Technical appendix: Distributional analysis of changes to tax, social security and public spending from 2010/11 to 2027/28

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Modelling changes to tax and social security from 2010/11 to 2027/28

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 the Landman Economics Tax-Transfer Model (TTM), which is a microsimulation model of the tax and social security system. The model has been updated and refined several times since originally being written in 2008-09.

Data and Outputs

The TTM 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 (LCFS) to analyse the impact of indirect taxes. The information in the FRS and LCFS 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, e.g. 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).
- Impact of reforms on number of families below Minimum Income Standards[1].
- 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).

Behavioural assumptions

The model produces distributional results on the assumption of *no behavioural change* between base and reform tax-benefit systems. In other words, we assume that the gross income, employment status, hours of employment and consumption behaviour of each individual in the FRS and/or LCF is the same under each of the tax/benefit systems analysed in the project. This is not a very realistic assumption. In reality we would expect individual behaviour to adjust in many cases in response to the financial incentives generated by the tax/benefit system and consumer behaviour to respond to changes in relative prices induced by indirect tax measures. However, adding behavioural responses into a tax and benefit microsimulation model introduces considerable additional complexity and would have been impractical for this project on both timing and costs grounds.

Modelling incomes and tax payments at an individual level

Because the analysis of incomes is at the individual level in this report, for couple benefit units it is necessary to make assumptions about who receives what income in the household. (For single adult benefit units, including single childless people and lone parents, there is only one adult, so the allocation process is straightforward).

Table A.1 below shows what assumptions are made about which adult in the couple receives each of the income sources – different types of market income and different types of benefit and other social security payments – and who makes each type of tax payment.

[1] The Minimum Income Standard is an ongoing programme of research funded by the Joseph Rowntree Foundation to define what level of income is needed to allow a minimum acceptable standard of living in the UK today. See http://www.minimumincomestandard.org/ for details.

Table A.1 also explains the assumptions about Housing Benefit and Council Tax (and Council Tax Support) which are allocated at a household level.

Table A.1. Assumptions about who receives incomes and who makes tax payments in the distributional analysis.

Income source	**Treatment for couples and multiple person households (FRS data unless otherwise specified)**
Gross earnings	Allocated to the person who receives it
Self-employment income	Allocated to the person who receives it
Other market incomes (e.g. investment, property)	Allocated to the person who receives it
Income tax payments	Calculated at an individual level based on gross taxable income
National Insurance Contributions payments	Calculated at an individual level based on gross income subject to NICs
Local taxes	Divided equally between adults in each household
Expenditure taxes	Allocated according to the share of each individual's expenditure on the relevant goods and services subject to each expenditure tax in the LCFS
Housing Benefit	Divided equally between each adult in the household
Council Tax Support	Divided equally between each adult in the household
Means-tested benefits	Divided equally between each adult in the couple
Tax credits	Divided equally between each adult in the couple

Universal Credit	Divided equally between each adult in the couple
Tax Free Childcare	Divided equally between each adult in the couple
State Pension	Paid individually at rates specified in the FRS data unless a single payment is made on behalf of both adults in the couple, in which case it is divided equally between each adult in the couple
Child Benefit	Paid to the mother (except for single father benefit units or two-parent families where both parents are male)
Other non-means-tested benefits (e.g. Attendance Allowance, Carers Allowance, PIP, Maternity allowance)	Paid to the adult who receives them in the FRS data

Reforms modelled

For this project we model as many of the reforms to taxes and transfer payments introduced between the June 2010 Budget and the March 2024 Budget (inclusive) as is possible given the data in the FRS (and LCF).

Broadly speaking, the tax and welfare reforms enacted by governments between 2010 and 2024 fall into three categories:

1. Reforms modelled with **high accuracy.** These include the following:
    - All changes to income-based taxation, e.g. income tax, National Insurance Contributions using the FRS data.
    - Most parts of the benefit, tax credit and Universal Credit systems using the FRS data.
    - Indirect taxes (e.g. VAT, excise duties) on the LCF data.
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 (or the LCF) datasets. 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.
    - 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.

