

## Exercise 5: Reforming income tax in the UK

### Objectives:

- Analyse the structure of the personal income tax in the UK focusing on the personal allowance policy (*tinta\_uk*) and the income tax policy (*tin\_uk*)
- Perform a reform in UKMOD that involves modifying the income tax for Scotland and the rest of the UK, using the *SchedCalc* and *DefConst* functions

### Description:

The table below summarises income tax bands applicable in the UK for tax year 2021/22 excluding the personal allowance:

| <b>Taxable income<br/>(England, Wales<sup>1</sup> and Northern Ireland)</b> | <b>Rate of tax</b>      |
|---|-------------------------|
| £0 - £37,700  | 20% (basic rate)        |
| £37,701 - £150,000  | 40% (higher rate)       |
| Over £150,000   | 45% (additional rate)   |
| <b>Taxable income (Scotland)</b>  | <b>Rate of tax</b>      |
| £0 - £2,097   | 19% (starter rate)      |
| £2,098- £12,726   | 20% (basic rate)        |
| £12,727- £31,092  | 21% (intermediate rate) |
| £31,093 - £150,000  | 41% (higher rate)       |
| over £150,000   | 46% (top rate)          |

<sup>1</sup> Note that, since April 2019, UK tax rates have been reduced by 10 percentage points, and the Welsh Parliament has had the power to apply Welsh rates. In 2021/22, the Welsh Parliament set all rates to 10 percentage points, in line with England and Northern Ireland.

Modify the part of the income tax schedule that affects higher-income individuals:

- In **Scotland**: keep the income tax schedule the same but: on incomes between £31,093 and £90,000 apply a rate of tax of 41%; on incomes between £90,001 and £150,000 apply a rate of tax of 46%; and on incomes above £150,000 apply a rate of tax of 50%
- In **the rest of the UK (rUK)**: keep the income tax schedule the same but: on incomes between £37,701 and £100,000 apply a rate of tax of 40%; on incomes between £100,001 and £150,000 apply a rate of tax of 45%; and on incomes above £150,000 apply a rate of tax of 50%

Analyse the impact of the tax reform on the government budget and income distribution.

### Directions:

- Open UKMOD and access the UK policy descriptions
- Copy the *UK\_2021* system, and call the copy *UK\_2021tax\_ref*
- Define the new tax band of £90,000 (Scotland)/£100,000 (rest of UK) per year as a constant in policy *ConstDef\_uk*
  - a. Income tax band values are defined with a *DefConst\_uk* function (see constants with prefix *\$ITThresh*). Define the new tax band as a constant (e.g. *\$ITThresh\_ref*) which has a value of £100,000 per year for UK (default constant value) and £90,000 per year for Scotland (i.e. *drgn1=12*).
- Add the new tax band and modify the tax rates for Scotland and rest of UK in the two *SchedCalc* functions used to calculate the income tax
  - a. Add parameters *Band\_Rate* and *Band\_UpLim* in each of the *SchedCalc* functions used to calculate the income tax in Scotland and rest of UK. You may need to adjust the group number of the parameters (see column *Grp/No*), so they apply on the correct parts of the tax schedule.
- Save your changes
- Run *UK\_2021tax\_ref*
- Use the Statistics Presenter, Baseline/Reform option, to analyse effects

