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Modelling Universal Basic Income using UKMOD

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Abstract

This paper focuses on the possibilities and functionalities offered by the tax-benefit microsimulation model for the UK – UKMOD to simulate and analyse the distributional impact of three examples of Basic Income schemes. We show how to build in functionalities to ensure fiscal neutrality and we aim to highlight some of the trade-offs that implementing a Basic Income scheme brings. This paper doesn't intend to engage with arguments around the desirability of introducing Basic Income but rather focuses on the options that UKMOD offers, giving a couple of examples of schemes based on a set of criteria described below.

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1. Introduction

The COVID-19 pandemic has spurred renewed interest in the possibilities of a Universal Basic Income to address the key problems of income insecurity, poverty and income inequality. Although these problems were exacerbated by the necessary measures to contain the virus, they predate the pandemic. In-work poverty has been growing in the last two decades (Joseph Rowntree Foundation, 2019a), the result of a combination of job insecurity and precarious working conditions with high costs of housing, childcare and transport, and a less generous social security system (JRF, 2019b). Income inequality has risen: changes to the tax and social security systems in the last decade have been regressive, with the lowest-income households estimated to have lost 17% of their living standards (income and public services) by 2020 (Women's Budget Group and Runnymede Trust, 2017). The current system of means-tested benefits combined with high costs of childcare, has also meant that people in low-income households, especially mothers, face very high participation tax rates when planning to return to gainful employment, for example after maternity leave, which in practice traps many families into poverty.

A Universal Basic Income has been proposed by some academics, think tanks and policy organisations as a way to mitigate these problems. Such Basic Income (BI) is claimed to contribute towards income security and financial autonomy for individuals through a fixed, unconditional and individual regular stipend. By offering everyone a guaranteed income, a BI scheme would work to reduce poverty and income inequality.

Several Basic Income schemes have been modelled and analysed for the UK using different tax and benefit microsimulation programmes. In recent years, the RSA analysed the feasibility of a Basic Income for Scotland in 2019, using the Landman Economics tax-transfer model (Painter *et al.*, 2019); Luke Martinelli tested the distributional impact of full and partial Basic Income schemes for the UK using IPPR's microsimulation model (Martinelli, 2017b), and Malcolm Torry compared three income maintenance policies, including a Basic Income, as a response to the coronavirus crisis in 2021, using the UKMOD model (Torry, 2021).

This paper focuses on the possibilities and functionalities offered by the UKMOD microsimulation programme to model and analyse the distributional impact of three examples of BI schemes. We show how to build in functionalities to ensure fiscal neutrality and we aim to highlight some of the trade-offs that implementing a Basic Income scheme brings. This paper doesn't intend to engage with arguments around the desirability of introducing BI but rather focuses on the options that UKMOD offers, giving a couple of examples of schemes based on a set of criteria described below.

UKMOD is a publicly available, free programme for the static microsimulation of tax and benefits in the UK, developed by the Centre for Microsimulation and Policy Analysis (CeMPA) at the University of Essex with funding from the Nuffield Foundation. It offers a high degree of flexibility in editing existing policies and implementing new ones. It is accessible to anyone interested in modelling policy reforms, such as Basic Income schemes, with or without possible changes in the personal income tax system to pay for them. Its built-in statistics presenter offers a quick and simple way of analysing the distributional impact of such schemes on incomes, poverty and inequality, and their fiscal impact on state revenues and spending. Therefore,

UKMOD allows to examine both the design and the distributional and fiscal implications of a Basic Income scheme, including its interaction with the rest of the tax and benefit system.

2. Criteria for the design of a Basic Income scheme

In order for a Basic Income scheme to reduce income inequality and poverty levels and improve income security, it would need to fulfil a set of criteria in its design and impact. To assess whether a Basic Income scheme is fulfilling those aims, we summarise the criteria as follows:

2.1 Principles

The Citizens' Basic Income Trust identifies the following characteristics for a Basic Income (Citizen's Basic Income Trust, n.d.):

- 'Unconditional': could vary only by age, not according to people's social or economic circumstances.
- 'Automatic': would not need to be applied for.
- 'Non-withdrawable': could not be withdrawn for any reason or means-tested.
- 'Individual': would be paid to the individual, and not on a household or couple basis.
- 'As a right of citizenship': in practice, paid to every legal resident, subject to a minimum period of residency in the UK.

2.2 Success criteria

A Basic Income is generally put forward as a policy to ensure income security, and to reduce poverty and inequality at the individual level. An effective BI scheme, to provide sufficient resources in the long-run and be fair and morally acceptable to many, must not discourage people from entering/remaining in the labour market. BI's unconditionality has led to it being supported by some campaigners for the rights of individuals with protected characteristics. Therefore, its efficacy could be measured by:

- Its impact on income inequality (both inter and intra-household) and on poverty;
- How many losers there are, and how severe their losses are, particularly among those already disadvantaged under the current tax/benefit system;
- Its effects on employment incentives, especially at the bottom of the income distribution;
- How it affects income inequality and employment incentives for individuals with protected characteristics (both within households and society as a whole).

Although it is important to model individual effects of a BI scheme, especially when it operates significant transfers within households, by moving away from means-tested benefits, this limited study does not investigate in detail any intra-household allocation. Instead it points out some ways in which a BI scheme may contribute to intra-household redistribution of income, including through changes to individual employment incentives.

2.3 What BI does and does not do

Given the trade-off at play between reducing poverty, avoiding unemployment traps and controlling costs – the well-known "iron triangle" of social policy (Blundell, 2001) - it is worth considering BI schemes that do not intend entirely to replace the whole existing social security system. Full BI schemes tend to either worsen poverty and increase income inequality or require high levels of income taxation (see for example Martinelli, 2017a). Previous studies have tended to keep some of the means-tested benefit system in place and complement it with a 'partial BI' to avoid significant losses of income for those at the bottom of the income distribution (e.g. Reed and Lansley, 2016; Torry, 2021).

This study examines BI schemes that augment but do not replace the existing social security system, so that means-tested or other benefits can still support the incomes of any for whom the BI is insufficient, including crucially those with specific additional costs like for disability, housing and child-rearing. This is done by:

- Maintaining existing means-tested benefits and their means-testing (although the existence of BI reduces reliance on them);
- Keeping existing non-means-tested benefits at unchanged levels (with the exceptions for children and pensioners described below in Section 2.5).

