The OECD Tax-Benefit Model

1. The architecture of the Model

The OECD Tax-Benefit model covers 40 countries (33 OECD countries and from 2005 Cyprus[1], Latvia, Lithuania, Malta, from 2008 Bulgaria and Romania and from 2013 Croatia) and produces output for the years 2001 to 2015. The model is composed of five parts:

- Part one is the main module, **taxben.do**. This is the program which executes first, generates the various menus, and creates the basic building blocks for each of the different types of model runs. It then calls the necessary parameter and program modules.
    - o Control files (see section 5) are read and executed
    - o Interface sub routines (see section 3)
    - o Call other modules: person, parameter, program and METR files.

- Part two are the 'person' files - **person_single_earn.do** and **person_two_earn.do**. These programs are called by the main taxben module, and set up the various family types and earnings levels, depending on which family type and model run (see section 4) was selected. All of the general assumptions which hold across all countries are created here.
    - o Individual age (set at 40)
    - o Employment record (22 years)
    - o Housing costs are 20% of AW

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[1]   * Footnote by Turkey: The information in this document with reference to « Cyprus » relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

* Footnote by all the European Union Member States of the OECD and the European Commission: The Republic of Cyprus is recognized by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

- Part three is the parameter files. These files set parameters such as income limits, tax rates, and define most other constants. These files exist because, in most cases, the basic structure of a tax-benefit system does not change from year to year. However, things like tax bands or income thresholds generally change each year. Thus, in many cases it is possible to create a model for a country for a particular year simply by updating these parameter files. The parameter files follow the naming convention **XPARMY.DO** where X is the two letter country abbreviation and Y is the year being modelled.

- Part four is the program files. These files model the structure and implementation of the tax and benefit rules, using the specific parameters defined in the parameter files. For example, a program file would contain the code 'if income is above A, tax it at B percent'. A and B would be defined in the parameter file for the country. The program files follow the naming convention **XPROGY.DO** where X is the two letter country abbreviation and Y is the year being modelled.

- Finally, **METR.do** is the program which computes the Marginal Effective Tax Rates.

METR

An indicator that can be used for measuring the extent to which taxes and benefits reduce the financial gain from work is the marginal effective tax rate (METR). This indicator measures what part of any additional earnings is "taxed away" through the combined effect of increasing tax and decreasing benefit. In other words, the METR measures the effective tax burden to which the additional earnings are subject to. Formally, we have:

$$METR = 1 - \frac{\Delta y_{net}}{\Delta y_{gross}}$$

[A1a]

Where Δy_{gross} are the "additional earnings" referred to above and Δy_{net} is the change in net income obtained after taxes and benefits so that the change in gross earnings between labour market states A and B is:

