# FAQ: simulating Consumption Taxes in EUROMOD

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## Contents



From model version J0.1+ beta onwards, EUROMOD includes the possibility of simulating consumption taxes (CT), together with direct taxes and benefits. A set of frequent questions and their answers follow.

This document has been prepared for the EUROMOD team at the JRC. For contact information and further support, check https://euromod-web.jrc.ec.europa.eu/support.

## GENERAL

- **Who developed this extension?**

  It is the result of a collective effort of the JRC, KU Leuven, University of Essex and Praxis over 2014-2021, in several phases. After that, JRC refined and updated the extension and fully incorporated to EUROMOD over 2022-2024.

- **Which taxes can be simulated?**

  EUROMOD can simulate the Value Added Tax (VAT) for all commodities and services and excises (ad-valorem and specific) on fuel, alcohol and tobacco. Simulations are coded at 5-digit COICOP code level (2003 version).

- **What is the coverage?**

  It is available for the 27 EU countries for seven years: 2010[1] and 2019-2024.

## DATA

- **What input data is used?**

  In order to simulate taxes on consumption, the standard EUROMOD EU-SILC-based data is matched with Household Budget Survey (HBS) data.[2] EUROMOD input datasets based on EU-SILC 2010 were matched with HBS 2010,[3] while datasets based on EU-SILC 2015 and 2019-2022 were matched with HBS 2015.[4] As a result, 149 new datasets were produced, with the following naming convention:

  CC_YYYY_sn_yyyy_co_mn.txt

  (e.g. SK_2022_b1_2015_03_e2.txt)

  where

  - CC = country code
  - YYYY = SILC year
  - sn = version (letter and number) of the SILC-based data
  - yyyy = HBS year (2010 or 2015)
  - co = COICOP version code (currently, 2003 for all cases, abbreviated to 03)
  - mn = version (letter and number) of the matched HBS (e = ESTAT, n = national)

  On top of the EU-SILC variables, these datasets contain expenditure shares (of disposable income) for 193 expenditure categories (for most countries excl. AT, DE and NL). These variables are named xs?????, where ????? is the corresponding 5-digit COICOP code. The meaning of each COICOP code can be consulted in the DRD files of the matched datasets.

- **Do these datasets replace the ones based only on EU-SILC?**

  Yes and no. It depends on the SILC year, as follows:

  - For all **EU-SILC waves up to 2022**, EU-SILC-only datasets will be always available. Matched EU-SILC-HBS datasets will be additionally available for SILC years 2010, 2015 and 2019-2022. I.e., for each matched dataset (e.g. SK_2022_b1_2015_03_e2.txt), the corresponding EU-SILC-only dataset (SK_2022_b1.txt) will remain available.
  - For **EU-SILC waves from 2023 onwards**, only matched datasets (e.g., SK_2024_b1_2015_03_e2.txt) will be produced and disseminated.

[1] 2012 for HR.

[2] Please note that the dataset includes expenditure in the form of expenditure shares of income and are allocated to each household member. Note that the original HBS expenditure data are provided at household level and as such to recover absolute expenditure data at household level they would need to be multiplied by total household income.

[3] For DK and HR, the EUROMOD EU-SILC-based data corresponds to 2012

[4] For DE, the only available dataset uses EU-SILC-based data of 2019; for IT the EU-SILC-based data 2019-2022 are not available; for LU the EU-SILC-based data 2020 is not available; for SK the EU-SILC-based data 2021 is not available.

- **Can I use the matched datasets even if I don't want to simulate consumption taxes?**

  Yes, and the results are the same as when you use the EU-SILC-only datasets. Simply the expenditure shares are not used in the simulation. In the beta version (J0.1+), matched datasets are never set as the best match of any system; however, from the stable version (J1.0+, to be released by February 2025), matched datasets will become the best match wherever available.

- **How can I get the matched datasets?**

  On top of the conditions needed to get access to the EU-SILC-only datasets, the Research Project Proposal (RPP) you have with EUROSTAT has to mention HBS. If this is not your case, you can amend your RPP to add HBS (all the information can be found here).

