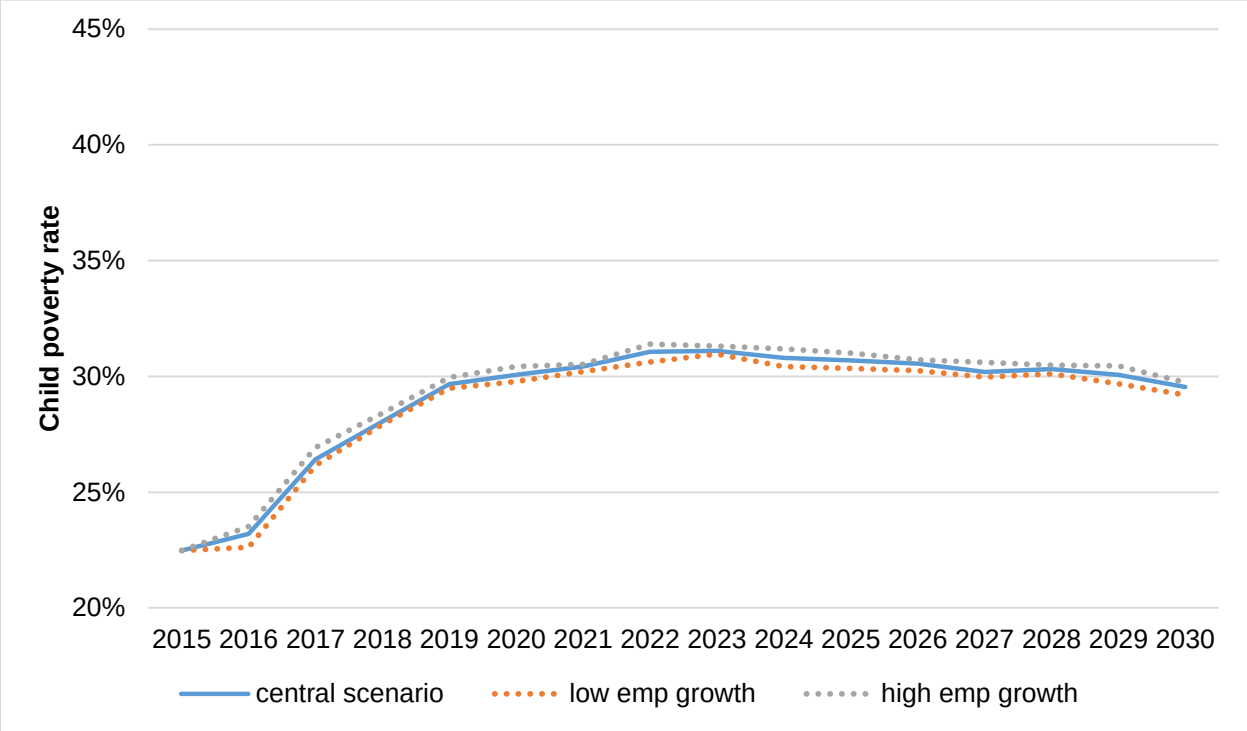


Figure A4.3. Impact of different wage growth assumptions on child poverty measure 2