The reform systems modelled

To break down the full impact of all reforms made between the June 2010 Budget and the March 2024 Budget inclusive, reforms are classified into 11 different sets of reforms with each set of reforms applied sequentially. Table A.2 shows the order in which the reforms are implemented.

Table A.2. Description of reforms and the order in which they are implemented.

System number	Name	Description
0	Baseline	April 2010 tax benefit system with no changes made except for uprating benefit rates, tax and NICs thresholds and the value of excise duties using the default uprating schema in place in 2010 (ROSSI index uprating for means-tested benefits and RPI uprating for non-means-tested benefits, tax credits, income tax and NICs thresholds and excise duty rates)

1	Income tax	System 0 plus all reforms to income tax from June 2010 Budget to March 2024 Budget (inclusive) scheduled to take effect up to and including the 2027/28 tax year.
2	NICs	System 1 plus all reforms to employee and self-employed National Insurance Contributions from June 2010 Budget to March 2024 Budget (inclusive) scheduled to take effect up to and including the 2027/28 tax year.
3	Indirect taxes	System 2 plus all changes to indirect tax (VAT, excise duties on motor fuels, alcoholic drinks and tobacco products, Insurance Premium Tax, Air Passenger Duty and soft drinks levy).
4	Pensioner benefit changes	System 3 plus: Changes to uprating of the main pensioner benefits (State Pension and Pension Credit) i.e. the “triple lock”. Introduction of the new State Pension from retirees from 2016 onwards
5	Other benefit uprating changes	System 4 plus: Switch from RPI/ROSSI to CPI default uprating for benefits and tax credits, and subsequent below-inflation increases and nominal freezes of some benefit and tax credit rates in some years.
6	2-child limit	System 5 plus: introduction of the limit of per-child support in tax credits and Housing Benefit to a maximum of 2 children for most children born after April 2017.
7	Benefit cap	System 6 plus introduction of the Benefit Cap for most working age households not in work (in 2013) and subsequent changes to the generosity of the cap.
8	Bedroom tax	System 7 plus introduction of the Social Sector Rent Reduction (“bedroom tax”) for social tenant households deemed to have one or more excess

		bedrooms for the number of people living in the household.
9	LHA restrictions	System 8 plus restrictions to Local Housing Allowance which determines the maximum level of Housing Benefit support in each local authority: see Hobson (2023) for full details of restrictions[2].
10	Universal Credit	System 9 plus the introduction of Universal Credit and subsequent changes to generosity (e.g. 2-child limit, reduction in taper rate, changes to work allowances). We assume that Universal Credit is fully rolled out for all claimants by 2027/28.
11	Other changes	Other changes that do not fit into any of the other categories in the analysis, for example: ● Reductions in Council Tax Support (in England) after localization of the benefit in 2013 ● Modellable changes to disability benefits (for example removal of the WRAG premium for Employment and Support Allowance claimants) ● Changes to some benefit rates (e.g. Carers Allowance) as a result of devolution to the Scottish Government ● Mitigation of certain aspects of the welfare reforms in Northern Ireland ● Introduction of higher Council Tax bands in Scotland

Presenting results in real terms

All the cash figures for the distributional impact of the tax and benefit systems are presented in April 2024 prices. The figures for distributional effects as a percentage of

[2] F Hobson (2023), Local Housing Allowance (LHA): Help with rent for private tenants, House of Commons Library Research Briefing.

income are calculated as a percentage of 'baseline' income if the April 2010 tax and benefit system had still been in place by April 2024, uprated as described above.

Variables used to analyse distributional impacts

The variables used for breakdowns at the household level in the analysis are shown in Table A.3 below.

Table A.3 Household Identifiers.

Identifier variable	**Variable(s) used to construct identifier**	
	FRS	**LCF**
Household income decile	Derived based on tax-benefit model simulation results	Derived based on tax-benefit model simulation results
Housing tenure	TENTYP2	A121

Individual-level analysis

The variables used for breakdowns at the individual level using the FRS data are shown in Table A.4 below. Note that the LCFS has additional information in the raw version of the dataset which has enabled us to add a disability variable for LCFS analysis (which has not been possible in previous versions of Landman Economics distributional analysis).