So, rather than pre-determining the nature of BI – partial or full, we examine the extent to which different levels of BI replace the need for means-tested benefits.

UKMOD relies on the sample and data from the Family Resources Survey, which is cross-sectional, and therefore limits modelling of entitlements built up over time. In particular, this means that UKMOD does not fully simulate eligibility and the level of most contributory benefits. Moreover, contributory benefits other than the state pension are mostly received by working-age adults for a specific, often temporary, reason, such as maternity leave, industrial injuries or sickness, and we left these unchanged.

Since 2013, there has been a cap on the total amount of benefits that a household can receive. Since everyone receives BI, we thought it inconsistent to include BI in the benefit cap.

The tax-benefit system sits alongside public services that provide for certain needs such as housing security and childcare. In the UK, means-tested cash benefits are used to help with the costs of meeting many such needs, which might be met in other countries through the provision of public services. Had our social protection system been designed differently, with greater reliance on universal basic services, there would be less need for much of the current benefit system. Means-tested benefits then pay a key role in the UK to compensate for not having a system of universal basic services.

2.4 How to fund it

Fiscal neutrality, which may be necessary for a Basic Income scheme to achieve initial political acceptance and be sustainable in the long run, will require a complementary reform of the tax system. This is the approach of some authors who have modelled BI for the UK (see for example Martinelli, 2017a; Torry, 2021). To assess the impact on poverty and inequality, it is the combined impact of changes to both tax and benefits including BI that needs to be examined. Introducing a BI is itself an inherently progressive move, increasing the incomes of the poor proportionately more than those of the rich, but we need to take into account how it is funded too, which could make the system as a whole more or less progressive. For example, abolishing the personal allowance makes the income tax system less progressive as poorer taxpayers lose more proportionately than richer, but if used to fund a BI which is extended to those with no taxable income, the changes may work out as progressive overall.

Of course, fiscal neutrality can be achieved not just through changes to the income tax and national insurance systems alone but also through drawing on other forms of revenue such as wealth taxes or revenue from sovereign wealth funds. However, given UKMOD only models personal income tax and national insurance contributions, the distributional impact of other forms of revenue cannot be fully assessed in this study.

To incorporate BI within reforms that are as a whole fiscally neutral, we have further assumed that our reformed tax-benefit system:

- has no Personal Allowance in the income tax system, since this effectively functions as a restricted form of Basic Income received by only those with other income;
- has no upper or lower limit for National Insurance contributions (NICs), so that NICs effectively become a flat tax on employment; the lower limit is abolished because with BI no one should be so dependent on their earnings that they cannot afford to pay NICs; the upper limit is also abolished to make the NI system less regressive and help pay for BI[*];
- has BI entering the means-test for other benefits and also taxable: to make a reasonable level of BI affordable and so that those who are best placed to do so contribute the most to its cost.

As argued above, keeping means-tested benefits is crucial in a social security system that relies on cash transfers to help with costs such as housing and childcare that vary greatly between people. In our model, the BI enters the means test, but it is not itself means-tested. For administrative convenience BI could be paid net of basic rate tax, with additional tax recouped through PAYE or individual tax returns.

Most other attempts at modelling BI schemes (Atkinson et al., 2017; Hirsch, 2015; Lansley and Reed, 2019; Martinelli, 2017a; Torry, 2021) also abolish the personal allowance, if only to raise funds to pay for BI, may change the NI system, and also include BI in means-tests for social security benefits, but do not tax it. Our model also taxes BI, so that those on higher incomes,

[*] Alternative assumptions would be to abolish only the lower or upper limit or to leave NICs unchanged

paying a higher marginal rate of tax, contribute more to its cost. To tax BI as well as make it part of the means-test for other benefits increases the progressivity of the tax-benefit system as a whole.

2.5 How much BI and for whom?

We have assumed that:

- Working-age adults get the standard BI, calculated as explained below.
- Everyone of pension age, regardless of their contribution record, gets their state pension (if any), possibly topped up to reach a pensioner's BI.
- Children receive a child's BI, a fixed proportion of a working-age adult's BI.

Our child's BI, just like the adult's and pensioner's BI, is taxable as the child's income and enters their benefit unit's means-test. This replaces Child Benefit.[†] (In an alternative BI scheme, described in Section 4.6, instead of giving a taxable BI to children, it is paid as Child Benefit to the mother/main carer, so does not enter the means-test and remains tax-free.)

Most other BI schemes modelled for the UK also give lower BI amounts to children and higher BI to pensioners than to working-age adults (Martinelli, 2017a; Torry, 2021), although some give a lower BI amount to pensioners (Reed and Lansley, 2016).

3. Three different methods of modelling BI in UKMOD

UKMOD allows us to make changes to both the benefit system and the income tax and NI system, and simulate those changes' effects on a representative sample of the UK population. Weighting is used to calculate aggregate fiscal effects and distributional and other effects on the population. Having made changes, we can then adjust either the level of BI (Method 1) or the amount of tax raised (Method 2) to achieve fiscal neutrality.

Other sources of funding for BI, including wealth taxes (Henry, 2014) or a sovereign wealth fund (Johnston, 2020; Lansley et al., 2018; Painter et *al*., 2018), have also been suggested. However, on the revenue side, UKMOD can model only income taxes and national insurance contributions (NIC). For a given level of BI, method 3 allows us to calculate any revenues from additional sources needed over and above specified tax and NIC changes.

Thus, three different ways of using UKMOD to investigate BI schemes have been developed:

- Method 1: to calculate the level of BI that a given change in the tax schedule could support.
- Method 2: to calculate the changes in tax rates required to support a BI of a given level.

[†] In practice the child's BI could be allocated to the mother/main carer, as Child Benefit is now.

- Method 3: to calculate the effect on the fiscal balance of given changes to both the level of BI and the tax schedule.

3.1 Method 1: Calculating a fiscally-neutral BI from a fixed tax schedule

Once changes are made to the tax system, a loop is incorporated into UKMOD which, starting from a low level, lets the level of BI rise incrementally until fiscal neutrality is achieved (or could start from a high level and reduce BI gradually).

