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Partial Equilibrium Trade Simulation (PETS) Model: Documentation

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1 Introduction

The objective of this AGRODEP Technical Note is two-fold. First, it aims to describe the mathematical structure of and the economic hypothesis behind the Partial Equilibrium Trade Simulation (PETS) model. Second, it gives a practical approach for use of the General Algebraic Modeling System (GAMS) code in running the model for calibration of the baseline scenario and for simulating the changes in trade policy scenarios.

PETS is a multi-region, multi-sector, dynamically recursive,[1] and partial equilibrium (PE) model. The model developed in Fontagne, Laborde, and Mitaritonna (2011) focuses on trade policy analysis using disaggregated geographical and sectoral levels of data.[2] This paper provides a perfect illustration of how this model can be used to study trade agreements, and any user of this model is advised to read it.

The model emphasizes the demand side, which is specified as a nested CES structure, where the initial regional income is assumed to be fixed. The demand is expressed at various levels of disaggregation matched by increasing substitutability (elasticity of substitution increases with higher level of disaggregation).

The supply side is assumed to be perfectly adjustable, i.e. the elasticity of supply is equal to infinity. This means that producer prices do not change and consumer prices only change with the changes in tariffs.

PETS expresses bilateral trade flows consistent with the Armington assumption that specifies commodities to be heterogeneous according to their geographical origin, and thus imperfect substitutes for one another (Armington 1969). As such, countries can export and import the same product at the same time due to consumer preferences for different varieties. The nested CES demand functions are used to reflect preferences among varieties originating from different countries. The price transmission between domestic and international market is imperfect and highly dependent on the choice of the CES trade elasticities and the initial share of trade.

Disaggregated data on trade flows and tariff rates support a great degree of heterogeneity across products and partners. Both trade flows and tariff rates are expressed at the standardized HS6 nomenclature level. The nested Armington structure allows the model to introduce horizontal (distinguishing between local and foreign goods) and vertical (distinguishing between two quality ranges of the same good) differentiation between products. Furthermore, differences in the level of development between two regions is also included. Thus, there is imperfect import substitutability in the model.

[1] Dynamically recursive models do not include expectation of value of variables in future periods in the model.

[2] The PETS model is fully documented in Fontagne, Laborde, and Mitaritonna (2011).

The model is illustrated with a detailed analysis of trade related aspects of Economic Partnership Agreements of two African negotiation groups (CEMAC and SADC) with the European Union. Trade data is based on COMEXT (from Eurostat) and BACI (from CEPII) and averaged over 2002-2004. Tariff data is obtained from the MAcMap-HS6v2 (Version 2, 2004) database for bilateral data on applied tariffs on goods and adjusted to reflect the 2006 EU GSP reform (Boumellassa et al. 2009). However, the model could be updated easily to any group of countries by using other data sources on trade and tariffs (e.g. WITS from the World Bank).

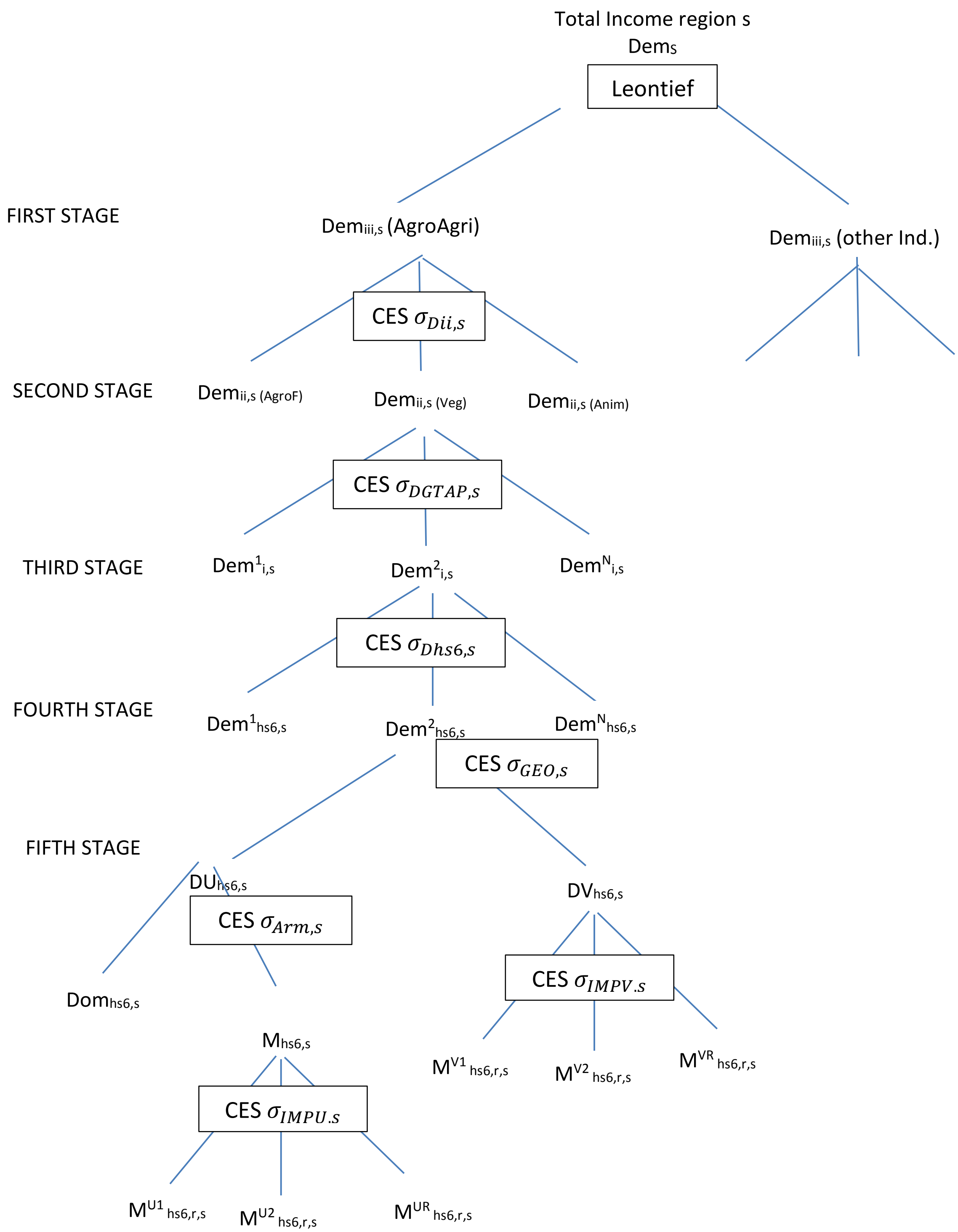
The document is organized as follows. In Section 2, we present the main pillars of the model structure. Section 3 provides a summary of equations and variables mapped to their counterparts in GAMS code followed by information on data structure in Section 4. Finally, Section 5 gives a brief introduction to running the model in GAMS.