Table A.4 Individual Identifiers

Identifier variable	**FRS variable used**	**LCFS variable used (derived dataset unless otherwise stated)**
gender	SEX	A004
ethnicity	ETHGR3	EthUKp (raw dataset)

disability	DISACTA1	HealIll (raw dataset)
Age group	AGE80	A005p
Demographic type	ADULTB, DEPCHLDB, AGE80 (age – to identify pensioners)	BUMEMBER=1 or 2 denotes one or two adult benefit units; BUMEMBER=3 denotes one or more children A005p (age – to identify pensioners)
Number of children	DEPCHLDB	BUMEMBER=3

Technical details of the Landman Economics public spending model

The Landman Economics public spending model combines data on trends in aggregate public spending (broken down into different spending categories) with survey micro-data on the usage of public services by households. This technical document gives an overview of both these types of data and the methods used to model the distributional impacts of public spending using the data sources.

Aggregate spending data

Data sources

The model uses aggregate public spending data from three sources, as follows:

- Data on spending in the financial years 2010-11 to 2022-23 (inclusive) are supplied from HM Treasury's *Country and Regional Analysis* (CRA) publication (HMT 2023 and earlier years). The analysis uses the detailed spending information in Tables A and B of the CRA document. The spending categories are mostly based on the United Nations' COFOG (Classifications of Functions of Government) definition as explained in more detail below.
- For youth services spending, which is not itemised explicitly in the CRA data, I use estimates from a 2023 report by the YMCA which analysed spending on youth services by each local authority in England. The YMCA estimates that between 2010 and 2023 there was a 73 per cent cut in real terms spending on

youth services, amounting to around £1 billion of real terms cuts (YMCA, 2023).

- Detailed future spending plans going forward to 2027/28 have not been published yet, but the UK Government did publish planned spending totals in the March 2024 Budget (HMT 2024 Table 2.1). The Institute for Government has analysed the Government's spending plans, taking into account its commitments for increased spending on the NHS and defence, and extra funding for an expansion of free childcare, and calculated that non-protected departments will face average real-terms cuts of 2.6 per cent per year in real terms from 2024/25 to 2027/28 (Institute for Government 2024). I have used these assumptions in modelling future spending for services outside healthcare and early years.

In addition to the spending data, the model uses data from the Office for National Statistics on population by age group (including recorded population changes between 2010 and 2022 and population projections between 2022 and 2028) to enable the adjustment of spending totals from the CRA data and projected future spending plans and YMCA data to take account of population changes as shown below.

Services included in the model

Not all public services are included in the Landman Economics public spending model – only those which can reasonably be allocated to households based on survey data on service usage ('allocatable services'). The included services are as specified in Table A5 below.

Table A5. Classification of the Functions of Government (COFOG) **of services and inclusion status in the Landman Economics public spending model**

COFOG classification	Included in model	Not included
1. General public services*	None	All
2. Defence	None	All
3. Public order and safety	3.1 Police services;	3.2 Fire-protection services;

	3.3 Law Courts	3.4 Prisons
4. Economic affairs	4.5 Transport	4.1 General 4.2 Agriculture, forestry, fishing and hunting 4.3 Fuel and energy 4.4 Mining, manufacturing and construction 4.6 Communication 4.7 Other industries
5. Environment protection	None	All
6. Housing and community amenities	6.1 Housing development	6.2 Community development 6.3 Water supply 6.4 Street lighting
7. Health	Medical services	Medical research Central and other health services
8. Recreation, culture and religion	Youth services (subcategory of 8.1: Recreational and Sporting Services)	Rest of 8.1 and other components of COFOG 8 (e.g. 8.2 Cultural Services)
9. Education	9.1 Pre-primary and primary education	9.3 Post-secondary non-tertiary education 9.4 Tertiary education Education not definable by level

	9.2 Secondary education	9.5 Subsidiary services to education
10. Social protection	Social service components of 10.1 (sickness and disability) and 10.2 (old age)	Transfer payment components of 10.1 and 10.2; other components of COFOG 10 (e.g. 10.5 unemployment)
Note: table omits R&D and n.e.c. (not elsewhere classified) components of all COFOG categories to save space. None of these are included in the model.		