On top of the changes outlined in Section 2.4, abolishing the Personal Allowance for income tax and both the upper and lower earnings limits of NI, our tax reform is to retain all existing tax bands, including for the devolved nations, and increase all rates by an arbitrary 3 percentage points.

All pensioners (those above state pension age) receive a top-up which, combined with their state pension, is equal post-tax to the full value of the current new state pension (for basic rate taxpayers), which is about £175 per week in 2020.

Children receive a fixed proportion of the working-age adult BI. That proportion is set at 45%, which is what a lone parent and teenager (the most expensive sort of child) requires over a single adult in the Minimum Income Standard (MIS) (see details below under Method 2).

The level of working-age adult's and child's BI's is incremented through the loop until fiscal neutrality is achieved. Because the level of post-tax pensioner's BI is fixed, it is not adjusted by the loop, though its cost will impact on the level of working-age adult's and child's BI arrived at.

Our simulation results show that without any additional revenue, the annual BI (for working-age adults) that can be supported by such tax rises is £5,450. Because BI is taxed and the personal allowance is abolished, all BI recipients pay tax, and so the annual working-age post-tax BI is £4,200.[‡] Children receive £2,453 gross (£1,890 post-tax) and pensioners receive a BI of £11,831 gross or £9,110 post-tax[§].

Method 1 (increase tax rates by 3 ppts and abolish PA and NICs thresholds)

Adult BI - £4,200 net (£5,450 gross)

Child BI - £1,890 net (£2,453 gross)

Pensioner BI - £9,110 net (£11,831 gross)

[‡] Net amounts for Scotland differ slightly because of a lower first rate of tax.

[§] All pensioners receive some top up to compensate for the pensioner's BI being taxed, leaving those in receipt of the full new state pension in the same net position as before. But the 29.1% of pensioners who do not receive the full pension received a top-up that left them on average £189 a year better off.

3.2 Method 2: Calculating fiscally-neutral tax changes from a fixed BI amount

In this method levels of BI are pre-determined for all BI recipients, working-age adults, pensioners and children. Some tax changes can be pre-determined too (e.g. abolishing PA). Then a parameter is set for the tax system which is allowed to rise (or fall) incrementally in a loop until fiscal neutrality is achieved. Any changes to the tax system that can be calibrated by a single parameter can be used, for example, a percentage points addition to the tax rates in each band, or multiples of the tax rates in each band.

We choose to give all individuals, working-age adults, pensioners and children, the level of gross income needed for basic rate taxpayers to achieve the Centre for Research in Social Policy's Minimum Income Standard (MIS) (Hirsch *et al*., 2020). The child's level is calculated as the amount by which the MIS of a single parent with a teenager exceeds that of a single adult. For 2020, these rates are £16,674, £14,764 and £7,503 net income per annum for working-age adults, pensioners and children respectively.[**] Again, we abolish the PTA and both the lower and upper limits to NICs. Keeping existing bands, we raise the tax rate incrementally in all bands by the same percentage points until fiscal neutrality is achieved.

We find that in the absence of other forms of revenue, all tax rates will have to be raised by 47.6 percentage points to fund a level of BI that meets MIS standards. However, the gross level of BI required to achieve that net amount would be above the current higher rate tax threshold, which we have therefore increased just sufficiently to leave BI taxed at the basic rate (now 67.6%). We expect large distributional impacts to take place alongside huge swings in marginal effective tax rates, which we discuss in the results section.

Method 2 (to fund MIS amounts below, all tax rates need to increase by 47.6 ppts)

Adult BI - £16,674 net (set by MIS) (£51,462 gross)

Child BI - £7,503 net (set by MIS) (£23,158 gross)

Pensioner BI - £14,764 net (set by MIS) (£45,568 gross)

[**] It is from these amounts that child's BI is set at 45% of the working-age adults in our version of Method 1.

3.3 Method 3: Fixing both BI and tax changes to calculate fiscal requirements

In this case, all parameters need to be fixed: levels of BI for all sections of the population, and all tax changes. These can be of any type.

We choose to combine our two schemes above, abolishing the personal tax allowance, and both the upper and lower earnings limits of NI and increasing all income tax rates by 3 percentage points, and paying a BI that gives a net income of their MIS to all basic taxpayers.

We find that the deficit increases by £564,527 million (£565bn). We can compare this gap with the annual increase in total wealth in the UK using the Wealth and Assets Survey (ONS, 2019) to give a scale of the funding requirement. Total wealth increased in nominal terms by about 16% since the 2014-16 survey to reach £14.6tn (£8.5tn excluding pension wealth), corresponding to an annual increase in wealth of about £1,125bn. To fully make up the deficit in the BI scheme would therefore require a tax on that wealth increase of 50% (=565/1125).

We do not show the distributional outcomes of this method because we are not able to take account of the consequences of whatever way the increased deficit would be funded.[††]

Method 3 (tax rates increase by 3 ppts, BI set to MIS amounts. Funding gap of £565bn)

Adult BI - £16,674 net (set by MIS) (£21,654 gross)

Child BI - £7,503 net (set by MIS) (£9,745 gross)

Pensioner BI - £14,764 net (set by MIS) (£19,174 gross)

4. Assessment of the two schemes

The results below show two main schemes that correspond to the ones modelled by Method 1 and 2 above:

- 1: Calculating BI from a fixed tax schedule, a rise by 3 percentage points of all income tax rates.
- 2: Calculating tax changes from a fixed BI amount, giving MIS BI to working-age adults, children and pensioners.

[††] Indeed, as far as the simulated outcomes are concerned, a vast majority of individuals and households are winners, with households in the lowest income decile gaining 320% and in the top decile group 12% of their disposable income, with an average gain for individuals of 61%. Poverty rates (with a fixed poverty line) fall to zero and 99% of households, including 85% of the richest, gain more than 5%.

Table 1 recaps the main (weekly) amounts of BI by age group.