## Exercise 5: Reforming income tax in the UK

### Step-by-step solution and further information:

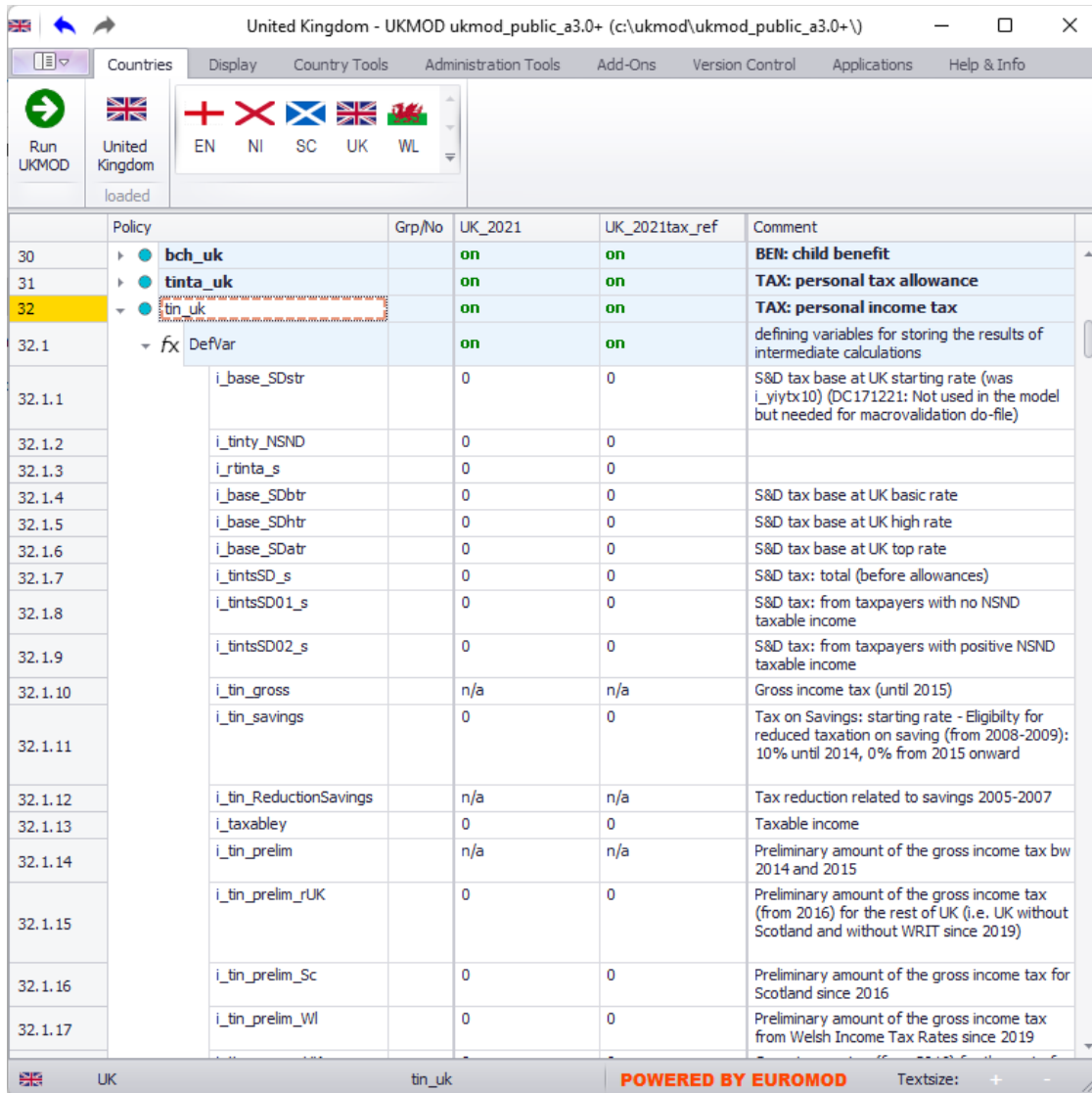
#### Step 1: Creating a new system

Our first task is to open UK and create a new system using the 2021 system as a base. Give the name *UK\_2021tax\_ref* to the new system. Hide all systems but these two - 2021 and 2021tax\_ref (see exercise 1 for explanation).

## Step 2: Analysing the current policy

Access the Income Tax policy in the UK (*tin\_uk*).