## MODEL

- **How are consumption taxes modelled in EUROMOD?**

  The modelling of consumption taxes is based on three components:

  - **A new policy, tco_CC**, which is placed at the end of the spine. It contains the parameters of VAT and excises (as constants). It sets them to the desired value for the simulation and it creates a set of income lists which are subsequently used by the CT add-ons to perform the calculation of consumption taxes each household pays based on their purchases.
  - **A new table, Consumption Taxes**, accessible from the Country tab. This table details the list of consumption taxes parameters (VAT, ad-valorem and specific excises, consumer prices only for goods subject to excises) for each category of goods. The CT table is country specific and it stores the baseline parameters by system-year. Information in the CT table should not be altered as they are meant to represent the baseline tax rules. The simulation of reform and counterfactual scenarios should not be done by changing the parameters in the table (baseline), instead the user should simply change the assignation in the spine (i.e. overwriting the constant value in the spine).
  - **Four new add-ons**, available in the Add-ons tab and runnable from the Run dialog. These add-ons are just instrumental to perform the necessary algebra for the computation of VAT and excises, so the user does not have to open or modify them. Specifically, CT_XBASE computes consumption taxes at baseline, while the other three compute consumption taxes under the reform allowing for the following behavioural assumptions:
    - CT_XCQ computes consumption taxes reform assuming constant quantities;
    - CT_XCIS computes consumption taxes reform assuming constant income shares;
    - CT_XCES computes consumption taxes reform assuming constant expenditure shares.

  To use the reform add-ons, you need first to run the baseline.

  The simulations are carried out as follows:

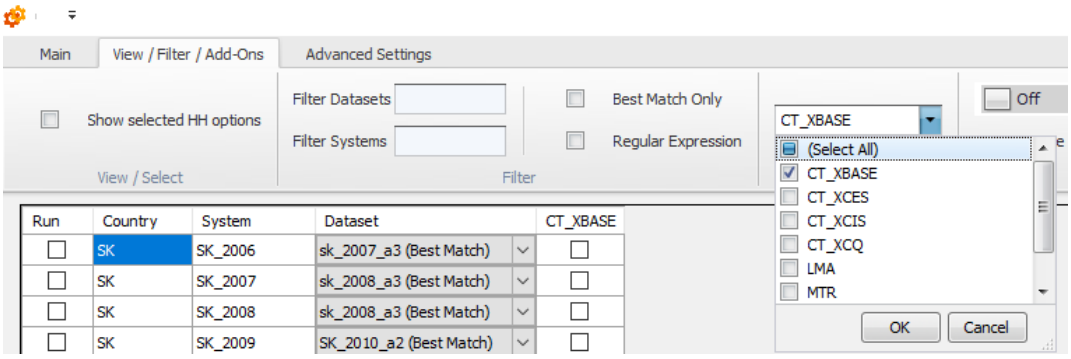
  - First, the standard EUROMOD simulations (direct taxes, social insurance contributions and benefits) are carried out. As a result, the model produces disposable income (ils_dispy) for each observation.

- Consumption is computed by multiplying the expenditure share of each COICOP code (from the input data) by the disposable income produced by EUROMOD. Please note that if you introduce changes in direct taxes, social insurance contributions or benefits, this will affect disposable income, hence consumption on each COICOP code.
- Then the corresponding VAT and excise liabilities are computed on consumption, and a new measure, post-CT disposable income, is computed as disposable income minus VAT and excises (ils_dispy - il_tva - il_txa - il_txv).

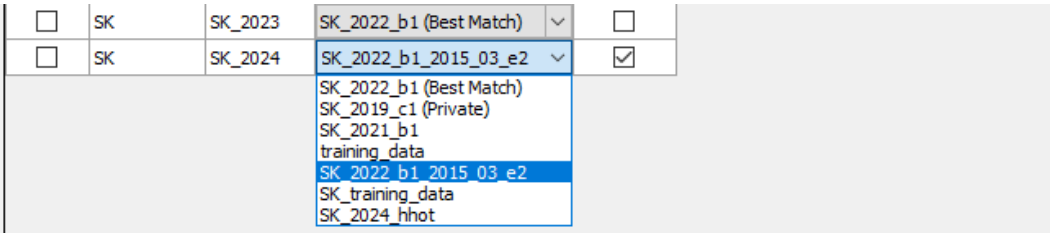
- **How do I run the baseline with consumption taxes?**

  You have to:

  - Open the Run dialog.
  - Make the CT_XBASE add-on column visible by selecting it in the dropdown menu available in the tab “View / Filter / Add-Ons”.




  - For the systems you want to run, tick the CT_XBASE column and select a matched dataset from the dropdown list in the Dataset column. Matched datasets are only available for systems where parameters for consumption taxes simulation are available (2010 and 2019-2022). The CT_XBASE add-on will run correctly only if using the matched dataset.