Table 1. Amount of weekly basic income by age group (£)

	Scheme 1		Scheme 2	
	Gross	Net	Gross	Net
Child	47.16	36.34	445.35	144.29
Working-age adult	104.81	80.77	989.65	320.65
Pensioner	227.52	175.36	876.30	283.92

Source: authors' calculations using UKMOD. Net adult rates are averaged across Scotland and rest of UK

"Net amounts" of BI are calculated by applying the basic rate of income tax to the gross amount in Scheme 1 and in reverse from net to gross in Scheme 2. The difference between the net and gross amounts of BI reflects the new basic tax rates applied, 23% in Scheme 1 and 67.6% in Scheme 2.

There are several ways by which we can assess the distributional impact of implementing BI schemes. We also assess their impact on employment incentives (METRs).

4.1 At-risk of poverty rates

One useful indicator is the poverty rate of individuals in different types of benefit units, measured by the equivalised disposable income of their household. At-risk of poverty rates (Before Housing Costs) in the Statistics Presenter and in Table 2 below are defined as the proportion of people living in households with equivalised income below 60% of the median equivalised household income before housing costs are taken into account.

In Table 2 the first three columns show the results using a floating poverty line, that is one based on the changes made to each scheme. The last two columns show the results using a fixed poverty line (that of the baseline system).

As expected, a higher BI set to MIS levels eradicates poverty (before housing costs) in most categories.

By contrast, Scheme 1, with lower tax rates and lower BI, provides mixed results. The reduction in floating poverty rates is lower for benefit units with children than for other benefit unit types. Indeed, the poverty rates for children themselves increase slightly against a floating poverty line and for lone parents against a fixed or floating poverty line. Pensioners stand to benefit most, especially couples, with poverty rates measured using a fixed poverty line reduced by half for single pensioners and by more than 80% for couples.

Table 2. Poverty rates by type of individuals and their benefit unit (floating and fixed) - BHC

	Floating			Fixed	
	Base	1	2	1	2
All	16.1%	13.4%	0.3%	11.0%	0.2%
Child	21.0%	22.2%	0.1%	18.2%	0.1%
Wk-age adult	14.0%	12.2%	0.4%	10.2%	0.2%
man	13.6%	11.4%	0.7%	9.5%	0.4%
woman	14.4%	12.9%	0.2%	10.9%	0.1%
Pensioner	17.1%	7.1%	0.0%	5.3%	0.0%
man	14.7%	4.6%	0.0%	3.4%	0.0%
woman	19.2%	9.2%	0.0%	6.9%	0.0%
Single man	17.5%	15.0%	1.8%	12.5%	1.0%
Single woman	16.7%	14.2%	0.3%	12.5%	0.2%
Couple w/o children	8.6%	5.9%	0.1%	5.2%	0.0%
Lone father	19.2%	24.5%	0.0%	20.9%	0.0%
Lone mother	29.7%	40.7%	0.1%	35.2%	0.1%
Couple w/ children	16.2%	14.8%	0.1%	11.7%	0.1%
Single male pens.	19.2%	12.1%	0.0%	9.5%	0.0%
Single female pens.	26.6%	17.9%	0.1%	13.8%	0.0%
Couple pens.	13.6%	2.3%	0.0%	1.6%	0.0%

Source: authors' calculations using UKMOD

Note: poverty rates BHC (before housing costs) – 60% of median equivalised household income (figures in the first four rows are identical to those computed by the Statistics Presenter of UKMOD).

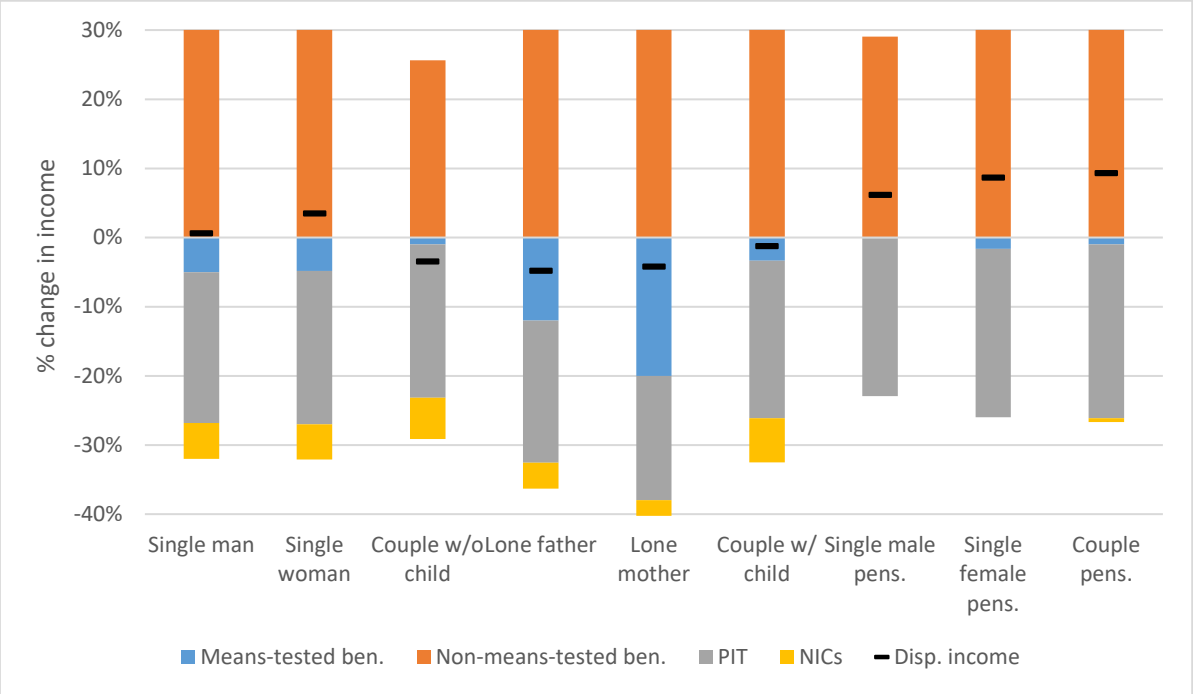
4.2 Mean income changes by benefit unit type

The average change in benefit unit disposable income and its components relative to the baseline disposable income is shown in Figures 1 and 2 by gendered household types[‡‡], for each of the two schemes. Overall changes in disposable income are smaller in the first scheme compared to the second, but there are differences in which types of households gain and lose, due to sharp swings in the components of disposable income. All households gain from increased non-means tested benefits since BI is included in this category, but they vary in how far corresponding reductions in means-tested benefits and rises in income tax and NICs affect them.