$$\Delta y_{gross} = y_{grossB} - y_{grossA}$$
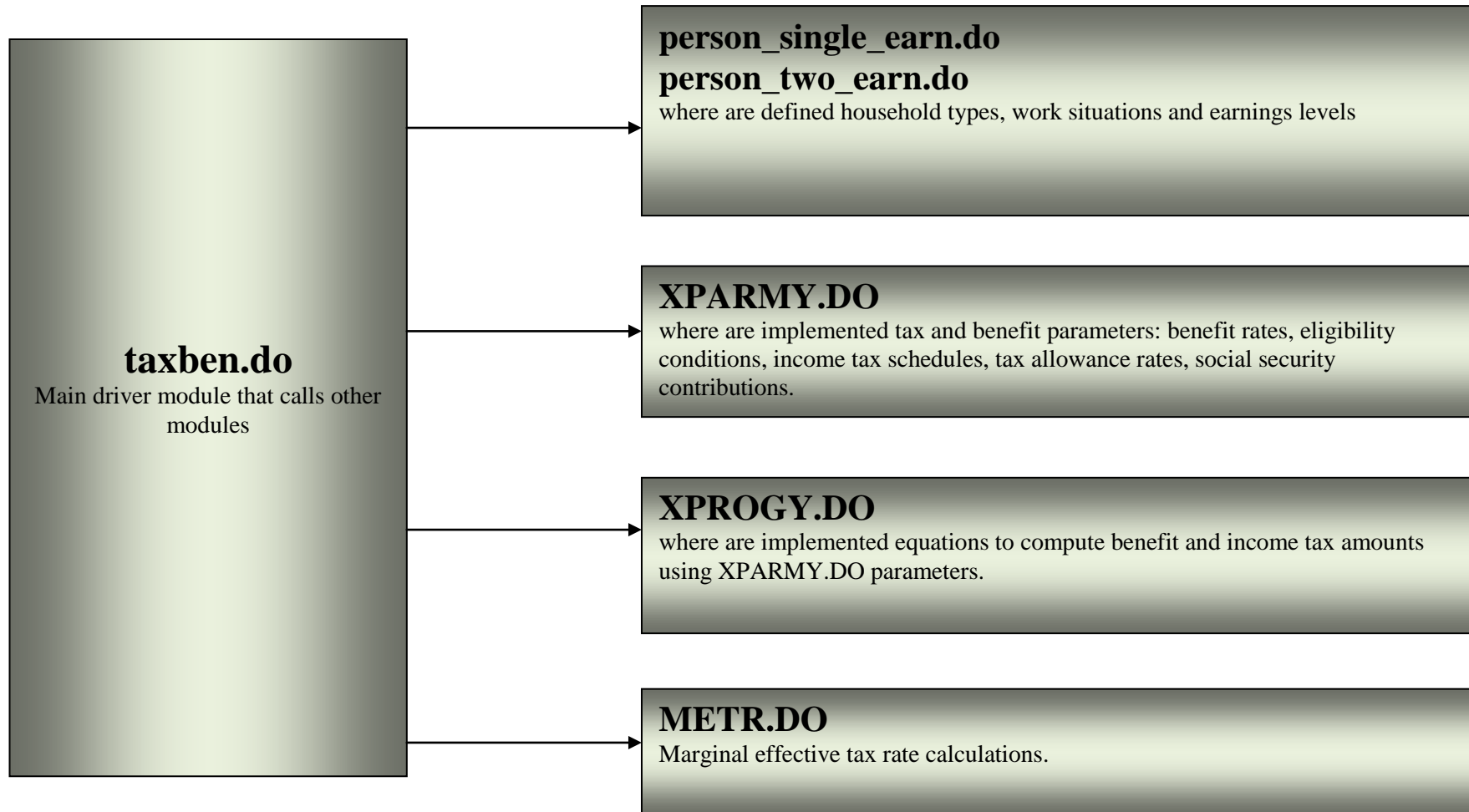
[A1b]

and the change in net income is:

$$\Delta y_{net} = y_{netB} - y_{netA} = (y_{grossB} - t_B + b_B) - (y_{grossA} - t_A + b_A)$$
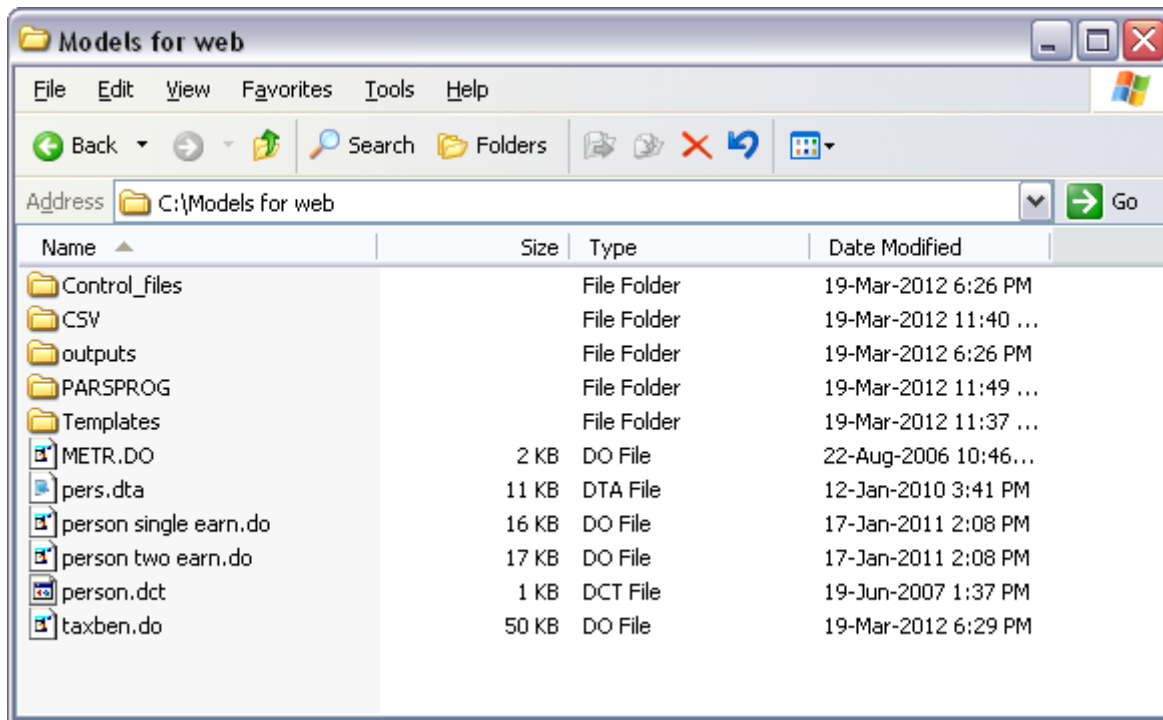[A1c]