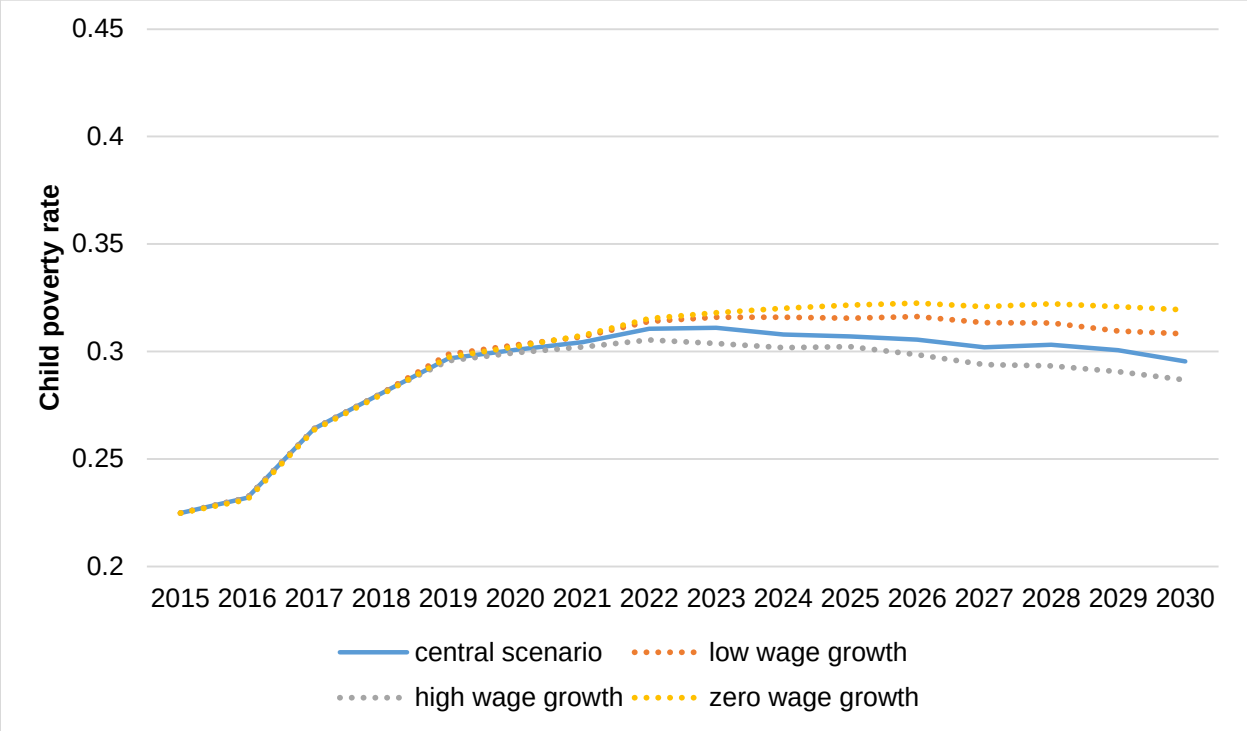
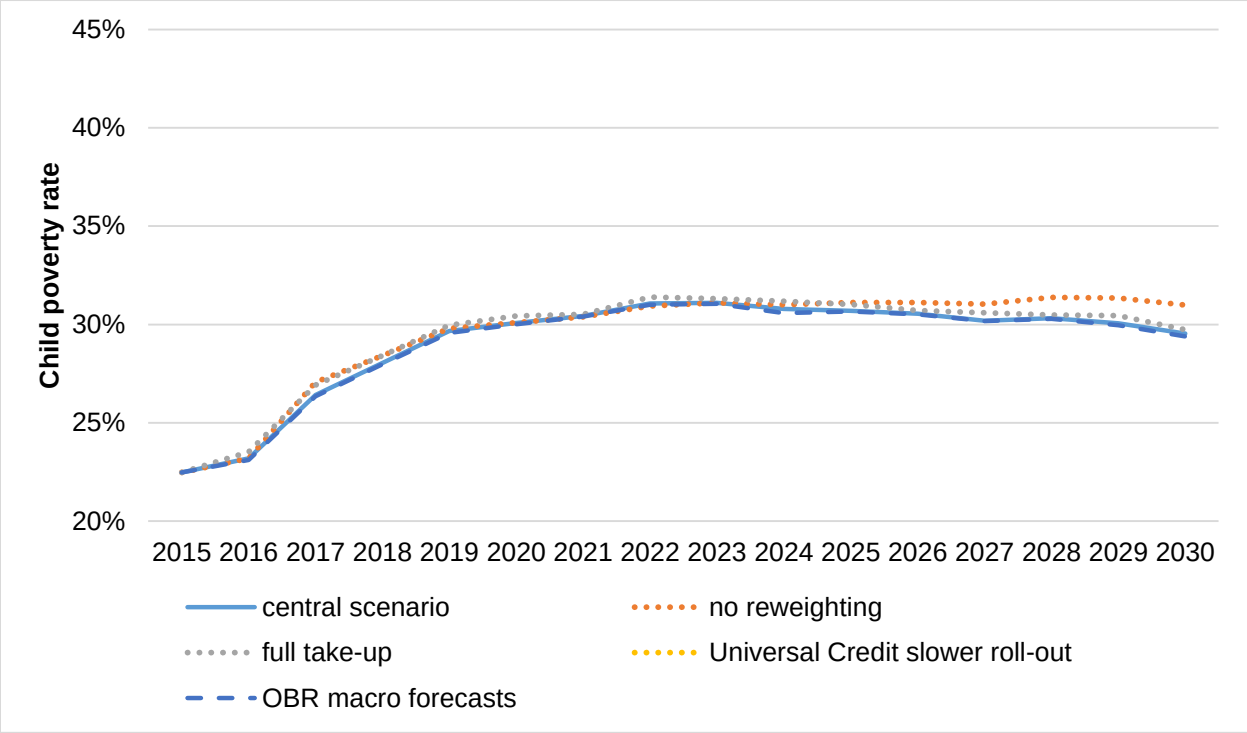


Figure A4.4. Impact of other robustness checks on child poverty measure 2



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