[‡‡] By gendered household types we actually mean types of benefit unit, in which single-headed benefit units are distinguished by the gender of their head. In the remainder, households and household types are to be understood as benefit units.

All parents and couples without children lose out in Scheme 1. Lone parents are most affected, as the level of their own BI and that of their children is insufficient to compensate them for the loss of means-tested benefits and the extra Income tax and NICs they pay (while at the same time substituting for Child Benefit). They lose an average £19 per week, just shy of the current first child's Child Benefit amount.

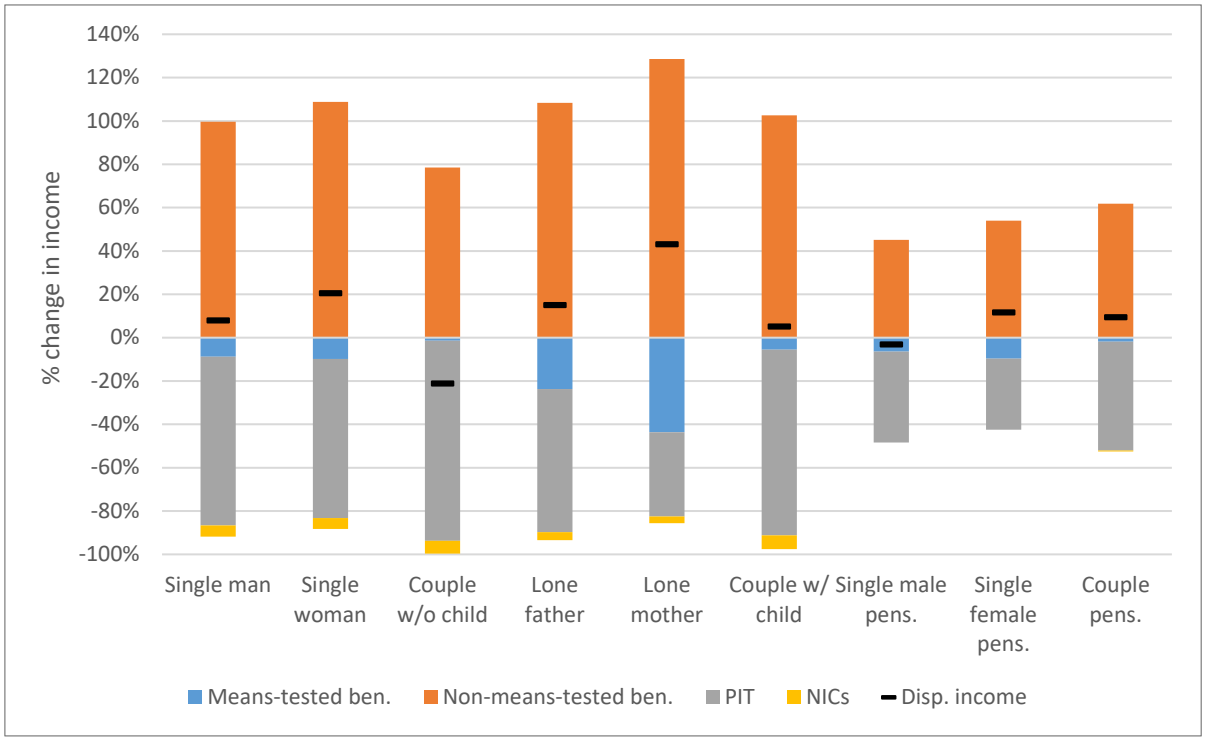
Figure 1. Relative change in disposable benefit unit income by gendered household type: Scheme 1



Source: authors' calculations using UKMOD.

Note: PIT stands for personal income tax and NICs for National Insurance contributions.

Figure 2. Relative change in disposable benefit unit income by gendered household type: Scheme 2



Source: authors' calculations using UKMOD

Pensioners are net beneficiaries in Scheme 1, given that all now receive the full amount, relatively benefiting those with low or non-existent state pensions, likely to be married women and single female pensioners. Couples without children, with their higher average earnings, pay more through the changes in the income tax system. Their net contribution is £29 per week on average, less than 5% of their baseline income. Those with children lose out, their basic income payments not compensating them for loss of means tested benefits and increased tax paid.

In Scheme 2, the redistribution between household types is magnified. But this time, those with children are net beneficiaries, with the higher BI amount outweighing the reduction in means-tested benefits. Lone mothers see their disposable income increase by 43%. Only couple households without children lose out; their higher incomes on average mean that each receiving BI does not compensate them for the increased tax paid.

The net gains or losses also follow gendered lines for single adult households: benefit units where the single adult is a woman gain more in each category. With their lower previous resources, women on average gain the same from a BI as men but pay less for it in tax. In particular in Scheme 2, single female pensioners gain an average £34 per week, whereas single male pensioners lose £11 on average.