2 Model Structure

The model assumes one representative household by country. This agent spends his income (assumed exogenous[3]) on two broad categories of goods (food related products and other goods), with Leontief preferences at the first stage. The second and third stages of the budget allocation are based on CES functions and allow allocation of a level of expenditures for all HS6 products. Figure 1 gives a visual representation of the model. The fourth and fifth stages allocate expenditures by origin using an Armington/CES approach where a first step represents the split between different regions, capturing a quality effect, and the lower level doing the allocation by exporting country (horizontal differential within a group of exporters with the same quality range).

[3] In the standard closure of this model, tariff revenue are not redistributed to households and therefore, nominal income is fixed.

Figure 1. Demand Tree



2.1 Dimensions and Sets

Sector's Sets

The PETS model distinguishes multiple sectors (or activities, industries) each of them producing one single commodity (or good, product).

- Set *iii* refers to the 2 main sectors: AgriAgro and OtherInd.
- Set *ii* refers to subsets of sectors in AgriAgro or OtherInd.[4]
- Set *i* refers to sectors at the GTAP level aggregation.[5]
- Set *i_hs6* refers to sectors at the hs6 level.[6]

Time

Since this is a dynamic model, each variable is thus indexed in time, *t*.

Geographical (regions or countries) Sets

- *r,* designates the origin or exporting country.
- *s*, designates the destination or importing country.
- *U* refers to countries with the same development level as country *s*.
- *V* indicates countries with different level of development as country *s*.

Other sets

Set *Temps* refers to the model time line: the model is solved for 2007, 2019, and 2027. Base year is 2007.

Set *Simul* refers to the simulation scenarios specified in the model:

- Reference (includes Cotonou preferences),
- GSP+,
- Scenario EPA1, and
- Scenario EPA2.

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[4] Usually user's defined sectors.

[5] Based on the GTAP database nomenclature of 57 sectors and 129 countries and regions (https://www.gtap.agecon.purdue.edu/databases/default.asp).

[6] Based on the MAcMap-HS6 database nomenclature of more than 5000 sectors, 169 importing countries and 220 partners (http://www.ifpri.org/book-5078/ourwork/program/macmap-hs6).

2.2 Variables and Parameters

The substitution elasticities used in the model are described below:

Table 1. Model parameters: Elasticities of substitution

Substitution elasticities	Description
$\sigma_{Dii,s}$	elasticity of substitution between demand at each main category
$\sigma_{DGTAP,s}$	elasticity of substitution between demand at GTAP level
$\sigma_{Dhs6,s}$	elasticity of substitution between demand at hs6 level
$\sigma_{DGEO,s}$	elasticity of substitution for demand at hs6 level between different qualities
$\sigma_{ARM,s}$	elasticity of substitution between import and domestic demand for same quality goods
$\sigma_{IMPU,s}$	elasticity of substitution between import demand from different countries for same quality
$\sigma_{IMPV,s}$	elasticity of substitution between import demand from different countries for different quality

The demand variables used in the model are described below:

Table 2. Model demand variables

Variables	Description
Dem_s	total demand in the country s (income)
$Dem_{iii,s}$	demand at iii level of sectors (Leontief relationship between sectors AgriAgro and OthInd/perfect complement)
$Dem_{ii,s}$	demand at ii level of sectors
$Dem_{i,s}$	demand at i level of sectors (GTAP)
$Dem_{hs6,s}$	demand at hs6 level of sectors
$DU_{hs6,s}$	demand in country s for hs6 products from countries with the same level of development
$DV_{hs6,s}$	demand in country s for hs6 products from countries with a different level of development
$M_{hs6,s,s}$	total demand of country s for hs6 products produced in country s
$M_{hs6,s}$	total imports of country s for hs6 products originating form regions with the same level of development
$M_{hs6,r,s}$	total imports of country s for hs6 products from country r (two equations for same and different quality)

All the prices in the model are denoted by P. Superscripts for P refer to the related demand variable.

2.3 Demand Equations

Regional income (revenue) is fixed.

(1) $$Income = Dem_s = \sum_{iii} P^D_{iii,s} \cdot Dem_{iii,s}$$

There is Leontief relation between AgriAgro and OthInd for $Dem_{iii,s}$ (First Stage)

(2) $$Dem_{iii,s} = a_{iii,s} \cdot Dem_s \qquad (iii = AgriAgro, OthInd)$$

Demand is allocated at each stage of disaggregation using CES functions with a different elasticity of substitution.

i.e.: $Dem_{iii,s}$ among $Dem_{ii,s}$ (Second Stage)

(3) $$Dem_{ii,s} = Dem_{iii,s} \cdot a^D_{ii,s} \cdot \left(\frac{P^D_{iii,s}}{P^D_{ii,s}}\right)^{\sigma_{Dii,s}}$$

i.e.: $Dem_{ii,s}$ among $Dem_{i,s}$ or GTAP (Third Stage)

(4) $$Dem_{i,s} = Dem_{ii,s} \cdot a^D_{i,s} \cdot \left(\frac{P^D_{ii,s}}{P^D_{i,s}}\right)^{\sigma_{DGTAP,s}}$$

i.e.: $Dem_{i,s}$ among $Dem_{hs6,s}$ or HS6 level (Fourth Stage)

(5) $$Dem_{hs6,s} = Dem_{i,s} \cdot a^D_{hs6,s} \cdot \left(\frac{P^D_{i,s}}{P^D_{hs6,s}}\right)^{\sigma_{Dhs6,s}}$$

At the last stage of disaggregation, nested Armington specifications allow for differentiation (Fifth Stage).