where t denotes total taxes and b denotes total benefits.

The earnings change Δy_{gross} can relate to a large or small change of working hours and/or hourly wages.

The architecture of Tax-Benefit Models

taxben.do

Main driver module that calls other modules

person_single_earn.do
person_two_earn.do
where are defined household types, work situations and earnings levels

XPARMY.DO
where are implemented tax and benefit parameters: benefit rates, eligibility conditions, income tax schedules, tax allowance rates, social security contributions.

XPROGY.DO
where are implemented equations to compute benefit and income tax amounts using XPARMY.DO parameters.

METR.DO
Marginal effective tax rate calculations.

2. Installing the Model

In order to install the application, the five files and four directories above must exist. All of the **XPARMY.DO** and **XPROGY.DO** files must be located in the PARSPROG directory. Two CSV files **AW.csv** and **APW.csv** files must be located in the CSV directory. If you have downloaded the zip file, the directory structure above should be created when you unzip the files (extract them rather than opening the zipped file, and be certain to instruct your unzip program to 'preserve directory structure' or 'use folder names'). Please note that it is necessary to set stata's current directory to the directory where taxben.do is located using the 'cd' command (e.g. 'cd c:\taxbenmodel').

3. Running a Model Interactively

It is first necessary to execute the program, typing 'do taxben' from the command line. After the program has been loaded into memory, typing 'start' will pull up the menu on the left. To run the Tax-Benefit model interactively, click the top option, 'Run with User Interface'.

The second menu (pictured below) allows the various options to be set. Note that no fields can be left blank if the model is to run successfully. Text entered in the "Your name" field defines the folder name where model output will be stored. Thus selection of a country and run type are imperative, even if everything else is to be left in its default setting.

Tax-Benefit Model Interface

Using APW [0] or AW [1] as the measure of average wages.

Primary benefits are [0] unemployment benefits of [1] social assistance.

[0] No social assistance is paid; [1] social assistance is paid if eligibility conditions are met.

Spouse is: [1] working; [2] not working but looking for work; [0] not working and not looking for work.

Title of output folder

OECD TAXBEN m

Your name

Social Assistance / Unemp.Benefit

Primary_Benefit_Social_Assistance? `1`
Unemployment_Benefit...0 `0`
Social_Assistance...1 `1`

Allow_Receipt_of_Social_Assistance? `1`
Never....0 `0`
Always_if_relevant_conditions_met...1 `1`

Marital Status?
◉ Single ○ Married

Spouse works? `0`
Inactive `0`
Working `1`
Available_to_work `2`

Definition of APW `1`
Old `0`
New `1`

Run types for various work and family situations.

n Children `2`
`0`
`1`
`2`
`3`
`4`

Child_Care? `0`
`0`
`1`

Part-time childcare? `0`
`0` ▲
`1` ▼
0_full_time
1_hypo_part_time
2_actual_part_time

[1] Child-care benefits are included in household net income.