4.3 Mean income changes by decile groups (BU)

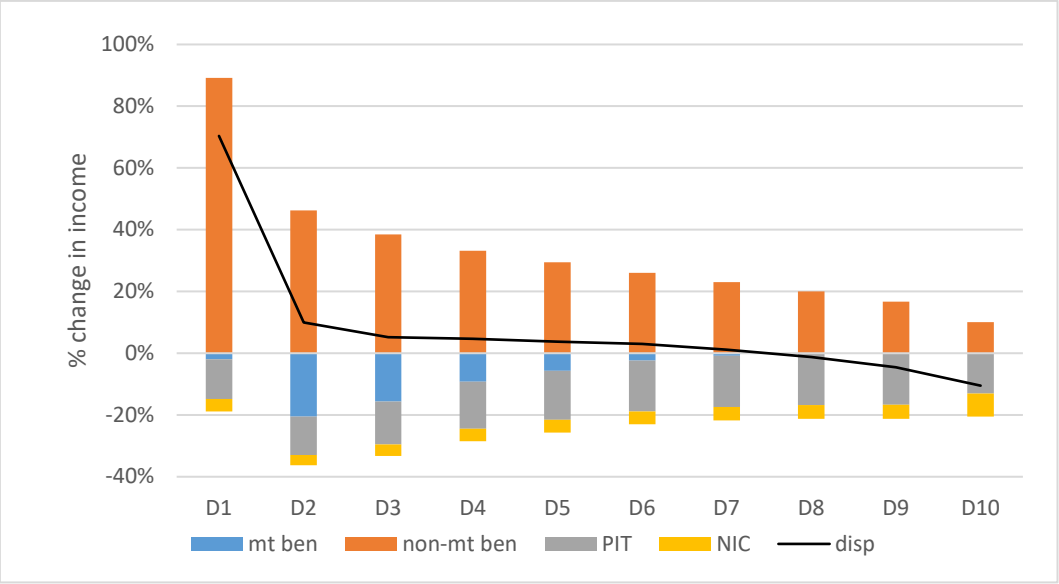
The redistribution at play also operates across income categories. Figures 3 and 4 show the average change in disposable benefit unit income for each scheme when individuals are placed in decile groups by their benefit unit's equivalised income.

The main beneficiaries from the introduction of a BI are in the lowest decile group, with an average gain of 71% in Scheme 1. The increase in taxation and reduction in means-tested benefits is more than compensated by the amount of BI. This also applies to the next seven decile groups. Only the top 30% of benefit units are net contributors, with the top 10% contributing a net 10% of their baseline disposable income.[§§] The first decile group gains on average £101 per week in disposable income and the top decile contributes most (a net loss of £177 per week). The ratio D10/D1 of disposable income is reduced by half, from 11.8 to 6.2.

The redistributive picture in Scheme 2 is magnified substantially. The top 30% remain net contributors, but by a much larger proportion of their income. The top 10% see a net contribution of 58% of their disposable income and the 9th decile group contributes nearly 30%. The bottom decile sees gains of 286% relative to their baseline income, with a decreasing percentage net gain in each higher income decile group. In relative terms, as a percentage of their income, the lowest income group contributes more in additional tax and lost means-tested revenue than the highest income groups but is more than compensated for that by the BI they receive (shown in Figure 4 as additional non-means-tested benefit). This means that overall, both schemes are more progressive than the baseline system, and Scheme 2 even more so than Scheme 1. Both schemes redistribute between the same groups (from the top three decile groups to the bottom six) but Scheme 2 operates a far more substantial redistribution of income.

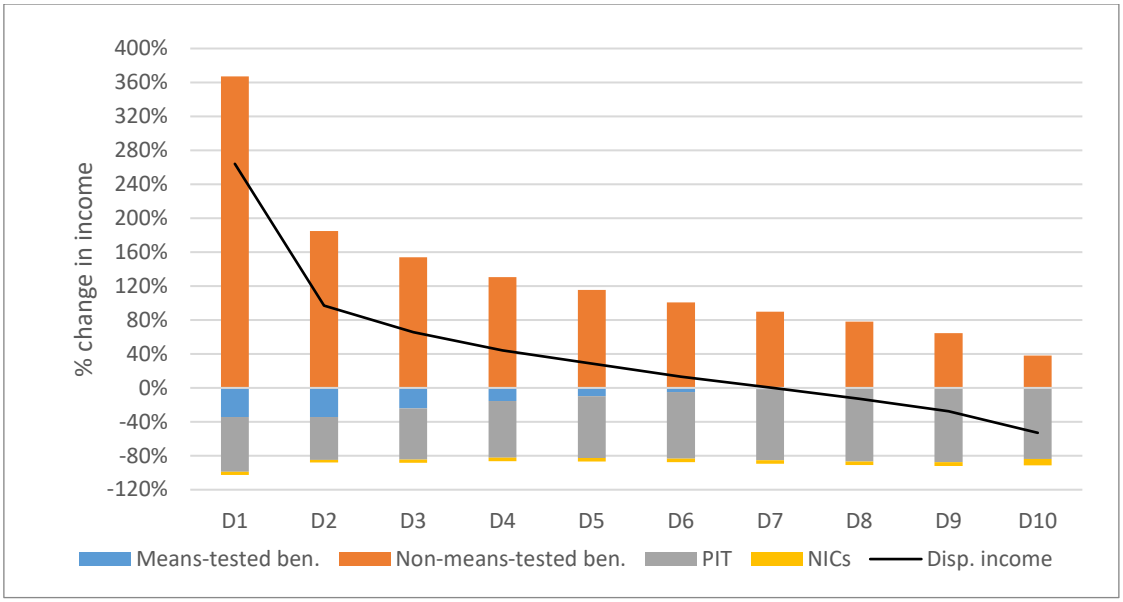
[§§] Technically top 30% but decile group 8 sees its net contribution average below 1%

Figure 3. Change in disposable income and its component by decile group (Scheme 1)



Source: authors' calculations using UKMOD

Figure 4. Change in disposable income and its component by decile group (Scheme 2)



Source: authors' calculations using UKMOD

In disposable income, the top decile group contributes almost a net £1000 per week in Scheme 2 while the bottom decile group sees a net gain of over £400 per week. The ratio D10/D1 of disposable income is reduced by 90%, from 11.8 to 1.3. These results show changes in average disposable income for different groups. A slightly different take on the same distributional picture is to look at the proportion of winners and losers in these different groups of households.

4.4 Winners and losers

Table 3 shows the proportion of winners and losers by more than 5% of their benefit unit's disposable income in each scheme.

Most individuals and benefit units are net gainers but there are significant proportions of net losers in each benefit unit type. In Scheme 2 this is particularly the case for benefit units without children while in Scheme 1, the groups with most net losers are lone parents, especially lone mothers, and to a lesser extent other working-age adults.