First, between quality ranges (vertical differentiation):

- Regions with same level of development

(6) $$DU_{hs6,s} = a^U_{hs6,s} \cdot D_{hs6,s} \cdot \left(\frac{P^D_{hs6,s}}{P^{DU}_{hs6,s}}\right)^{\sigma_{GEO,s}}$$

- Regions with different level of development

(7) $$DV_{hs6,s} = a^V_{hs6,s} \cdot D_{hs6,s} \cdot \left(\frac{P^D_{hs6,s}}{P^{DV}_{hs6,s}}\right)^{\sigma_{GEO,s}}$$

Second, within the same quality range, between import and domestic demand (horizontal differentiation:

(8) $$M_{hs6,s} = a^M_{hs6,s} \cdot DU_{hs6,s} \cdot \left(\frac{P^{DU}_{hs6,s}}{P^M_{hs6,s}}\right)^{\sigma_{ARM,s}}$$

(9) $$M_{hs6,s,s} = a^{DOM}_{hs6,s} \cdot DU_{hs6,s} \cdot \left(\frac{P^{DU}_{hs6,s}}{P^M_{hs6,s,s}}\right)^{\sigma_{ARM,s}}$$

Finally, between origins of imports:

- within same quality range

(10) $$M_{hs6,r,s} = a^{M}_{hs6,r,s} \cdot M_{hs6,s} \cdot \left(\frac{P^{D}_{hs6,s}}{P^{M}_{hs6,r,s}}\right)^{\sigma_{ImpU,s}}$$

- within different quality range

(11) $$M_{hs6,r,s} = a^{M}_{hs6,r,s} \cdot DV_{hs6,s} \cdot \left(\frac{P^{DV}_{hs6,s}}{P^{M}_{hs6,r,s}}\right)^{\sigma_{ImpV,s}}$$

2.4 Price Equations

(12) $$P^{M}_{hs6,r,s} = P^{CIF}_{hs6,r,s} \cdot (1 + \tau^{Adv}_{hs6,r,s})$$

(13) $$P^{M}_{hs6,s} = \left(\sum_{r\epsilon U(s)} a^{M}_{hs6,r,s} \cdot (P^{M}_{hs6,r,s})^{1-\sigma_{ImpU,s}}\right)^{\frac{1}{1-\sigma_{ImpU,s}}}$$

(14) $$P^{DU}_{hs6,s} = \left(a^{DOM}_{hs6,s} \cdot \left(P^{M}_{hs6,s,s}\right)^{1-\sigma_{ARM,s}} + a^{M}_{hs6,s} \cdot \left(P^{M}_{hs6,s}\right)^{1-\sigma_{ARM,s}}\right)^{\frac{1}{1-\sigma_{ARM,s}}}$$

(15) $$P^{DV}_{hs6,s} = \left(\sum_{r\epsilon V(s)} a^{M}_{hs6,r,s} \cdot (P^{M}_{hs6,r,s})^{1-\sigma_{ImpV,s}}\right)^{\frac{1}{1-\sigma_{ImpV,s}}}$$

(16) $$P^{D}_{hs6,s} = \left(a^{U}_{hs6,s} \cdot \left(P^{DU}_{hs6,s}\right)^{1-\sigma_{GEO,s}} + a^{V}_{hs6,s} \cdot \left(P^{DV}_{hs6,s}\right)^{1-\sigma_{GEO,s}}\right)^{\frac{1}{1-\sigma_{GEO,s}}}$$

(17) $$P^{D}_{i,s} = \left(\sum_{hs6} a^{D}_{hs6,s} \cdot (P^{D}_{hs6,s})^{1-\sigma_{Dhs6,s}}\right)^{\frac{1}{1-\sigma_{Dhs6,s}}}$$

(18) $$P^{D}_{ii,s} = \left(\sum_{i} a^{GTAP}_{i,s} \cdot (P^{D}_{i,s})^{1-\sigma_{Dgtap,s}}\right)^{\frac{1}{1-\sigma_{DGtap,s}}}$$

(19) $$P^{D}_{iii,s} = \left(\sum_{ii} a^{D}_{ii,s} \cdot (P^{D}_{ii,s})^{1-\sigma_{Dii,s}}\right)^{\frac{1}{1-\sigma_{Dii,s}}}$$

3 Summary of Model Structure in GAMS

Table 3. Equations of PETS

Equations		
Demand		
Regional Income		GAMS
1.	Dem_s	eq_REV(s_,t,sim)
First stage: Leontief		**GAMS**
2.	$Dem_{iii,s}$	eq_DemMCat(s_,t,sim)
Second stage: CES		**GAMS**
3.	$Dem_{ii,s}$	eq_DemCat(ii,s_,t,sim)
Third stage: CES		GAMS
4.	$Dem_{i,s}$	eq_Demtot (i,s_,t,sim)
Fourth stage: CES		GAMS
5.	$Dem_{hs6,s}$	eq_Dhs6 (i_hs6,s_,t,sim)
Fifth stage: Nested Armington		GAMS
6.	$DU_{hs6,s}$	eq_DUhs6(i_hs6,s_,t,sim)
7.	$DV_{hs6,s}$	eq_DVhs6(i_hs6,s_,t,sim)
8.	$M_{hs6,s}$	eq_Domhs6(i_hs6,s_,s_,t,sim)
9.	$M_{hs6,s,s}$	eq_Mhs6(i_hs6,s_,t,sim)
10.	$M_{hs6,r,s}$	eq_MMhs6U (i_hs6,r,s_,t,sim)
11.	$M_{hs6,r,s}$	eq_MMhs6V (i_hs6,r,s_,t,sim)
Prices		
12.	$P^M_{hs6,r,s}$	eq_PMMhs6(i_hs6,r,s_,t,sim)
13.	$P^M_{hs6,s}$	eq_PMhs6U(i_hs6,s_,t,sim)
14.	$P^{DU}_{hs6,s}$	eq_PDUhs6(i_hs6,s_,t,sim)
15.	$P^{DV}_{hs6,s}$	eq_PDVhs6(i_hs6,s_,t,sim)
16.	$P^D_{hs6,s}$	eq_PDhs6_1(i_hs6,s_,t,sim)
17.	$P^D_{i,s}$	eq_Ptot(i,s_,t,sim)
18.	$P^D_{ii,s}$	eq_Pcat(ii,s_,t,sim)
19.	$P^D_{iii,s}$	eq_PMcat(iii,s_,t,sim)

Table 4. Parameters of PETS

Parameters	Description	GAMS code
$\sigma_{Dii,s}$	elasticity of substitution between demand at each main category	sigma_Dtotcat(iii,s)
$\sigma_{DGTAP,s}$	elasticity of substitution between demand at GTAP level	sigma_Dtot(ii,s)
$\sigma_{Dhs6,s}$	elasticity of substitution between demand at hs6 level	sigma_Dhs6(i,s)
$\sigma_{DGEO,s}$	elasticity of substitution for demand at hs6 level between different qualities	sigma_GEO(i_hs6,s)
$\sigma_{ARM,s}$	elasticity of substitution between import and domestic demand for same quality goods	sigma_ARMU(i_hs6,s)
$\sigma_{IMPU,s}$	elasticity of substitution between import demand from different countries for same quality	sigma_IMPU(i_hs6,s)
$\sigma_{IMPV,s}$	elasticity of substitution between import demand from different countries for different quality	sigma_IMPV(i_hs6,s)

Note: Sigma's are elasticities of substitution between demands for commodities.