Figure 1: Analysing *tin\_uk*



| Policy  | Grp/No                 | UK_2021 | UK_2021tax_ref | Comment  |
|---------|------------------------|---------|----------------|--|
| 30      | bch_uk                 | on      | on             | BEN: child benefit   |
| 31      | tinta_uk               | on      | on             | TAX: personal tax allowance  |
| 32      | tin_uk                 | on      | on             | TAX: personal income tax   |
| 32.1    | fx DefVar              | on      | on             | defining variables for storing the results of intermediate calculations  |
| 32.1.1  | i_base_SDstr           | 0       | 0              | S&D tax base at UK starting rate (was i_yiytx10) (DC171221: Not used in the model but needed for macrovalidation do-file)        |
| 32.1.2  | i_tinty_NSND           | 0       | 0              |  |
| 32.1.3  | i_r tinta_s            | 0       | 0              |  |
| 32.1.4  | i_base_SDbtr           | 0       | 0              | S&D tax base at UK basic rate  |
| 32.1.5  | i_base_SDhtr           | 0       | 0              | S&D tax base at UK high rate   |
| 32.1.6  | i_base_SDatr           | 0       | 0              | S&D tax base at UK top rate  |
| 32.1.7  | i_tintsSD_s            | 0       | 0              | S&D tax: total (before allowances)   |
| 32.1.8  | i_tintsSD01_s          | 0       | 0              | S&D tax: from taxpayers with no NSND taxable income  |
| 32.1.9  | i_tintsSD02_s          | 0       | 0              | S&D tax: from taxpayers with positive NSND taxable income  |
| 32.1.10 | i_tin_gross            | n/a     | n/a            | Gross income tax (until 2015)  |
| 32.1.11 | i_tin_savings          | 0       | 0              | Tax on Savings: starting rate - Eligibility for reduced taxation on saving (from 2008-2009): 10% until 2014, 0% from 2015 onward |
| 32.1.12 | i_tin_ReductionSavings | n/a     | n/a            | Tax reduction related to savings 2005-2007   |
| 32.1.13 | i_taxabley             | 0       | 0              | Taxable income   |
| 32.1.14 | i_tin_prelim           | n/a     | n/a            | Preliminary amount of the gross income tax bw 2014 and 2015  |
| 32.1.15 | i_tin_prelim_rUK       | 0       | 0              | Preliminary amount of the gross income tax (from 2016) for the rest of UK (i.e. UK without Scotland and without WRIT since 2019) |
| 32.1.16 | i_tin_prelim_Sc        | 0       | 0              | Preliminary amount of the gross income tax for Scotland since 2016   |
| 32.1.17 | i_tin_prelim_WI        | 0       | 0              | Preliminary amount of the gross income tax from Welsh Income Tax Rates since 2019  |

- Income concepts are defined in a common policy *IIDef\_uk* at the top of the spine.
- Explore how personal income tax is calculated:
  - Policy *tinta\_uk* calculates personal income tax allowance
  - Policy *tin\_uk* computes personal income tax.
- Explore how they work, what are the relevant output variables and how they interact with the rest of the tax-benefit system.

Further information can be found in the Country Report (see <https://www.iser.essex.ac.uk/research/publications/working-papers/cempa/cempa2-22> ).

Locate the SchedCalc (Schedule Calculator) functions, used for the calculation of the income tax, by checking the comment column and the implementation. Expand it by clicking on the arrow on the left hand side of the function.

Figure 2: NSND income tax calculation in 2021/22 (tin\_uk)