Table 3. Proportion of winners and losers by individuals and benefit unit type

	Scheme 1		Scheme 2	
	loss >5%	gain>5%	loss >5%	gain>5%
All	26%	35%	34%	59%
Child	36%	29%	25%	69%
Wk-age adult	29%	28%	40%	53%
man	28%	28%	42%	51%
woman	29%	29%	38%	55%
Pensioner	3%	64%	25%	67%
man	4%	63%	28%	65%
woman	3%	65%	23%	69%
Single man	23%	32%	35%	59%
Single woman	21%	37%	29%	64%
Couple w/o children	31%	22%	58%	35%
Lone father	56%	11%	28%	64%
Lone mother	58%	18%	9%	87%
Couple w/ children	30%	30%	31%	62%
Single male pens.	6%	46%	28%	61%
Single female pens.	2%	58%	19%	72%
Couple pens.	4%	68%	27%	66%
Decile groups				
D1	14%	83%	4%	96%
D2	25%	65%	0%	100%
D3	25%	54%	0%	100%
D4	18%	51%	0%	98%
D5	15%	43%	3%	83%
D6	7%	29%	20%	73%
D7	5%	14%	31%	30%
D8	15%	7%	84%	7%
D9	46%	3%	97%	2%
D10	87%	1%	99%	1%

Source: authors' calculations using UKMOD

4.5 Marginal effective tax rates

The story around basic income is not just about the amount of income in people's pockets and the reduction of means-testing. Its viability also depends on the decisions people make about employment once they receive a BI. On the one hand, with BI people may be able to live without taking employment, and increased tax rates may reduce their gain from employment. On the other hand, people are less dependent on means-tested benefits that clawback a substantial portion of that gain from employment. This is especially important for second earners in low-income households, a majority of women, who face substantial employment disincentives when accounting for childcare costs. So it would be useful to know a BI scheme's overall effect on employment incentives, especially at the extensive margin, by examining participation tax rates - how much a person gains from entering employment. However, marginal effective tax rates, which are a measure of employment incentives at the intensive margin - how much an already employed person's household gains from increasing their earnings by a fixed percentage - are easier to calculate, and may still give us some insights into the factors influencing employment decisions across different groups.

UKMOD allows a direct analysis of marginal effective tax rates (METR). To do so UKMOD re-estimates the tax paid by each earner and benefit received by their benefit unit, assuming that person's employment income has increased by 3%.[***] Participation tax rates, giving the employment incentives to enter employment, are not directly calculated by UKMOD, because they require additional assumptions about the job that they take.

Taking the extreme example of Scheme 2, one expects its marginal effective tax rates to be very high, given that marginal income tax rates for basic rate taxpayers have increased by 47.6 percentage points compared to the baseline. Indeed, the median METR of all earners is about 34% in the baseline, 39% in Scheme 1 and jumps to 100% in Scheme 2. However, the most interesting question is how the change in METR is distributed between different groups. In particular we examine the extent to which earners in low-income benefit units – who face a high METR in the baseline compared with those in higher-income benefit units because of benefit withdrawal – see a reduction in their METR. In a nutshell the question is: for whom does the replacement of means-tested benefits by non-means-tested BI reduce average METRs more than the rise in tax rates increases them?

Tables 4 and 5 show the changes in average METR (from taxes, benefits and in total) for each scheme relative to the baseline METR, for different groups.

For example, it is interesting to note that in Scheme 1, lone parents, despite losing out on average in terms of mean income, see their METR reduced, mainly due to a switch from means-

[***] Earnings can be changed by a different percentage.

tested benefits to the non-means-tested BI. In Scheme 2, the average METR of all gendered household types increases due to the rise in tax rates.

Table 4. Changes to mean marginal effective tax rates of earners by household type (% points) compared to baseline

	Scheme 1			Scheme 2		
	Ben	Tax	total	Ben	Tax	total
Single man	0	0	0	-4	71	67
Single woman	-1	12	11	-5	73	68
Man in couple w/o child	-3	14	10	-2	66	64
Woman in couple w/o child	-1	12	10	-2	69	67
Lone father	-2	12	10	-30	67	37
Lone mother	-15	14	-1	-44	78	34
Father in couple	-20	18	-2	-13	66	53
Mother in couple	-9	13	4	-9	73	64
All	-5	13	8	-7	70	62
Female earner	-8	15	6	-16	74	58
Male earner	-6	12	7	-10	70	60
Two earners	-3	13	10	-4	68	64

Source: authors' calculations using UKMOD

Distinguishing individuals by their benefit unit's income decile group as in Table 5 shows a U-shaped picture, with earners in the lowest two decile groups facing an increase in METR in Scheme 1, whereas those in the following two decile groups find their METR falls. The main contribution to this is the tax increase from abolishing the personal allowance and NIC thresholds, which affects the METR's of the lowest earners most. The METR of earners in the second quintile (decile groups 3 and 4) reduces more from the reduction of means-testing than it increases through the rise in tax rates. Further disaggregation by type of benefit unit and income levels would be useful here to distinguish couples and sole earners in low-income households. Scheme 2 sees a similar increase in METR across the board. There are no systematic differences in changes in METR by gender in each decile group.

Table 5. Changes to mean marginal effective tax rates of earners by decile group (% points)

	Scheme 1			Scheme 2		
	Ben	Tax	total	Ben	Tax	total
D1	-13	32	19	-31	96	65
D2	-16	24	9	-28	88	61
D3	-19	15	-4	-27	79	52

D4	-12	11	-1	-18	73	55
D5	-7	10	3	-10	71	61
D6	-2	9	7	-4	69	65
D7	-1	10	8	-2	69	67
D8	-1	11	11	-1	67	66
D9	0	13	13	0	65	65
D10	0	13	13	0	60	60

Source: authors' calculations using UKMOD

Table 6 is probably the most interesting in terms of locating the effect of METR changes with respect to the level of METR in the baseline system. The groups show the categories of baseline METR for those with positive earnings. The first group with METR = 0 consists of those whose earnings are so low that even if they marginally increased, no tax or NICs would be payable in the current system (because their earnings are below both the personal allowance and the NICs lower earnings limit), nor would they lose benefits (so either their household is not on means-tested benefits or, if it is, their earnings fall within the earnings disregard). The next group has an METR between 0 and 20%. About 65% of earners in this and the previous group are women. The next three groups, with METR between 20% and 80%, include a majority of men, while the last group, with an METR between 80% and 400%, is predominantly comprised of female earners (58%).