Table 5. Variables of PETS

Variable	Definition	GAMS
Dem_s	Total Demand in the country s (Income)	RevO(s_)
$Dem_{iii,s}$	Demand at iii level of sectors (Leontieff relation between AgriAgro and OthInd)	DemtotMCat(iii,s_,t,sim)
$Dem_{ii,s}$	demand at ii level of sectors	DemtotCat(ii,s_,t,sim)
$Dem_{i,s}$	demand at i level of sectors (GTAP)	DemTot(i,s_,t,sim)
$Dem_{hs6,s}$	demand at hs6 level of sectors	Dhs6(i_hs6,s_,t,sim)
$DU_{hs6,s}$	demand in country s for hs6 products from countries with the same level of development	DUhs6(i_hs6,s_,t,sim)
$DV_{hs6,s}$	demand in country s for hs6 products from countries with a different level of development	DVhs6(i_hs6,s_,t,sim)
$M_{hs6,s,s}$	total demand of country s for hs6 products produced in country s	MMhs6(i_hs6,s_,s_,t,sim)
$M_{hs6,s}$	total imports of country s for hs6 products originating from regions with the same level of development	Mhs6(i_hs6,s_,t,sim)
$M_{hs6,r,s}$	total imports of country s for hs6 products from country r for same quality	MMhs6(i_hs6,r,s_,t,sim)
	total imports of country s for hs6 products from country r for different quality	MMhs6(i_hs6,r,s_,t,sim)

4 Data Structure

4.1 Country and Region List

This section documents the data set and nomenclature of the current model. In Section 7, how the data structure and the inputs of the model can be changed is explained.

The African regions CEMA and SADC[7] are included in the model run, along with EU, the region with which they are negotiating.

Please note that each country is added using its ISO number (Table 6). Data for other countries are included in the main data files and the user can add these countries to the model run in GAMS when executing the main gams file "bat.gms" with the option *users1*= <ISO code> (see section 5.3).

Table 6. Countries in the model

ISO	CEMAC	ISO	SADC	ISO	EU
120	Cameroon	024	Angola	918	European Union
140	Central African Republic	072	Botswana		
148	Chad	426	Lesotho		
178	Congo	508	Mozambique		
180	Congo (DR)	516	Namibia		
226	Equatorial Guinea	748	Swaziland		
266	Gabon	834	Tanzania		

4.2 Commodity List

There are different levels of sectoral aggregation for the commodities included in the data set. Table 7 presents the sectoral distribution.

[7] These countries are in sets named gr2 – CEMAC and gr4 – SADC.

Table 7. Sectoral aggregation

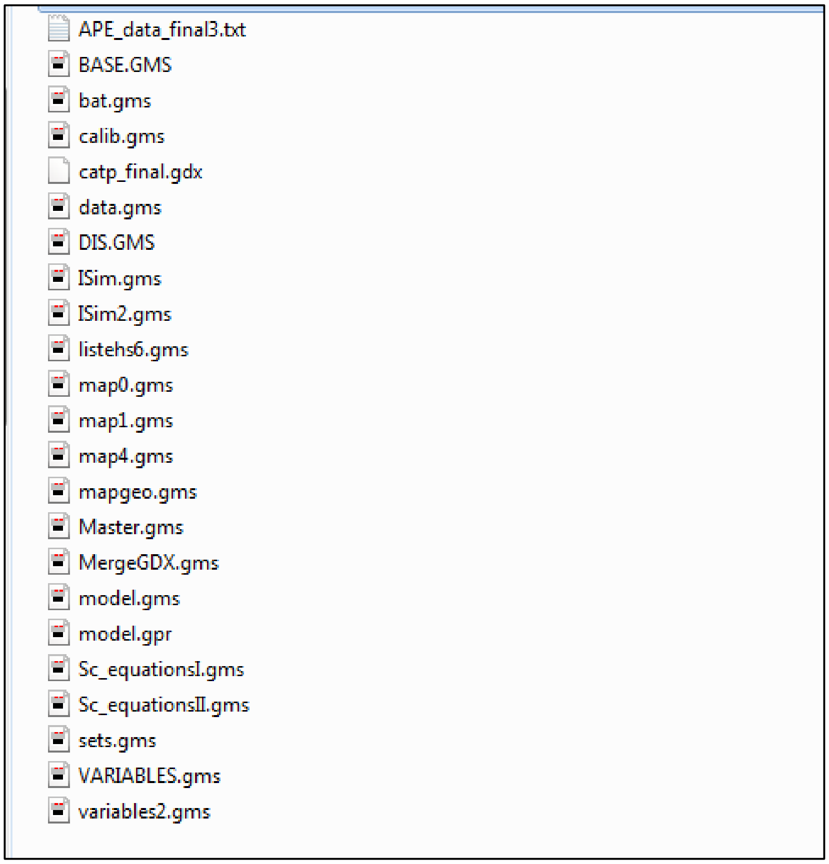
Main Sector (iii)	Sector ii	Sector i (GTAP)	
AgriAgro = iii1	Livestocks and Animal prodn.	cmt	Meat: cattle, sheep, goats, horse
	Livestocks and Animal prodn.	ctl	Cattle, sheep, goats, horses
	Livestocks and Animal prodn.	mil	Dairy products
	Livestocks and Animal prodn.	oap	Animal products nec
	Vegetal Prod	c-b	Sugar cane, sugar beet
	Vegetal Prod	gro	Cereal grains nec
	Vegetal Prod	ocr	Crops nec
	Vegetal Prod	osd	Oil seeds
	Vegetal Prod	pcr	Processed rice
	Vegetal Prod	pdr	Paddy rice
	Vegetal Prod	pfb	Plant-based fibers
	Vegetal Prod	sgr	Sugar
	Vegetal Prod	v-f	Vegetables, fruit, nuts
	Vegetal Prod	vol	Vegetable oils and fats
	Vegetal Prod	wht	- Wheat
	Vegetal Prod	wol	Wool, silk-worm cocoons
	Other Agr. Food	b-t	Beverages and tobacco products
	Other Agr. Food	fsh	Fishing
	Other Agr. Food	ofd	Food products nec
OtherInd = iii2	Primary	coa	Coal
	Primary	frs	Forestry
	Primary	gas	Gas
	Primary	nmm	Mineral products nec
	Primary	oil	Oil
	Primary	omn	Minerals nec
	Primary	p-c	Petroleum, coal products
	Elec. and Machinery	ele	Electronic equipment
	Elec. and Machinery	mvh	Motor vehicles and parts
	Elec. and Machinery	ome	Machinery and equipment nec
	Elec. and Machinery	omf	Manufactures nec
	Metallurgy	fmp	Metal products
	Metallurgy	i-s	Ferrous inetals
	Metallurgy	lum	Wood products
	Metallurgy	nfm	Metals nec
	Other Industries	crp -	Chemical, rubber, plastic prods
	Other Industries	omt	Meat products nec
	Other Industries	ppp	Paper products, publishing
	Textile	lea	Leather products
	Textile	tex	Textiles
	Textile	wap	Wearing apparel