  - Click on Run.

  The run produces four datasets:

  - CC_yyyy_xbase_std.txt: includes the main simulations: direct taxes, social contribution, benefits and consumption taxes;
  - CC_yyyy _tco_cq.txt: an auxiliary file storing the consumption quantities for the constant quantity reform scenario;
  - CC_yyyy _tco_ces.txt: an auxiliary file storing total expenditures and savings for the constant expenditure shares reform scenario;
  - CC_yyyy _tco_fclb.txt: an auxiliary file storing the calibration factors at baseline and used by all reform scenario to ensure consistency of calibration between baseline and reforms.

- **How do I model reforms?**

  As in the standard use of EUROMOD, you have to create first a new reform system, as a copy of a baseline system (e.g., SK_2024_reform based on SK_2024). Then, given that consumption taxes are harmonised at EU-level, usual reforms will just consist of parametrical changes of VAT rates and excises and its allocation to different items. In particular:

  - If you want to **<u>change the values of an existing standard or reduced rate of VAT for all goods to which the rate applies</u>**, you have to do it in the function of the tco_CC policy in the spine. In the baseline system, these rates are just set to the values stored as constants in the Consumption Taxes table and representing the actual tax rules in place in each country and year. These are named as follows: $tco_base_t_std for standard, $tco_base_t_red* for reduced rates and $tco_base_t_zero for zero rate. To simulate a reform, modify the assignation of these parameters in the spine of the reform system that has been created. E.g., replacing $tco_base_t_std by 0.25.

| | | | | | |
|---|---|---|---|---|---|
| 33 | tco_sk | | off | off | TAX: Commodities |
| 33.1 | fx DefConst | | on | on | Parameters |
| 33.1.1 | $tco_t_std | 1 | $tco_base_t_std | 0.25 | vat - standard rate |
| 33.1.2 | $tco_t_red1 | 2 | $tco_base_t_red1 | $tco_base_t_red1 | vat - reduced rate 1 |
| 33.1.3 | $tco_t_red2 | 13 | n/a | n/a | vat - reduced rate 2 |
| 33.1.4 | $tco_t_zero | 3 | $tco_base_t_zero | $tco_base_t_zero | vat - 0% rate and exempted |
| 33.1.5 | $tco_theta1 | 4 | 20% | 20% | Theta- Tax incidence parameter level 1 |
| 33.1.6 | $tco_theta2 | 5 | 50% | 50% | Theta- Tax incidence parameter level 2 |
| 33.1.7 | $tco_theta3 | 6 | 80% | 80% | Theta- Tax incidence parameter level 3 |
| 33.1.8 | $tco_theta0 | 7 | 100% | 100% | Theta=1 |
| 33.1.9 | $tco_theta_flag | 12 | 0 | 0 | TIP: switch – set equal 1 to activate tax incidence pass through (TIP) calculations |

  - If you want to **<u>change the rate of VAT applied to specific items (single or multiple consumption goods)</u>**, you have to do it in the second function of the tco_CC policy in the spine where VAT rates are assigned to each specific item. The parameter needs to be changed in a reform system column that has to be created. E.g., if rice is taxed at the standard VAT rate and you want to tax it at the first reduced rate, you have to change $tco_t_std to $tco_t_red1.

| | | | | | |
|---|---|---|---|---|---|
| 33.2 | fx DefConst | | on | on | Parameters: vat rates (all goods) |
| 33.2.1 | Run_Cond | | GetDataCOICOPVersion=2003 | GetDataCOICOPVersion=2003 | |
| 33.2.2 | $tco_t_01111 | | $tco_t_std | $tco_t_red1 | 01111 : 01 Food and nonalcoholic beverages - 1 Food - 1 Bread and cereals - 1 Rice |
| 33.2.3 | $tco_t_01112 | | $tco_t_red1 | $tco_t_red1 | 01112 : 01 Food and nonalcoholic beverages - 1 Food - 1 Bread and cereals - 2 Bread |
| 33.2.4 | $tco_t_01113 | | $tco_t_std | $tco_t_std | 01113 : 01 Food and nonalcoholic beverages - 1 Food - 1 Bread and cereals - 3 Pasta products |