Run_Type `8`
Long-term-unemployment `0`
Unemp_by_APW_levels `1`
By-Principal-earnings `2`
By-Spouse-earnings `3`
Empl_by_APW_levels `4`
Child_care `5`
Child_age_evolution `6`
Couple_const_share `7`
Couple_varying_share `8`

Country:
`at`
al ▲
at
be
ba
bg
ca
cl ▼

Year?
`12`
95 ▲
97
99
01
02
03
04 ▼

Rent (% of AW)
`0.2`

Post_Child_Care_Incomes? `0`
`0`
`1`

[1] Child care costs are included in household net income.

child_age_evolution? `0`
`0`
`1`

Transition_into_work? `0`
....No........0 `0`
....Yes.......1 `1`

Reference_earnings
..........APW---->
...2/3*APW---->
....0.4*APW---->
....0.5*APW---->
....0.6*APW---->
....etc

`1`
1 ▲
2/3
.4 ≡
.5
.6
.7
.8 ▼

OK   Cancel

Include transitional into-work benefits, available for transitions from unemployment to employment

Rent as a percent of AW (set to 0 to exclude receipt of housing benefits)

Switch to activate *child-age-evolution* run-type

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4. Explanation of Model Options

A - The nine types of Model Run

The primary question to ask when running the model is what sort of model you wish to examine. The Tax-Benefit model has seven model structures for which it can generate data. The Tax-Benefit Model is flexible to the extent that new model structures can be created to produce data for other projects than Tax-Benefit project, e.g. Sickness and Disability project and Child Well Being project. The model structures are specified in the 'Run Type' box, and are as follows:

- *Run Type Zero* - Long Term Unemployment. This run type assumes full time unemployment. By default previous earnings are set at 100% of AW, although this can be varied using a control file (see below). The model runs for each month in unemployment (from the first month to the 60th month) to determine benefits received over time. This allows the user to see the expiration of duration-limited benefits such as Unemployment Insurance.
- *Run Type One* - Unemployment by AW Levels. This run type assumes unemployment (no working hours) and various the previous earnings levels between 0 and 200% of AW. In the case of a two earner couple[2], the secondary partner is assumed to work full time earning wages equal to 67% of AW by default, although this can be varied using a control file (see below).
- *Run Type Two* - By Principle Hours. This run type varies the number of hours worked per week by the primary partner between 0 and 40 hours (full time-work that corresponds to 100% of AW) then earnings keep on increasing up to 200% of AW. In the case of a two earner couple[1] the secondary partner is assumed to work full time earning wages equal to 67% of AW by default, although this can be varied using a control file (see below).
- *Run Type Three* - By Spouse Hours. This run type varies the number of hours worked per week by the primary partner between 0 and 40 hours (full time-work that corresponds to 100% of AW) then earnings keep on increasing up to 200% of AW. In the case of a two earner couple[1], the primary partner is assumed to work full time earning wages equal to 67% of AW by default, although this can be varied using a control file (see below).
- Run Type Four - Employment by AW Levels. This run type assumes the primary is working full time (40 hours per week) but changes the wage level from 0 to 200% of AW.
- *Run Type Five* – By childcare costs. This Run Type varies childcare costs from 0 to 100% of AW. The primary earner is assumed to work full-time at 100% AW. In the case of a two earner couple[1], the secondary partner is assumed to work full time earning wages equal to 67% of AW. Run Type Five can be executed for 2004 and 2008.
- *Run Type Six* – By child age increase. This Run Type varies child age from 0 (birth) to 27 years. The primary earner is assumed to work full-time at 100% AW. In the case of a two earner couple[1], the secondary partner is assumed to work full time earning wages equal to 100% of AW. The full features of Run Type Six (such as parental leave and child-birth

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[2] - A 'two earner couple' refers to a model run with the 'Marital Status' switch set to 'married' and the 'spouse works' switch set to one.

grants) can only be accessed for 2003 and only for a selection of countries (Denmark, France, Germany, Hungary, Italy, Japan, United Kingdom, and United States.

- *Run Type Seven* –Constant income splits within couples. This Run Type varies total household earnings, while holding the proportion earned by each partner constant. It requires users to specify couple families with working spouses.
- *Run Type Eight*– Varying income splits within couples. This Run Type holds total family earnings fixed, and varies the proportion earned by each partner. It requires users to specify couple families with working spouses.

B - Social Assistance / Unemployment Benefit

Two switches exist for controlling the receipt of Social Assistance, or minimum income benefits. The first switch, 'Primary Benefit Social Assistance' determines whether the models are being run for someone eligible for unemployment or not. If the switch is set to '1', the person is assumed to be ineligible for any sort of unemployment benefit. If it is set to '0, they are assumed to be eligible for Unemployment benefits.

