

# How to build an integrated CGE microsimulation model

## Step-by-step instructions with an illustrative exercise

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In its simplest form, the application of CGE microsimulation techniques is identical to the procedures followed in disaggregating household categories in a standard CGE model. One must first make the link between the income and expenditure data from a nationally representative household survey and the household income and expenditure accounts in the SAM underlying the initial CGE model. In the standard case, household-level data are then multiplied by their sample weights and aggregated into household categories for introduction into the standard CGE model. In the case of CGE microsimulation models, we simply skip the aggregation step and introduce all of the weighted households into the CGE model itself.

The stage of reconciling survey and national accounts data is complex and time-consuming, but not specific to microsimulation techniques. Thus, in the context of this exercise we focus on the steps to follow once this reconciliation is already completed and the household survey data is organized in terms of the SAM income and expenditure accounts. We use a simple CGE model – Exterplus – to construct an illustrative exercise<sup>1</sup>. The accompanying exercise.zip file contains the seven files that you need to complete this exercise:

- Initial Exterplus SAM (*sam.xls*)
- Initial Exterplus SAM aggregated to one household category (*sam\_agg.xls*)
- Weighted household-level income-expenditure vectors organized in terms of Exterplus SAM accounts (*incexp.xls*)
- GAMS program to re-balance the SAM (*balance.gms*)
- Calibration/model file for Exterplus (*exterplus2.gms*)
- Excel file that automatically translates aggregate SAM data into table format for calibration (*exterplus2\_agg.xls*)
- GAMS code to generate tables of results (*tables\_exterplus.gms*)

### A. Integration of aggregate household survey data in base SAM

In this first step, we first aggregate the Exterplus SAM to have only one household category (to facilitate the reconciliation with the household survey data). We then replace the resulting household income and expenditure vectors using data from the household survey (which we assume is already organized in terms of the Exterplus SAM accounts). Finally, we save the resulting unbalanced SAM in ASCII format in preparation for the next step.

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<sup>1</sup> This is a slightly enriched version of the Exter model used in our training programs.

(i) Aggregate the 4 household categories used in the Exterplus SAM provided (*sam.xls*) into one category (named "H1"). If you want to skip this step, we have provided the resulting aggregate SAM (*sam\_agg.xls*).

(ii) Calculate column totals in *incexp.xls* and replace in the corresponding household income and expenditure vectors of the aggregate SAM (*sam\_agg.xls*). As the totals include the sample-weighted values of all households in a nationally representative survey, they represent total values for all households in the economy. Note that total savings is calculated as a residual in *sam.xls* and *sam\_agg.xls*

HINT: Use "Copy", "Paste Special" and "Values". Save this file as *unbalanced.xls*. Note the disequilibria in the row entitled "check".

(iii) Then, insert a row at the very top of this worksheet, write "Table SAMA(I,J)" in cell A1, delete the bottom row entitled "check", and add a semi-colon (;) in its place. This will allow GAMS to read the data as a table in section B below. To this end, save the new file as a space delimited text file: *unbalanced.prn*.

## B. Re-balancing the SAM

The GAMS program provided (*balance.gms*) automatically takes the data from *unbalanced.prn*, re-balances the SAM and puts the new SAM values in an ASCII file. The program can alternatively use the XLLINK program to import the unbalanced SAM Excel file (*unbalanced.xls*) and to export the balanced SAM into another Excel file (*balanced.xls*). This alternative has the advantage of keeping all the decimal values, but it does not always work on some computers. It is possible to activate the XLLINK method by following the instructions provided in the *balance.gms* program.

(i) Run the GAMS program (*balance.gms*) to establish equilibrium in your new SAM while minimizing the variations in all SAM cells. The new SAM is automatically "put" in a file named *balanced.xls*<sup>2</sup>.

(ii) Check in the list file for "parameter probs" to ensure no values have been changed to zero.

## C. Preparing the microsimulation model.

In this last step, we first copy the new balanced aggregate SAM into an Excel file that automatically organizes the SAM in terms of the various data tables needed to calibrate the model. The resulting tables are saved in an ASCII file from which data are automatically imported by the GAMS code. We then "test" the new data by running an aggregate (one household category) version of the Exterplus model. If it works well, we replace the aggregate household data by the individual weighted data from the household survey and adjust the GAMS code to include an equivalent number of households in the model. We then test the resulting CGE microsimulation model.

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<sup>2</sup> Note that when the XLLINK program is NOT used, *balanced.xls* is actually an ASCII file. There is no problem in using the ".xls" extension for an ASCII file.

(i) Open *balanced.xls* (respond "delimited", "tabs" to queries if XLLINK was not used above) and *exterplus2\_agg.xls* and replace the data in the "SAM" Excel sheet in *exterplus2\_agg.xls* by the new balanced SAM data (*balanced.xls*) using cut and paste<sup>3</sup>. Save this file as *exterplus2\_new.xls*.

(ii) Save the "tables" sheet in *exterplus2\_new.xls* as a space delimited text file: *exterplus2\_new.prn*

(iii) Adjust *exterplus2.gms* to have only one household category (named "H1") and change the name of the included document to *exterplus2\_new.prn*. Save this file as *exterplus2\_new.gms*.

(iv) Run this aggregate model and ensure the reproduction of base-year values and that LEON is practically zero.

(v) Copy the household-level consumption and income vectors from *incexp.xls* into the TABLES HOUSEHOLD(H,\*) table in the "tables" sheet of *exterplus2\_new.xls*, and save the resulting file as *microsimulations.xls*

HINT: As the household-level vectors are very long, to avoid copying overtop of the bottom half of the HOUSEHOLD table, you can first cut and paste it to the right of the upper half of this table. Once you have filled the upper half of the table with household-level data, you can cut and paste the bottom half below it.

(vi) Save the resulting "tables" sheet in *microsimulations.xls* as a space delimited text file: *microsimulations.prn*

NOTE: Make sure that decimals are indicated with period (.) and not comma (,)

(vii) Adjust *exterplus2\_new.gms* to have 3373 household categories:

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H Households          / H1*H3373 /
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and change the name of the included document to "*microsimulations.prn*". Save the resulting GAMS code as *microsimulation.gms*

(viii) Run the *microsimulation.gms* code and ensure reproduction of base year and that LEON = 0 in simulations.

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<sup>3</sup> If you paste using "paste special", "values", the formatting will be maintained. If you copy only the interior of the SAM (excluding row and column "Total"), the totals will be calculated automatically and you can verify that the SAM is balanced in the "check" row.

**ANNEX**  
**French-English translation of EXCEL commands**

SUM	SOMME
Cut	Couper
Copy	Copier
Paste	Coller
Paste Special (values)	Collage spécial (valeurs)
Delete	Supprimer
Open	Ouvrir
Save/Save as	Enregistrer/Enregistrer sous
Space delimited text (*.prn)	Texte (séparateur : espace) (*.prn)