5 Running the Model

The model consists of files and directories saved under the same directory.

Figure 2 shows the list of the files for this directory.

Figure 2. Model structure in GAMS



5.1 Data Files

The data required to run the model are included in various files:

- Data.gms (includes Armington elasticities from the GTAP data base for sectors)
- Data_input.txt (includes bilateral data for each sector and country for tariff and trade values)
- Other_Input.gdx (includes import elasticities and dependence ratios)

5.2 Results Files

Results are computed for each model run for each country (case_024 and caseAG_024) and outputted as gdx files. In the second step, these results files are merged using "mergeGDX.gms" to generate "0_mergedDE.gdx" and "0_mergedAG.gdx".

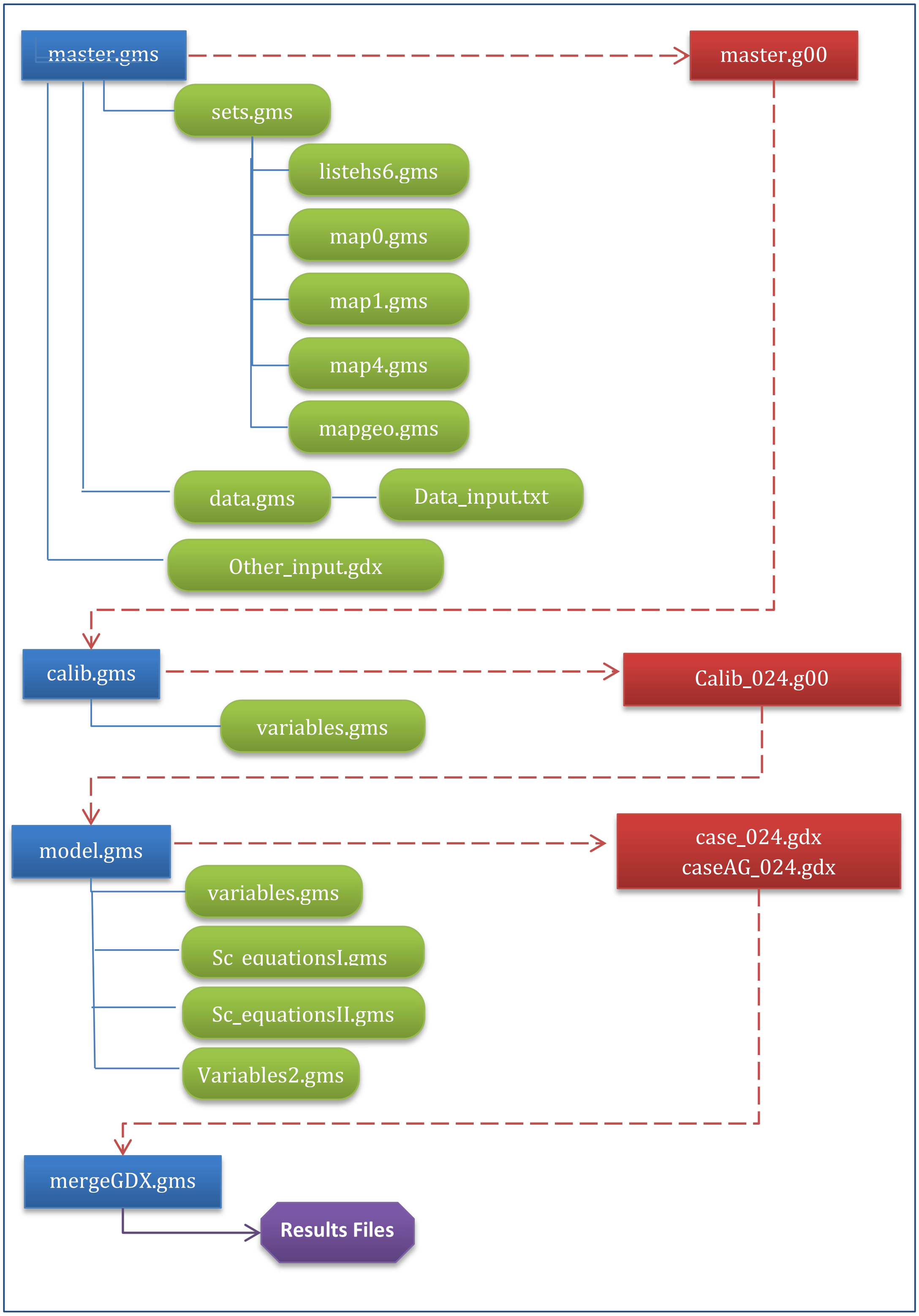
5.3 Main Directory

The main gams file “bat.gms” calls all the programs required to run the model. “Master.gms” is called once per run; “calib.gms” and “model.gms” are called and generate results in the form of *.gdx files for each country individually. These results files are combined by the last program file “mergeGDX.gms.” The program files can be grouped in two main categories:

- The first set are the main files called in “bat.gms”
- All other files are called in the main files.

Figure 3 below depicts the linkages between the different files. Blue boxes represent the main files of the program included in “bat.gms”.