The second switch, 'Allow Receipt of Social Assistance', determines whether income is evaluated for minimum income benefits. If this switch is set to '0', no social assistance will be received, even at very low income levels. If the switch is set to '1', social assistance benefits are calculated if income is below minimum thresholds.

C - Reference Earnings

This switch allows the wage level to be changed. By default, wages are set to 100% of AW for a full time worker. Thus, if someone works 20 hours per week, they will earn (gross) 50% of AW. However, this is not always the wage level one wishes to examine. Changing this number allows one to scale the wage level up or down. If, for example, one wanted to examine someone working full time, but earning the minimum wage level, and one knew that minimum wages were 41% of AW in a particular country, one could enter '0.41' in the reference earnings field, and full time wages (or previous wages, for calculation of unemployment benefits) would be equal to minimum wage. Note that this scaling factor applies to both workers in the case of a two earner couple.

D - Transition Into Work

In many countries, moving from a state of unemployment to a state of employment can result in special benefits being awarded. For example, a lump sum might be paid upon starting a new job (to cover the one-time costs often associated with a new job), or a benefit might be paid based to recipients of unemployment benefit who find a new job quickly, based on the amount of benefit they had remaining when the new job was found. The model uses this switch to pay these special benefits. Thus, if the 'Transition Into Work' switch is set to one, the model assumes the individual is moving from a state of unemployment to a state of employment. It is very important to set this switch to '0' if you wish to look at the net income position of an individual in a steady state of employment or unemployment, or if you wish to examine the transition from employment to unemployment.

E - Child Care

At this time, the child care switches ('Child Care YES/NO' and 'Post Child Care Incomes') are implemented in all cases for 2004 and 2008. If the two switches are set to '1', household net incomes will include childcare benefits and be reduced by childcare costs. If only the switch Child Care Yes/No is set to '1', then household net incomes will include childcare benefits without childcare costs.

F - Child age

Child age varies depending on the Run Type and the number of children within households that is limited to 4. For Run Types 0 to 4, ages are 6, 4, 10 and 8. For Run Type 5, ages are 3, 2, 5 and 4. For Run Type 6, ages are 0 (birth), 2, 7 and 12. The first age is given to the child in the one-child-household. The first and the second ages are given to the children in the two-child-household, and so on. Child ages are set by default in the *taxben.do* file. However they can be redefined by using control file options.

5. Running the Model Using a Control File

The OECD Tax-Benefit model has several options which are not reflected in the interactive menu. Additional functionality can be accessed using a *control file*. A sample control file has been included with the Tax-Benefit zip file. The first line is a header line telling the program which variables will be set by the control file. Each additional line in the control file represents one model run, using the parameters set by that line.

Options which may be set using the control file include:

nRuns - required - number of runs contained in the outfile.
def_wage - AW (1) or APW (0).
yr - Tax-Benefit year to be modelled.
ref_earn - allows the scaling of earnings. Normally this variable is set to 1 (100% of AW), but occasionally one may want to change the scale of the earnings levels, e.g. minimum wage level.
run_type - as explained above, generally an integer between 0 and 4.
intoWork - determines whether the run will be for an individual moving into work.
mars - marriage status - 1 for married, 0 for single
sp_works - determines whether the second partner is: working (1); not working but seeking work (2); or not working and not seeking work (0).
cCh - number of children household
primSA - SA as primary benefit (no unemployment benefits are paid)
allowSA - SA is paid if conditions are met
spouse_inc - is the spouse the one earning income?
principal_days - number of days per week worked. 5 days per week is 40 hours, or full time employment.

runcmnt - Comments to be placed in the outfile.
outfile – required – specifies the Excel workbook name to which data will be written.
tabname – required – specifies the tab (worksheet) within the Excel workbook to which data will be written.
country - specifies the country (two letter code corresponding to those in the drop-down menu of the interface).
outvar1 to **outvar30** - output variables to be written to *outfile*.

Childcare control files also include:

chAge# - age of child# (where # is an integer from 1 to 4 inclusive)
chCare - childcare benefits are paid
postCCinc - childcare benefits and costs are counted in household net income.