| Policy   | Grp/No           | UK_2021          | UK_2021tax_ref   | Comment   |
|----------|------------------|------------------|------------------|---|
| 32.23    | fx SchedCalc     | on               | on               | Income tax schedule since 2008/09                 |
| 32.23.1  | Who_Must_Be_Elig | one              | one              |   |
| 32.23.2  | base             | i_taxabley       | i_taxabley       | Tax base  |
| 32.23.3  | band_rate        | \$ITRate1        | \$ITRate1        | First band rate                                   |
| 32.23.4  | band_uplim       | \$ITThreshHigh   | \$ITThreshHigh   | Upper limit of first band                         |
| 32.23.5  | band_rate        | \$ITRate2        | \$ITRate2        | Second band rate                                  |
| 32.23.6  | band_uplim       | \$ITThreshAdd    | \$ITThreshAdd    | Upper limit of second band                        |
| 32.23.7  | band_rate        | \$ITRate3        | \$ITRate3        | Third band rate                                   |
| 32.23.8  | Output_Var       | i_tin_prelim_rUK | i_tin_prelim_rUK | Preliminary gross income tax                      |
| 32.23.9  | TAX_UNIT         | tu_individual_uk | tu_individual_uk |   |
| 32.24    | fx SchedCalc     | on               | on               | Welsh Rates of Income Tax since 2019/20 (NSND)    |
| 32.24.1  | Who_Must_Be_Elig | one              | one              | (rates for EN and NI are 0)                       |
| 32.24.2  | base             | i_taxabley       | i_taxabley       | Tax base  |
| 32.24.3  | band_rate        | \$ITRate1Wl      | \$ITRate1Wl      | First band rate                                   |
| 32.24.4  | band_uplim       | \$ITThreshHigh   | \$ITThreshHigh   | Upper limit of first band                         |
| 32.24.5  | band_rate        | \$ITRate2Wl      | \$ITRate2Wl      | Second band rate                                  |
| 32.24.6  | band_uplim       | \$ITThreshAdd    | \$ITThreshAdd    | Upper limit of second band                        |
| 32.24.7  | band_rate        | \$ITRate3Wl      | \$ITRate3Wl      | Third band rate                                   |
| 32.24.8  | Output_Add_Var   | i_tin_prelim_Wl  | i_tin_prelim_Wl  | Preliminary gross income tax from WRIT            |
| 32.24.9  | TAX_UNIT         | tu_individual_uk | tu_individual_uk |   |
| 32.25    | fx Elig          | on               | on               | Identification of Scottish taxpayers              |
| 32.25.1  | Elig_Cond        | (drgn1=12)       | (drgn1=12)       |   |
| 32.25.2  | TAX_UNIT         | tu_individual_uk | tu_individual_uk |   |
| 32.26    | fx SchedCalc     | on               | on               | Scottish income tax schedule since 2016/17 (NSND) |
| 32.26.1  | Who_Must_Be_Elig | one              | one              |   |
| 32.26.2  | base             | i_taxabley       | i_taxabley       | NSND Tax base                                     |
| 32.26.3  | band_rate        | \$ITRateSSc      | \$ITRateSSc      | Starter rate                                      |
| 32.26.4  | band_uplim       | \$ITThreshBSc    | \$ITThreshBSc    | Upper limit of first band                         |
| 32.26.5  | band_rate        | \$ITRateBSc      | \$ITRateBSc      | Basic rate  |
| 32.26.6  | band_uplim       | \$ITThreshIntSc  | \$ITThreshIntSc  |   |
| 32.26.7  | band_rate        | \$ITRate1        | \$ITRate1        | Intermediate rate                                 |
| 32.26.8  | Band_UpLim       | \$ITThreshHigh   | \$ITThreshHigh   |   |
| 32.26.9  | Band_Rate        | \$ITRate2        | \$ITRate2        | Higher rate                                       |
| 32.26.10 | Band_UpLim       | \$ITThreshAdd    | \$ITThreshAdd    |   |
| 32.26.11 | Band_Rate        | \$ITRate3        | \$ITRate3        | Top rate  |
| 32.26.12 | Output_Var       | i_tin_prelim_Sc  | i_tin_prelim_Sc  |   |
| 32.26.13 | TAX_UNIT         | tu_individual_uk | tu_individual_uk |   |

There are three *SchedCalc* functions: one for Wales, one for Scotland, and one for the rest of the UK. Note, however, that the function for Wales currently implies identical income tax rates to England and Northern Ireland, and so is not discussed further here. The income tax base is defined by *i\_taxable* (this variable is based on the income list *il\_Taxabley\_NSND*, defined in policy *IIDef\_uk*). The income tax bands are defined as constants – with the prefix *\$ITThresh* – using a *DefConst* function in policy *ConstDef\_uk* (you can also use the search option (Ctrl+F) to locate the constants in the model, e.g. search for *\$ITThreshHigh*):

- *\$ITThreshHigh*: Basic Rate limit for the rest of UK / Intermediate Rate limit in Scotland
- *\$ITThreshAdd*: Higher Rate limit
- *\$ITThreshBSc*: Starter Rate limit in Scotland
- *\$ITThreshIntSc*: Basic Rate limit in Scotland

Only two of the constants are used in the tax calculations for the rUK and all four for Scotland. To find out the tax band values, you can also hover with the cursor over the constant names within the *SchedCalc* functions.