  - If you want to **<u>change specific excises</u>**, you have to do it in the fourth function of the tco_CC policy. Again, in the baseline system specific excises are set to their values stored as constants in the Consumption Taxes table (i.e $tco_base_a_[COICOP code]) which are assigned to the parameters of the simulation (i.e $tco_a_[COICOP code]). In a reform system column, to change a specific excise on, e.g, cigarettes in SK from 91.3 EUR to 100 EUR per 1,000 pieces, you have to replace $tco_base_a_02211 (91.3 in the Consumption

Taxes table) with “100” in the spine. It is important to be careful with the unit measure of reference (i.e. EUR per 1,000 pieces or EUR per Kg, etc.).

| | | | | | |
|---|---|---|---|---|---|
| 33.4 | DefConst | | on | on | Parameters: specific excises (excise goods) |
| 33.4.1 | $tco_a_02111 | 1 | $tco_base_a_02111 | $tco_base_a_02111 | excise - specific - 02111 Ethyl alcohol (per 100 l of pure alcohol) |
| 33.4.2 | $tco_a_02121 | 2 | $tco_base_a_02121 | $tco_base_a_02121 | excise - specific - 02121 Wine (per 100 l) |
| 33.4.3 | $tco_a_02122 | 3 | $tco_base_a_02122 | $tco_base_a_02122 | excise - specific - 02122 Sparkling wine (per 100 l) |
| 33.4.4 | $tco_a_02131 | 4 | $tco_base_a_02131 | $tco_base_a_02131 | excise - specific - 02131 Beer (per 100 L per Plato of finished product) |
| 33.4.5 | $tco_a_02211 | 5 | $tco_base_a_02211 | 100 | excise - specific - 02211 Cigarettes (per 1000 pieces) |
| 33.4.6 | $tco_a_02212 | 6 | $tco_base_a_02212 | $tco_base_a_02212 | excise - specific - 02212 Cigars (per 1000 pieces) |

- If you want to **change ad-valorem excises**, you have to do it in the fifth function of the tco_CC policy. It works exactly as the fourth function, but the relevant constants are named $tco_base_v_[COICOP code]. The parameter can be changed in a reform system column.

Note that by default all scenarios assume a full pass-through of consumption taxes, meaning that any proportional change in consumption tax rate would be fully reflected in the consumer price. The model allows relaxing this assumption by setting the pass-through flag $tco_theta_flag=1 in the first function and changing the pass-through proportion parameters for the relevant item(s) from $tco_theta0 to the desired pass-through rate (i.e. $tco_theta2) in the third function. This functionality is still under testing. For more information, see section 7.1.3 here).

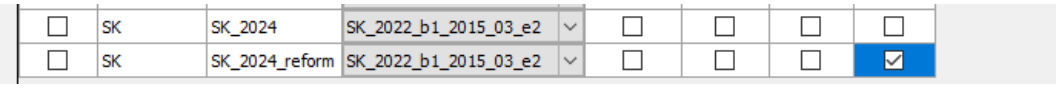
| | | | | | |
|---|---|---|---|---|---|
| 34.1 | DefConst | | on | on | Parameters |
| 34.1.1 | $tco_t_std | 1 | $tco_base_t_std | $tco_base_t_std | vat - standard rate |
| 34.1.2 | $tco_t_red1 | 2 | $tco_base_t_red1 | $tco_base_t_red1 | vat - reduced rate 1 |
| 34.1.3 | $tco_t_zero | 4 | $tco_base_t_zero | $tco_base_t_zero | vat - 0% rate and exempted |
| 34.1.4 | $tco_theta1 | 5 | 20% | 20% | Theta- Tax incidence parameter level 1 |
| 34.1.5 | $tco_theta2 | 6 | 50% | 50% | Theta- Tax incidence parameter level 2 |
| 34.1.6 | $tco_theta3 | 7 | 80% | 80% | Theta- Tax incidence parameter level 3 |
| 34.1.7 | $tco_theta0 | 8 | 100% | 100% | Theta=1 |
| 34.1.8 | $tco_theta_flag | 13 | 0 | 1 | TIP: switch - set equal 1 to activate tax incidence pass through (TIP) calculations |
| 34.2 | DefConst | | on | on | Parameters: vat rates (all goods) |
| 34.3 | DefConst | | on | on | Tip-Parameters: tax incidence parameter (all goods) |
| 34.3.1 | $theta_01111 | 1 | $tco_theta0 | $tco_theta0 | 01111 : 01 Food and nonalcoholic beverages - 1 Food - 1 Bread and cereals - 1 Rice |
| 34.3.2 | $theta_01112 | 2 | $tco_theta0 | $tco_theta2 | 01112 : 01 Food and nonalcoholic beverages - 1 Food - 1 Bread and cereals - 2 Flours and other cereals |
| 34.3.3 | $theta_01113 | 3 | $tco_theta0 | $tco_theta0 | 01113 : 01 Food and nonalcoholic beverages - 1 Food - 1 Bread and cereals - 3 Bread |