Analysis of the CRA data shows that in England, these 'allocatable services' accounted for around 75% of total public spending in the 2022-23 tax year when combined with the transfer spending payments included in the Landman Economics tax-transfer model used for the tax and social security modelling component of this project. The remaining 25% was composed of services such as defence and environmental protection, the benefits of which cannot be straightforwardly assigned to particular households. To the extent that most of the non-allocated spending, like defence, can reasonably be assumed to be general "public good" spending, benefiting all citizens, this exclusion is unlikely to affect the results materially.

The choice of baseline scenario

We have compared changes in spending per head on each public service with a baseline scenario in which spending on each service in cash terms rises in line with the CPI (Consumer Prices Index). Normally the GDP deflator (an index measure of growth in prices across the whole UK economy, including producer as well as consumer prices) would be used to uprate nominal public spending to real terms, but the UK has experienced above-target price inflation since 2021, and the CPI better reflects price pressures arising from increased in energy costs (which are included in the CPI but excluded from the GDP deflator because they are import costs, whereas the GDP deflator focuses on domestic production). Thus, the baseline scenario in this model is a scenario in which spending per head on public services (adjusted for

population growth) stays constant in real terms. The model measures the distributional impact of increases – or cuts – in spending against that baseline.

It is important to note here that a baseline scenario where spending on public services stays constant in real terms is a much lower rate of growth than the long-run historical average over the last 70 years, which is for total public spending to rise roughly in line with real GDP (with some short-term variations)[3]. Most of the time, real GDP is growing (i.e. nominal GDP grows faster than the GDP deflator. This in turn means that the long-run tendency is for public spending to *increase* in real terms. For example, over the time period we are focusing on in this report, real GDP is forecast to grow by just over 20% between 2010/11 and 2021/22 (OBR, 2021).

Measured against a baseline scenario where spending on services is constant as a share of GDP, our analysis would show larger-scale cuts to most services (and therefore larger losses to individuals and households). From a long-run historical perspective, this would be the most appropriate comparison.

Population age groups used for service use variables

The Landman Economics public spending model adjusts spending per benefit unit on each public service to take account of changes in the size of the relevant population for the service. Table A6 shows the relevant age groups used for the assessment of population growth in service users for each service.

Table A6. Age groups used for relevant population for each service

Service	**Relevant age group (to nearest 5-year age bands)**
Health	Weighted average for adult (18+) population based on analysis of probability of using health services (GPs and hospitals) by age group.
Social care: disabled	18-64
Social care: elderly	65 and over

[3] The table on 'Public Finances since 1900' produced by the Office for Budget Responsibility (OBR, 2021) shows that spending was between 34% and 47% of GDP in every year between 1946-47 and 2019-20 inclusive. In 2020-21 spending rose to 52% of GDP, mainly due to the temporary sharp fall in GDP during the Covid-19 pandemic.

Early years	0-4
Schools	5-18
Youth services	10-15
Police and criminal justice	All adults (18+)
Transport	All ages
Social housing	All ages

Survey data on service use

The Landman Economics public spending model uses data from the Understanding Society (USoc) survey dataset to measure service use across all of the types of public services included in the model. The analysis in this report uses data from Wave 10 of USoc, which was collected in 2018 and 2019. The Wave 10 data have been used in preference to more recent waves because of potential distortions in the pattern of service use (particularly healthcare services) during the Covid pandemic. Some of the public service use variables are only collected in even-numbered waves, and the most recent released data from an even-numbered wave is Wave 12 (collected in 2021 and 2022) which overlaps with the second period of Covid lockdown.

Service use variables in Understanding Society

Table A7 shows the variables which are used to proxy use of services by individuals for each of the public service categories included in the model.