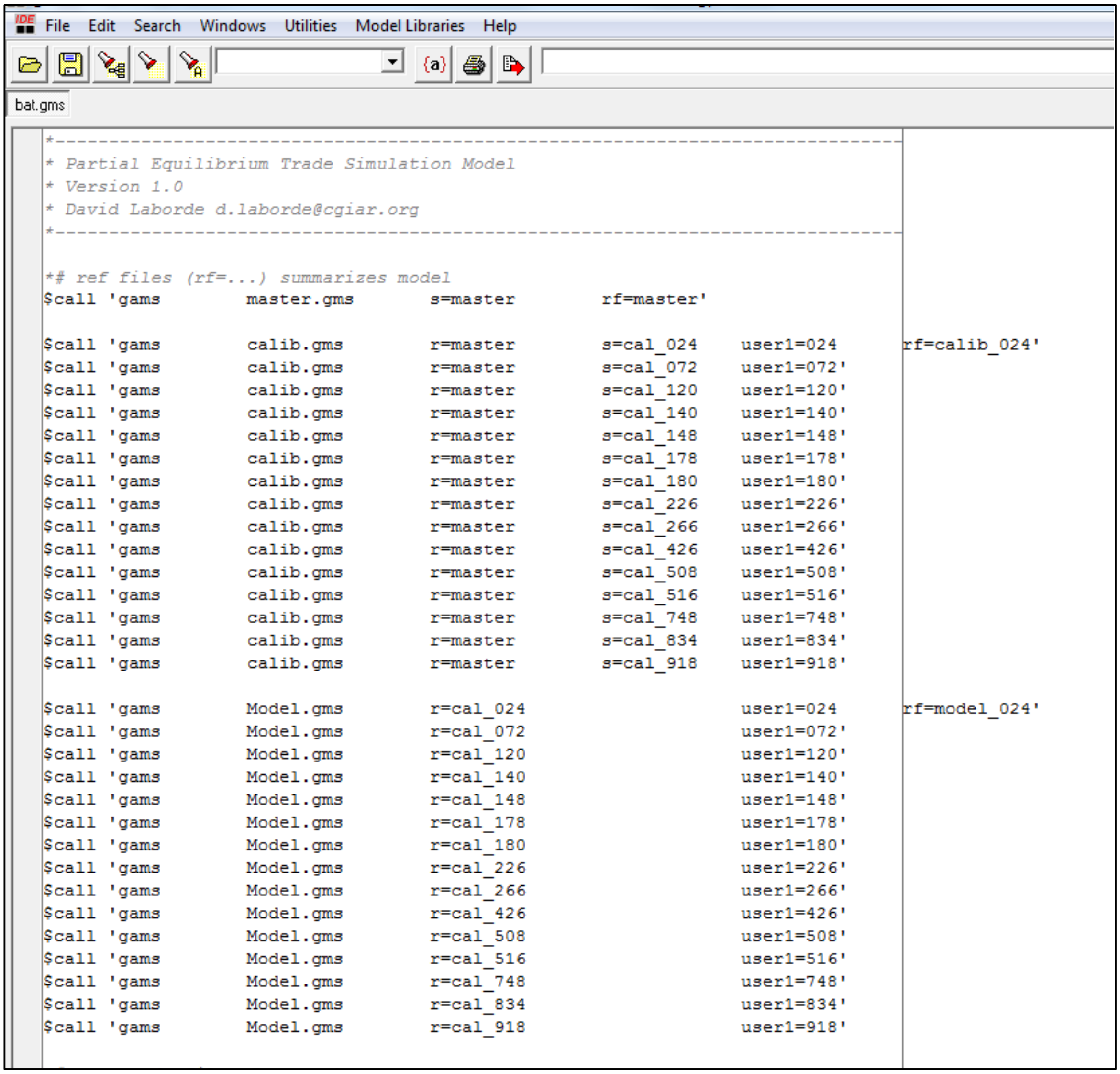
Figure 3. GAMS files for model



In order to run the model, the user must run “bat.gms” which call all the main program files. Here are the steps to follow.

1. Create a new project file “model.gpr” in GAMS-IDE. This project file should be located in the same directory as all other files.
2. Open the program file “bat.gms” that includes all other files. To run the program, simply press on the button with the red arrow.
3. In “bat.gms”, files are created that are then used as in input to other files. They can also recall an already saved file. The necessary save and restart commands for each file run are already included in “bat.gms”. For example, “master.gms” output is saved with the command, “s=master”. This output is retrieved by “calib.gms”, with the command “r=master”, for country 024, specified in the argument “user1=024”.
4. To run the model just for one country, the user can transfer these command lines to the command box.