- **How to run the simulation of a reform?**

  Running a reform scenario requires two **sequential** steps:

  - First, you have to **run the baseline system with the CT_XBASE add-on** (i.e. SK_2024 in our case) with the matched dataset (SK_2022_b1_2015_03_e2 in our case). The baseline run produces the above-described auxiliary files containing information on consumed quantities and current savings which are needed to simulate the reforms

- After that (not simultaneously!), you can **run the reform system**, again with the matched dataset, **with any of the other three add-ons (CT_XCES, CT_XCIS, CT_XCQ)**; you have to make them visible in the run window like you did with CT_XBASE before. This produces an output file with a suffix indicating which add-on has been used to produce the data, and hence the behavioural assumption used. In our example, we run SK_2024_reform with constant quantities (CT_XCQ), so we get SK_2024_reform_cq_std.txt.




# RESULTS

- **What does the output contain?**

  The output contains:

  - The standard EUROMOD output variables, i.e. uprated input variables and simulated variables and income lists for direct taxes, social insurance contributions and benefits.
  - EUROMOD output variables related to consumption taxes:
    - Consumption as income share (xs?????) at 5-digit COICOP category;
    - Consumption expenditure at 5-digits COICOP category (x?????) and aggregated at 2-digit COICOP (il_x??);
    - Simulated consumption taxes: VAT (tva?????), ad-valorem excise (txv?????) and specific excise (txa?????) liabilities by 5-digit COICOP category, as well as aggregate consumption tax liabilities at 2-digit COICOP (il_tva??, il_txa?? and il_txv??);
    - Simulated consumption quantities[5] (xx?????);
    - Expenditures and tax liabilities adjusted by National Account at 5-digits and 2-digits COICOP (x?????_na, tva?????_na, txa?????_na, txv?????_na, il_x??_na, il_tva??_na, il_txa??_na and il_txv??_na);
    - Total consumption taxes paid by each household, assigned to the household head: VAT non-adjusted (il_tva) and adjusted (il_tva_na) by National Accounts, and excises non-adjusted (il_tx = il_txa + il_txv) and adjusted (il_tx_na = il_txv_na + il_txa_na) by National Accounts.

- **How can I analyse the results?**

  Like when running EUROMOD with EU-SILC-only data, there are several ways of analysing your results:

  - **Statistics Presenter** (Applications → EUROMOD Statistics). From software version 3.7.4 onwards, the standard options of the Statistics Presenter (Default, Baseline-reform, Multiple systems) offer indicators of simulations produced including consumption taxes, if simulated. The tool recognises the output and produces results according to the simulations found. When consumption taxes are simulated, the main variable for

[5] Simulated quantities are expressed in units in which specific excises are levied only for items subject to excises for which EUROMOD knows the consumer price paid (i.e. quantities = expenditures/consumer price, hence xx????? = x?????/$tco_q_?????). Note that for items on which excises are not levied, producer price is assumed to be equal 1, hence consumer price is 1+VAT. In this case xx????? are measured in monetary terms at producer prices. For more details on this, see section 7.1.1 here.

distributional analysis is post-CT disposable income, which is the result of deducting consumption taxes from the disposable income computed by EUROMOD.

- **In-depth Analysis** (Applications → EUROMOD Statistics). The tool can be used with any EUROMOD output, including or not simulations of consumption taxes. The default values of the tables were chosen for the standard simulations without consumption taxes, but the tool is fully customisable and can produce indicators based on any variable included in the output.
- **Macrovalidation** (Applications → Macrovalidation). When the output contains simulated consumption taxes, the macrovalidation tool offers two additional tabs that compare the results of the simulations with external statistics: one with the results obtained in the simulation (non-calibrated) and the other with those results calibrated to match national accounts (calibrated). External statistics are stored in Country tools → External statistics.
- **External software**. Since EUROMOD produces tab-separated text files as output, you can also use any statistical software (R, Python, Stata, Excel, etc.) to analyse the results.