Table A7. Service use variables in Understanding Society Wave 10

Service	**Variables used (Wave 10)**	

Health	J_h12gp: number of times talked to GP in last 12 months J_h12hop: number of hospital outpatient visits in last 12 months J_hospd: number of days in hospital as an inpatient in last 12 months	Calculation of costs of GP visits, hospital outpatient visits and hospital inpatient stays use data on average costs from Manchester Unit Costs database (see https://greatermanchester-ca.gov.uk/what-we-do/research/research-cost-benefit-analysis/).
Social care (domiciliary)	J_disdif1, J_disdif2, …J_disdif12: functional disability variables J_servuse3: receipt of social care services	See Section A.2 below for more details
Social care (residential)	Prediction from ELSA regression on probability of entering residential social care (in England)	See Section A.2 below for more details
Early years	Childcare type: J_wrkch2a1: nursery school or class J_wrkch2a2: special educational needs nursery J_wrkch2a3: day nursery or creche J_wrkch2a4: playgroup or pre-school J_wrkch2a5: childminder J_wrkch2a6: nanny/carer in home J_wrkch31-J_wrkch36: hours spent per week in each of these settings	

Education (school level)	Number of children aged 5-10 (for primary) Number of children aged 11-16 plus those aged 17-18 not in further/higher education (for secondary) I_schsta, K_schsta, I_stillp, K_stillp – attending private school (in child dataset)	Data from Waves 9 and 11 on children attending private school is merged in with Wave 10. Children attending private school are excluded from the school service use variable (so that only those attending state schools are included in the analysis).
Youth services	J_yp: frequency of attending youth club (in youth dataset)	This variable is in the youth dataset – we merge it with the adult dataset at the benefit unit level.
Transport	J_trbus: frequency of bus journeys J_trtrn: trequency of train journeys J_trcar: frequency of car journeys (for allocation of road spending)	

Social housing	J_tenure_dv = 3 or 4 (social tenant households) in household dataset	
Police and criminal justice	J_servuse5 (use of police services)	

Allocation of services to users

For services where the service use variable in Understanding Society is an adult variable (health, social care, transport and police services) the services are allocated to adults in the USoc data directly.

For services where the variable is a child or youth dataset variable (early years, schools and youth services), use of these services is allocated equally to both adults in couple families.

A limitation of the USoc data is that for some services where children are a subset of service users, we do not have data on children's service use because the questions are only asked in the dataset. This is the case for health, social care, transport and police services. The model will therefore underestimate the extent to which families with children are affected by cuts to these services. In the case of health, this is mitigated by the fact that parents will usually attend GP appointments for their children and these will show up as GP appointments in the adult dataset.

Social housing services are allocated based on the housing tenure variable in the USoc household-level dataset.

Estimating use of residential social care services

Modelling receipt of residential care services is harder than receipt of domiciliary care services because we do not observe any USoc sample members in care homes because USoc panel members who enter residential care are dropped from the sample[4]. Therefore, an alternative strategy for allocating public spending on residential care is used, which uses a regression for sample members in the English Longitudinal Survey of Ageing (ELSA) which predicts the probability of ELSA members moving into residential care in future waves conditional on age and other characteristics in Wave 1. The predicted probabilities of moving into residential care

[4] The USoc data does include a variable for why individuals who were interviewed for USoc in previous waves left the USoc sample, but this does not include an option for "moved into residential care".

from the ELSA regression are used to make an out-of-sample prediction for USoc sample members of their probability of moving into residential care, and these probabilities are used to allocate public funding for residential social care across the USoc sample (combined with the results of the residential care means-test as explained below).

Means-testing for social care

As well as modelling the receipt of social care, for the purposes of modelling the distributional impact of public spending on social care it is essential to model the means-tests for domiciliary and residential care. The means tests determine whether care recipients receive free social care or whether they have to self-fund. For England, the following rules apply:

- Residential care is subject to an asset test which includes the value of the care recipient's home (for homeowners who live on their own). Anybody with total assets in excess of £23,250 (including house value) is not eligible for state-funded residential care.
- Domiciliary care is subject to an asset test which *excludes* the value of the care recipient's home. Anybody with total assets in excess of £23,250 (excluding house value) is not eligible for state-funded domiciliary care.

Information in the USoc data on savings, the value of housing (for homeowners) and household structure (whether the householder lives on their own or not) is used to determine eligibility for publicly funded social care.

References

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