Figure 3: Checking constant values by moving the cursor over the constant names

| fx | SchedCalc        |   | on                      | Scottish income tax schedule since 2016/17                                   |
|----|------------------|---|-------------------------|--|
|    | Who_Must_Be_Elig |   | one                     |  |
|    | base             |   | <i>i_taxable</i>        | NSND Tax base  |
|    | band_rate        | 1 | <i>\$ITRateSSc</i>      | Starter rate   |
|    | band_uplim       | 1 | <i>\$ITThreshBSc</i>    | Upper limit of first band  |
|    | band_rate        | 2 | <i>\$ITRateBSc</i>      | Basic rate   |
|    | band_uplim       | 2 | <i>\$ITThreshIntSc</i>  |  |
|    | band_rate        | 3 | <i>\$ITRate1</i>        | Intermediate rate  |
|    | Band_UpLim       | 3 | <i>\$ITThreshHigh</i>   |  |
|    | Band_Rate        | 4 | <i>\$ITRate2</i>        | Higher rate  |
|    | Band_UpLim       | 4 | <i>\$ITThreshAdd</i>    | <i>\$ITThreshHigh</i> = 34500#y<br><i>\$ITThreshHigh</i> = drgn1=12: 31580#y |
|    | Band_Rate        | 5 | <i>\$ITRate3</i>        | Top rate   |
|    | Output_Var       |   | <i>i_tin_prelim_Sc</i>  |  |
|    | TAX_UNIT         |   | <i>tu_individual_uk</i> |  |

### Step 3: Reforming the policy

In the reform system *UK\_2021tax\_ref*, add a new constant (i.e. parameter “placeholder”) in the *DefConst* function where the income tax parameters are defined. The new constant will contain the value of the new income tax band – call it e.g. *\$ITThresh\_ref*. This constant should take the value of £100,000 per year. The constant should not have any group number (see column Grp/No), to make it the default value.

To define the value of the tax band for Scotland, add a new constant (i.e. parameter “placeholder”) with the same name (e.g. \$ITThresh\_ref), a value of £90,000 per year and a group number = 1. Applying the group number means that condition#1, i.e. the individual should be from Scotland (drgn1=12), applies. Once you are done, your implementation should look as displayed below.

Figure 4: The new income tax band defined as a constant

| Policy | Grp/No | UK_2021  | UK_2021tax_ref | Comment  |
|--------|--------|----------|----------------|--|
| 3.4.20 |        | 0#y      | 0#y            | Default value for the whole of UK                                      |
| 3.4.21 |        | n/a      | 100000#y       | Tax threshold for reform scenario (default)                            |
| 3.4.22 |        | 0.2      | 0.2            | Default value for the whole of UK: First rate                          |
| 3.4.23 |        | 0.4      | 0.4            | Default value for the whole of UK: Second rate                         |
| 3.4.24 |        | 0.45     | 0.45           | Default value for the whole of UK: Third rate                          |
| 3.4.25 |        | 0        | 0              | Default value for the whole of UK: Starter rate Sc                     |
| 3.4.26 |        | 0        | 0              | Default value for the whole of UK: Basic rate Sc                       |
| 3.4.27 |        | 0        | 0              | Default value for the whole of UK: First WRIT                          |
| 3.4.28 |        | 0        | 0              | Default value for the whole of UK: Second WRIT                         |
| 3.4.29 |        | 0        | 0              | Default value for the whole of UK: Third WRIT                          |
| 3.4.30 | 1      | drgn1=12 | drgn1=12       | If person living in Scotland, use the following income tax parameters: |
| 3.4.31 | 1      | 5000#y   | 5000#y         | Starting rate band for savings upper threshold                         |
| 3.4.32 | 1      | 2097#y   | 2097#y         | Starter rate limit   |
| 3.4.33 | 1      | 12726#y  | 12726#y        | Basic rate limit   |
| 3.4.34 | 1      | 31092#y  | 31092#y        | Intermediate rate limit  |
| 3.4.35 | 1      | 150000#y | 150000#y       | Higher rate limit  |
| 3.4.36 | 1      | 0.19     | 0.19           | Starter rate   |
| 3.4.37 | 1      | 0.2      | 0.2            | Basic rate   |
| 3.4.38 | 1      | n/a      | 90000#y        | Tax threshold for reform scenario (SC)                                 |
| 3.4.39 | 1      | 0.21     | 0.21           | Intermediate rate  |