The control file **Standard_all_ctrys_01_10.dta** is included in the distribution, which can be used as a basis to create additional user-defined control files. Ensure any derived control files have up-to-date values in the variable **nRuns**.

6. Tax-Benefit Model output

If the interface is used to run the models, output variables will be shown through the STATA Data Editor. If you run the model using the control files, the output variables that are defined in control files are exported into an Excel workbook.

The main variables output are:

SA - Social Assistance
UB - unemployment Benefits including unemployment insurance (UI) and unemployment assistance (UA) benefits
IT - Income Tax minus any tax credits
SC - Social Security Contributions
HB - Housing Benefits
FB - Family benefits including lone-parent benefits
NET - Household net income
GROSS - Household gross earnings
METR - Marginal Effective Tax Rate which is calculated on the basis of increases in gross earnings of 1 percent of AW (or of the reference wage, if this is different). The negative and positive extreme values are limited by thresholds of -20 and 120
PoAW - Percentage of Average Wage
ÁW - Average Wage value
IW - in-work benefits

Childcare output files also include:

cc_cost - childcare costs

cc_benefit - childcare benefit including childcare cost subsidies

The Excel worksheet specified in **tabname**, within the workbook specified in **outfile**, will either be created, or replaced if it already exists. (The workbook will be saved in the folder **BaseFolder\outputs\[UserName]\output_A[P]W**, where **BaseFolder** is the folder containing *taxben.do* .)

If the **outfile** specified in the control file takes the form *CountryName_YY*_fixedH.xlsx, *CountryName _ YY _*changingH.xlsx or *CountryName _ YY _*fixedH_inclSA.xlsx (as they do in the provided control file), the model will initially use the templates (saved in the Templates folder) to create standard output files that have pre-prepared summary statistics and graphs.

These standard output files are:

CountryName _ YY _changingH.xlsx: The household earnings are related to the working days in a week. The rise of earnings from 0 to 100% of average wage is linked to the increase of working days from 0 to 5 (full-time). Then the earnings keep on rising to 200% of average wage. The household can remain eligible for unemployment benefits which decrease or stop depending on income ceilings or number of working days.

CountryName _ YY _fixedH_inclSA.xlsx: Household wage earners are working full-time and their earnings are increasing from 0 to 200% of average wage. Household wage earners are unemployed and their unemployment benefits are calculated on previous earnings that vary from 0 to 200% of AW. Social assistance benefits are calculated if income is below minimum thresholds.

CountryName_YY_fixedH.xlsx: Household wage earners are working full-time and their earnings are increasing from 0 to 200% of average wage. Household wage earners are unemployed and their unemployment benefits are calculated on previous earnings that vary from 0 to 200% of AW. No social assistance will be received, even at very low income levels.

The standard "changing hours" output files show income simulations for various household types:

1.   Single: "S" / "S (2)"(entitled / not entitled to UI benefits)

2.   Single parent: "S2C" / "S2C (2)" (entitled / not entitled to UI benefits)

3.   One-earner couple   "1C" / "1C (2)" (entitled / not entitled to UI benefits)

4.   One-earner couple with 2children   "1C2C" / "1C2C (2)" (entitled / not entitled to UI benefits)

5.   Two-earner couple   "2C67" / "2C67 (2)" (entitled / not entitled to UI benefits)

6. Two-earner couple with 2 children "2C2C67"/"2C2C67 (2)" (entitled / not entitled to UI benefits)

7. Two-earner couple "2C100"/"2C100 (2)" (entitled / not entitled to UI benefits)

8. Two-earner couple with 2 children "2C2C100" / "2C2C100 (2)" (entitled / not entitled to UI benefits)

9. Two-earner couple "2C167"/"2C167 (2)" (entitled / not entitled to UI benefits)

10. Two-earner couple with 2 children "2C2C167" / "2C2C167 (2)" (entitled / not entitled to UI benefits)

Example of graphs that are produced in **changing hour** files (showing the United States, in 2010):