The groups with the highest METRs, those above 60%, which must be due to means-tested benefit withdrawal, are those whose employment incentives are increased by moving to a BI scheme, with their METR falling significantly in Scheme 1. Despite large increases in marginal tax rates in Scheme 2, those with the highest baseline METR still face a significant fall in their METR, albeit not as strong as in Scheme 1.[†††] There are no substantial differences in the change in METR by gender within each category.

Table 6. Changes to mean marginal effective tax rates of earners by baseline MTR group (% points)

	Scheme 1			Scheme 2		
	Ben	Tax	total	Ben	Tax	total
METR= 0%	3	34	37	0	99	99
0-20	0	26	26	-1	89	88
20-40	0	9	9	0	66	66
40-60	-3	13	10	-5	60	55
60-80	-33	12	-20	-44	73	29
METR > 80%	-39	14	-25	-85	77	-8

Source: authors' calculations using UKMOD

[†††] Note that these figures may hide large differences within groups. A quick look at quantile distribution reveals that even among these high baseline METR groups (METR above 60%), about 80% of people experience a decrease in their METR in scheme 1. In scheme 2, by contrast, only about 10% of earners in the top group with very high baseline METRs experience a decrease in their METR.

4.6 Alternative treatment of children's BI

In an alternative to Scheme 1, we have estimated what would be the implications of treating the BI for children differently, by paying it as a reformed Child Benefit, while leaving all other features of Scheme 1 unchanged.

Compared to Scheme 1, this way of paying BI for children has the following features:

- It is the mother/main carer who receives Child Benefit on behalf of their child and not the child;
- It is not taxed;
- It does not enter the means-test;
- The Child Benefit Higher Rate Charge that was introduced in 2013 is abolished to keep CB, as a form of BI, universal;
- Child Benefit is removed from the benefit cap, for the same reason.

After finding the corresponding level of working-age adult BI, this yields a Child Benefit of £ 34.65 per week for each child, just below the net child BI of £36.34 per week in Scheme 1, where the latter but not the former would enter the means-test of other benefits. With fiscal neutrality, the same tax changes and a pensioner BI that is fixed, this means that the adult's net BI falls slightly from £80.77 to £77.07 per week (still above JSA in 2020).

Results show that the main effect is redistributive towards poorer households with children and thus on child and lone parents' poverty rates. While Scheme 1 saw a rise in poverty rates (BHC) for lone mothers (even with a fixed poverty line) from 30% to 35%, this alternative scheme pushes poverty rates for lone mothers down to 27% and lone fathers to 15%. Couples with children see their poverty rate at 12% unchanged from Scheme 1, while that of single pensioners rises by up to 5% and poverty rates of other household types rise slightly. The same goes for net gains in disposable income. Lone mothers stood to lose 4% of their disposable income in Scheme 1 while they gain 1% in this alternative. And in terms of winners and losers, while 58% of lone mothers face losses of more than 5% in Scheme 1 and only 18% gaining by more than 5%, this alternative scheme reduces the proportion of lone mothers who would lose more than 5% of their income to 23%, while 27% of them would gain by more than 5%.

A small trade-off operates in the form of increased METR. While lone mothers and fathers in couples saw a reduction of their METR in Scheme 1 compared to the baseline (by 1 and 2 percentage points respectively), this alternative scheme entails a small increase by 4 and 6 percentage points respectively. Again further investigation is needed to gauge the intra-household effects for couples with children in either alternative of Scheme 1 and in Scheme 2.

Note that applying the alternative treatment of children to Scheme 2 makes little difference because there is very little means-testing remaining in the system.

5. Conclusion

In this paper we have shown how UKMOD can be used flexibly to model different versions of UBI and different ways of funding them. We have analysed two relatively extreme schemes, including an alternative treatment of children, and examined differences in their outcomes. Our results demonstrate the challenges faced by advocates of BI who want to achieve fiscal neutrality by funding it from within the (income and NI) tax-benefit system. However, a modest version of BI that remains well below minimum income standards and could be funded by a 3 percentage point rise in tax rates would still go some way to eliminating income poverty, substantially reducing inequality and improving employment incentives for those on means-tested benefits. Reaching levels of BI in line with minimum income standards would entail substantial redistribution, however. Disposable incomes of the top 10% of households would only be 1.2 times that of the bottom 10%, which in itself would be a radical transformation of current capitalist systems. It may seem unrealistic but it is not without merit as it establishes a benchmark on funding requirements and distributional implications against which the effect of other equalising policy measures can be assessed, such as better public services, more generous benefits for specific needs and / or public ownership of many vital parts of the economy.

It is difficult to separate discussion of what constitutes an adequate level of BI from the effect of other forms of public spending and taxation. In particular, need for income depends on what still must be paid for, given the level of public service provision. Public services also form the background to people's employment decisions. For example, the current means-tested benefit system combined with very high private childcare costs can produce a poverty trap for many mothers. Universal childcare provision would not only reduce the level of BI needed, but reduce reliance on means-tested benefits for many families with young children, increasing employment incentives (De Henau, 2017).

This might mean that a lower BI is feasible while still achieving the aims at the lower end of the income distribution, provided other needs are well covered on top of that minimum with complementary benefits (e.g. for disability) for those unable to take on more paid employment.

UKMOD is not designed to model public service provision. However, UKMOD could take these other aspects of in-kind benefits into account, for example by changing the structure of childcare costs (e.g. by setting them to zero) and or housing costs and benefits to simulate universal access to basic services that would interact with different levels of BI and tax changes. The versatility of UKMOD makes it an excellent candidate for examining such implications to expand the discussions surrounding social security reforms.

Another avenue for further investigation that is crucially missing in many BI analyses, including this one, is to account more fully for the intra-household effects of moving away from means-testing, with greater access to independent income for all household members (complementarily to the effect on their employment incentives). For example, there is a lot to say about how individual rights to social security benefits may or may not improve gender equality, given the known employment disincentive for second earners of means-tested benefits (compounded for low-income families with young children by high private childcare costs) and/or reduce intra-household financial abuse (WBG, 2018). A fuller gender analysis that

accounts for these different success criteria and the trade-offs between them would shed more light on the feasibility in practice of a UBI that would make a genuine difference to inequality and poverty within and between households in the UK context.

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