Figure 4. "bat.gms" file in PETS

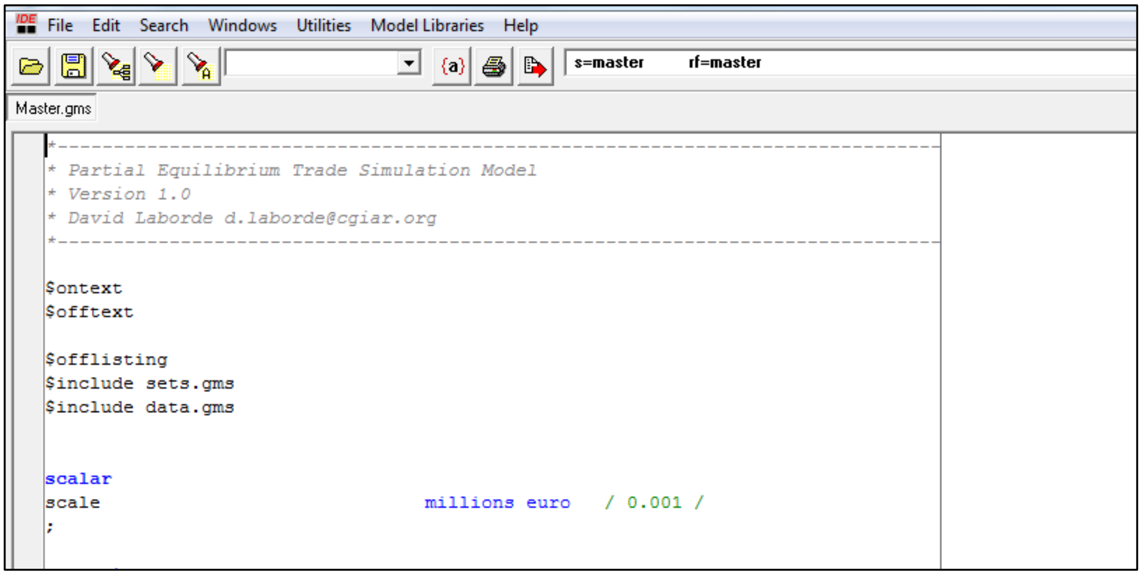



```
*------------------------------------------------------------------------------
* Partial Equilibrium Trade Simulation Model
* Version 1.0
* David Laborde d.laborde@cgiar.org
*------------------------------------------------------------------------------

*# ref files (rf=...) summarizes model
$call 'gams        master.gms       s=master        rf=master'

$call 'gams        calib.gms        r=master        s=cal_024     user1=024     rf=calib_024'
$call 'gams        calib.gms        r=master        s=cal_072     user1=072'
$call 'gams        calib.gms        r=master        s=cal_120     user1=120'
$call 'gams        calib.gms        r=master        s=cal_140     user1=140'
$call 'gams        calib.gms        r=master        s=cal_148     user1=148'
$call 'gams        calib.gms        r=master        s=cal_178     user1=178'
$call 'gams        calib.gms        r=master        s=cal_180     user1=180'
$call 'gams        calib.gms        r=master        s=cal_226     user1=226'
$call 'gams        calib.gms        r=master        s=cal_266     user1=266'
$call 'gams        calib.gms        r=master        s=cal_426     user1=426'
$call 'gams        calib.gms        r=master        s=cal_508     user1=508'
$call 'gams        calib.gms        r=master        s=cal_516     user1=516'
$call 'gams        calib.gms        r=master        s=cal_748     user1=748'
$call 'gams        calib.gms        r=master        s=cal_834     user1=834'
$call 'gams        calib.gms        r=master        s=cal_918     user1=918'

$call 'gams        Model.gms        r=cal_024                     user1=024     rf=model_024'
$call 'gams        Model.gms        r=cal_072                     user1=072'
$call 'gams        Model.gms        r=cal_120                     user1=120'
$call 'gams        Model.gms        r=cal_140                     user1=140'
$call 'gams        Model.gms        r=cal_148                     user1=148'
$call 'gams        Model.gms        r=cal_178                     user1=178'
$call 'gams        Model.gms        r=cal_180                     user1=180'
$call 'gams        Model.gms        r=cal_226                     user1=226'
$call 'gams        Model.gms        r=cal_266                     user1=266'
$call 'gams        Model.gms        r=cal_426                     user1=426'
$call 'gams        Model.gms        r=cal_508                     user1=508'
$call 'gams        Model.gms        r=cal_516                     user1=516'
$call 'gams        Model.gms        r=cal_748                     user1=748'
$call 'gams        Model.gms        r=cal_834                     user1=834'
$call 'gams        Model.gms        r=cal_918                     user1=918'
```

5. In "master.gms", sets and parameters of the model are defined ("sets.gms") and data is incorporated ("data.gms").

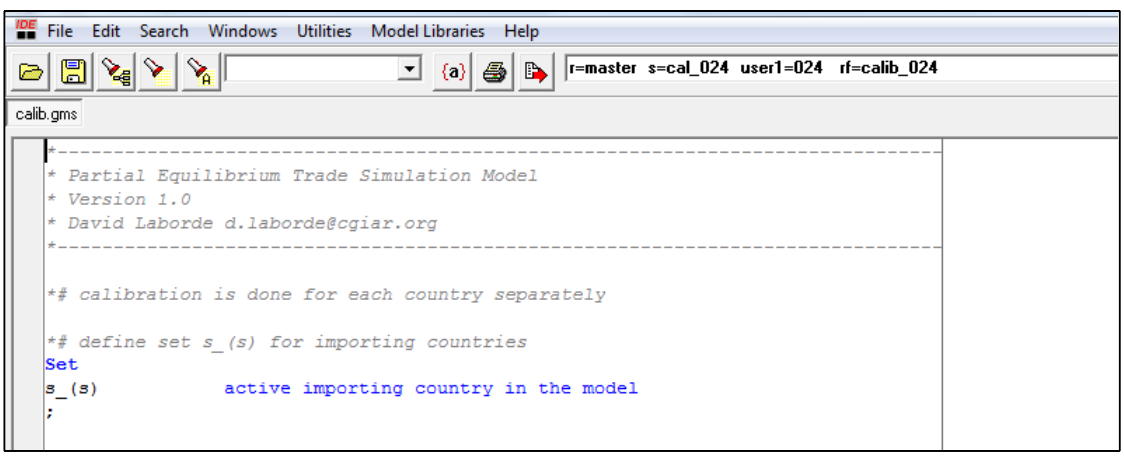
   Running the "master.gms" file with the option "s=master", automatically creates a file named "master.g00", which can then be used as an input in other files with a restart command, "r=master".

Figure 5. "master.gms" file in PETS



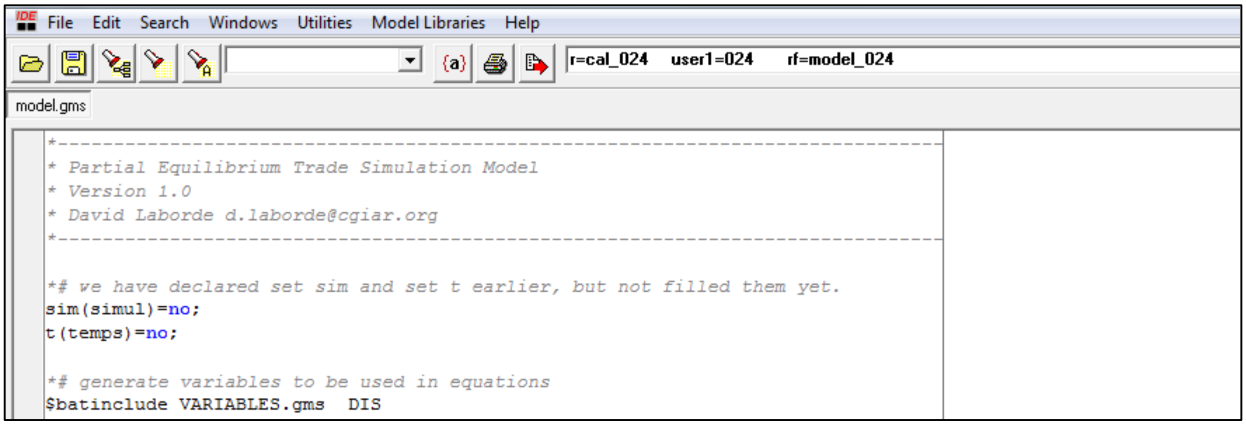
6. In "calib.gms", values for the parameters are uploaded or computed, and price values for the base year are initialized. We calibrate the shares for CES functions. We also load initial tariff data. Running the "calib.gms" file with the option "s=cal_024", automatically creates a file named "cal_024.g00", which can then be used as an input in other files.