To modify the income tax schedule, add parameters Band\_Rate and Band\_UpLim in each of the SchedCalc functions used to calculate the income tax in Scotland and the rest of the UK. You will need to adjust the group number of the parameters (see column Grp/No), so they apply on the correct parts of the tax schedule (see Figures 3e – 3g).

Figure 5: Adding new parameters to the SchedCalc function

The screenshot shows the UKMOD software interface with the 'Add Parameters' dialog box open. The dialog is titled 'SchedCalc (order: 23) in policy tin\_uk'. It contains a table of parameters to be added to the function. The parameters are:

| Add                                 | Parameter        | Replaces   | Grp/No | Count | Default | Description                                   |
|-------------------------------------|------------------|------------|--------|-------|---------|---|
| <input type="checkbox"/>            | Do_Average_Rates |            |        |       |         | If set to yes the rate of the highest ban...  |
| <input type="checkbox"/>            | Quotient         |            |        |       |         | If defined Base is divided by the quotie...   |
| <input type="checkbox"/>            | Base_Threshold   |            |        |       |         | If Base is smaller result is set to zero.     |
| <input type="checkbox"/>            | Round_Base       |            |        |       |         | If defined Base is rounded to nearest w...    |
| <input type="checkbox"/>            | Simple_Prog      |            |        |       |         | If set to yes the same rate/amount is a...    |
| <input checked="" type="checkbox"/> | Band_Rate        |            | 4      | 1     |         | Rate to apply on band.                        |
| <input type="checkbox"/>            | Band_Amount      |            | 4      | 1     |         | Amount to add for band.                       |
| <input type="checkbox"/>            | Band_LowLim      |            | 4      | 1     |         | Lower limit of band.                          |
| <input checked="" type="checkbox"/> | Band_UpLim       |            | 4      | 1     |         | Upper limit of band.                          |
| <input type="checkbox"/>            | Output_Add_Var   | Output_Var |        |       |         | Variable for storing the result of the fun... |
| <input type="checkbox"/>            | Result_Var       |            |        |       |         | Variable for storing the result of the fun... |
| <input type="checkbox"/>            | Flin_Var         |            |        |       | sel_s   | Variable indicating whether a person is       |

At the bottom of the dialog, there are checkboxes for 'Show Common Parameters' and 'Show Footnote Parameters', both of which are checked. There are also buttons for 'Description (F5)', 'Summary (F6)', 'Add', and 'Close'.