One-earner-couple with 2 children, eligible for unemployment insurance benefits
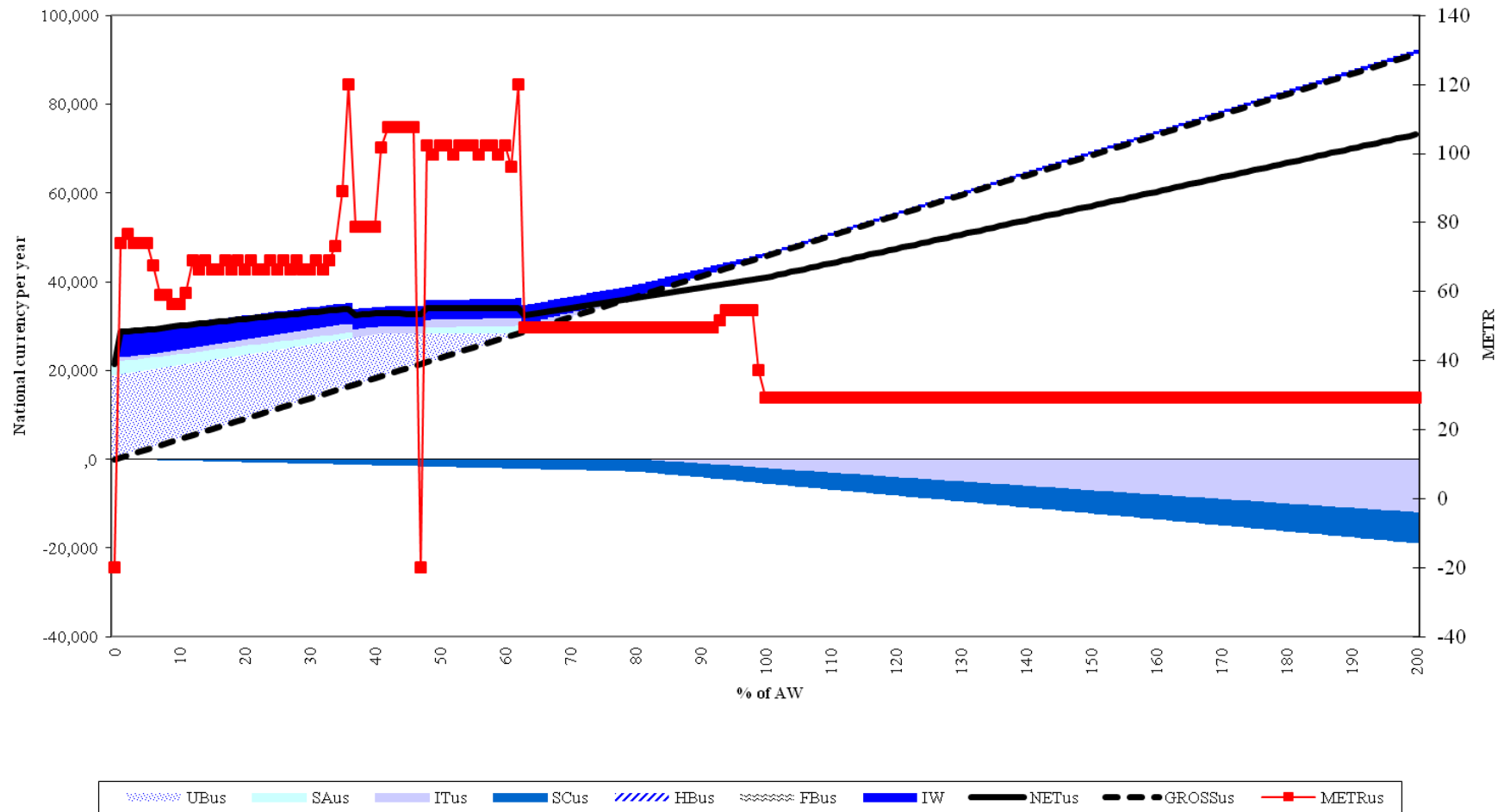
7. Troubleshooting

Occasionally, errors occur with the program. One of the most common occurs when the programs exit abnormally (because, for example, a variable has been referenced which does not exist). If this occurs, the first thing to check is the current directory (using the STATA command 'cd'). The program changes directory when it runs, and an abnormal exit may leave you in the wrong directory. If this is not the problem, exiting STATA and re-starting may solve the problem. We would like to emphasize that although we appreciate reports of any errors or bugs, we cannot offer support on these programs.

Please send all feedback to the OECD tax-benefit modelling team with the subject "Tax-benefit models".