Figure 6: Modified income tax schedule for the rest of the UK

| Policy   | Grp/No           | UK_2021          | UK_2021tax_ref   | Comment   |
|----------|------------------|------------------|------------------|---|
| 32.22    | fx Elig          | on               | on               | Identification of non-Scottish taxpayers (except 2016)          |
| 32.22.1  | Elig_Cond        | !(drgn1=12)      | !(drgn1=12)      | In 2016, this schedule partially applies to Scottish tax-payers |
| 32.22.2  | TAX_UNIT         | tu_individual_uk | tu_individual_uk |   |
| 32.23    | fx SchedCalc     | on               | on               | Income tax schedule since 2008/09                               |
| 32.23.1  | Who_Must_Be_Elig | one              | one              |   |
| 32.23.2  | base             | i_taxabley       | i_taxabley       | Tax base  |
| 32.23.3  | band_rate        | 1 \$ITRate1      | \$ITRate1        | First band rate   |
| 32.23.4  | band_uplim       | 1 \$ITThreshHigh | \$ITThreshHigh   | Upper limit of first band                                       |
| 32.23.5  | band_rate        | 2 \$ITRate2      | \$ITRate2        | Second band rate  |
| 32.23.6  | band_uplim       | 2 \$ITThreshAdd  | \$ITThresh_ref   | Upper limit of second band                                      |
| 32.23.7  | band_rate        | 3 \$ITRate3      | \$ITRate3        | Third band rate   |
| 32.23.8  | Band_UpLim       | n/a              | \$ITThreshAdd    |   |
| 32.23.9  | Band_Rate        | n/a              | 0.5              |   |
| 32.23.10 | Output_Var       | i_tin_prelim_rUK | i_tin_prelim_rUK | Preliminary gross income tax                                    |
| 32.23.11 | TAX_UNIT         | tu_individual_uk | tu_individual_uk |   |
| 32.24    | fx SchedCalc     | on               | on               | Welsh Rates of Income Tax since 2019/20 (NSND)                  |

Figure 7: Modified income tax schedule for Scotland

| Policy   | Grp/No           | UK_2021          | UK_2021tax_ref   | Comment   |
|----------|------------------|------------------|------------------|---|
| 32.25    | fx Elig          | on               | on               | Identification of Scottish taxpayers              |
| 32.25.1  | Elig_Cond        | (drgn1=12)       | (drgn1=12)       |   |
| 32.25.2  | TAX_UNIT         | tu_individual_uk | tu_individual_uk |   |
| 32.26    | fx SchedCalc     | on               | on               | Scottish income tax schedule since 2016/17 (NSND) |
| 32.26.1  | Who_Must_Be_Elig | one              | one              |   |
| 32.26.2  | base             | i_taxable        | i_taxable        | NSND Tax base                                     |
| 32.26.3  | band_rate        | 1                | \$ITRateSSc      | Starter rate                                      |
| 32.26.4  | band_uplim       | 1                | \$ITThreshBSc    | Upper limit of first band                         |
| 32.26.5  | band_rate        | 2                | \$ITRateBSc      | Basic rate  |
| 32.26.6  | band_uplim       | 2                | \$ITThreshIntSc  |   |
| 32.26.7  | band_rate        | 3                | \$ITRate1        | Intermediate rate                                 |
| 32.26.8  | Band_UpLim       | 3                | \$ITThreshHigh   |   |
| 32.26.9  | Band_Rate        | 4                | \$ITRate2        | Higher rate                                       |
| 32.26.10 | Band_UpLim       | 4                | \$ITThreshAdd    | \$ITThresh_ref                                    |
| 32.26.11 | Band_Rate        | 5                | \$ITRate3        | \$ITRate3   |
| 32.26.12 | Band_UpLim       | 5                | n/a              | \$ITThreshAdd                                     |
| 32.26.13 | Band_Rate        | 6                | n/a              | 0.5   |
| 32.26.14 | Output_Var       |                  | i_tin_prelim_Sc  | i_tin_prelim_Sc                                   |
| 32.26.15 | TAX_UNIT         |                  | tu_individual_uk | tu_individual_uk                                  |

#### Step 4: Produce and analyse micro-data output

Save policies and run UKMOD to produce micro-output for the baseline (UK\_2021) and new system (UK\_2021tax\_ref). Then use the *Statistics Presenter Tool* (UKMOD Statistics – baseline/reform) to analyse the impact on the government budget and household incomes of the reform (see Exercise 2 for details).

#### Solution

See Excel file “Exercise 5.xlsx”