Figure 6. "calib.gms" file in PETS



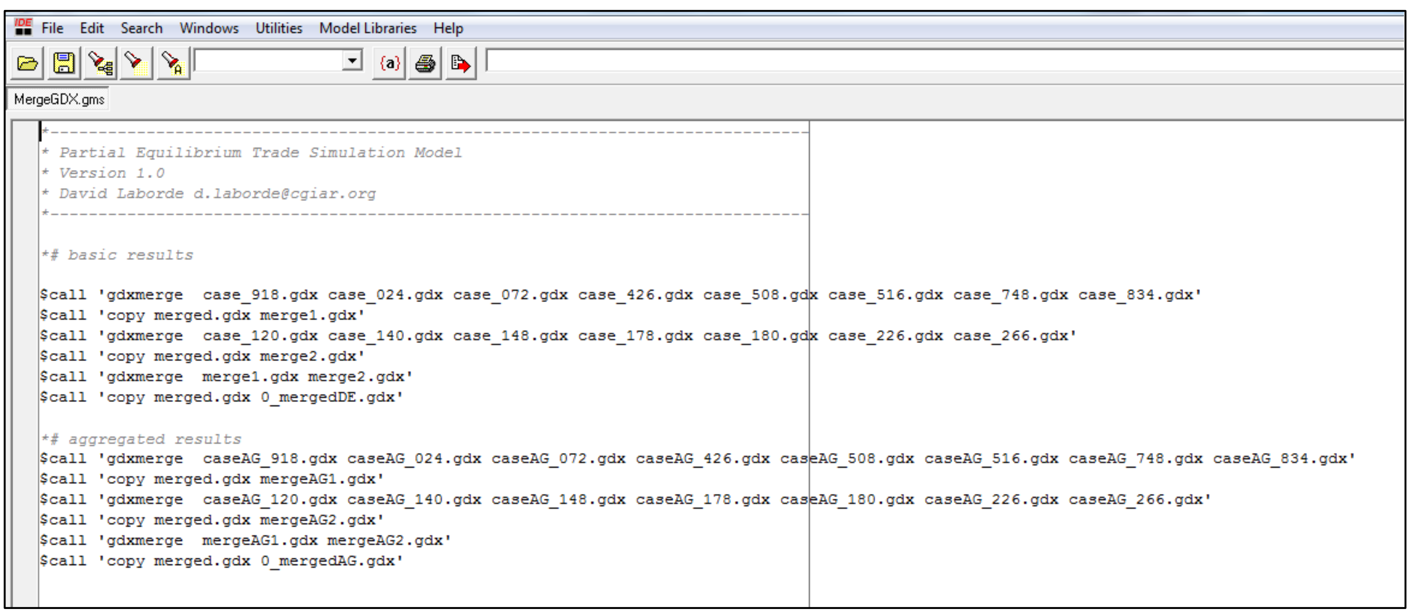
7. In "model.gms", all variables and equations of the model are defined, and the model solves for the whole simulation period, including the base year. The user can run this file individually making sure that "r=cal_024 user1=024" appears in the command box.

Figure 7. "model.gms" file in PETS



8. Hypotheses regarding the reference scenario are defined in the "sets.gms" file, specifically in the set *Simul*. The user may choose to utilize the default scenarios, in which case nothing needs to be changed in the "sets.gms" file.
9. Finally, the user needs to run the "MergeGDX.gms" file in order to merge the produced output files in which results will appear. Two gdx files are automatically generated for each country after the "model.gms" run. These gdx files can be read directly in GAMS and is created in the main directory.

Figure 8. "MergeGDX.gms" file in PETS



6 Running Scenarios with the Model

The current model is calibrated for the base year 2007 and reference scenario (or baseline) is run for 2007, 2019, and 2027, defined in set *Temps* in “sets.gms”. The reference scenario is dynamic with policy changes reflecting the evolution of the world without the Economic Partnership Agreements. Please note that the reference scenario includes Cotonou preferences for all years and this reference scenario is the starting point for the trade policy analysis.

The scenario options can be chosen by the model user using set “Simul” in “sets.gms”, where three scenario choices are currently provided in GAMS code: GSP+, Scenario EPA1, and Scenario EPA2 in addition to the baseline. In scenario analysis, base year (2007) value for tariffs in EPA1 and EPA 2 scenarios are set to the 2007 value of tariffs in GSP+ scenario.

In “Data_input.txt”, tariff data for multiple years of the baseline and the scenarios are given at HS6 level. The list is as follows. EAV_ is Cotonou preferences, i.e. reference scenario. EAV1 is GSP scenario, EAV2 is GSP+ scenario, EAV3 is EPA 1 scenario for 2019, EAV4 is EPA 1 scenario for 2027, EAV5 is EPA 2 scenario for 2019, EAV6 is EPA 2 scenario for 2027. These tariff rate data is later mapped to each scenario in “calib.gms”.

The results of the scenarios are stored in “0_mergedDE.gdx” and “0_mergedAG.gdx”. The scenario results are compared with respect to the baseline for each specific year (and not to the base year of 2007).

7 Update of Model with New Data

PETS model also provides a framework for trade policy analysts who want to use this model to analyze other trade policy scenarios or scenarios that include different regions and product coverage. The user can include additional scenario analysis in the model by adding new tariff and trade value data and by modifying the GAMS code.

7.1 Introducing New Tariff Scenarios to the Existing Model

The current model can be used to analyze other trade policy scenarios for the countries already included in the model. For this purpose, only tariff data for different scenario analysis needs to be added or modified without changing the trade value data or any other part in the model database.

New tariff scenarios can reflect new trade agreements in the baseline, such as common external tariff during a Customs Union implementation, reduction of some bilateral tariffs (free trade area) or a specific change for one country (unilateral reform), or in the EPA scenarios (e.g. a new list of sensitive products).

The new tariff data for new scenario analysis should be at HS6 level for the commodities included in the model and at bilateral level for the countries included in the analysis since model structure is set up for bilateral trade with Armington. If only the tariff rates for commodities and countries for the existing scenarios are changed within “Data_input.txt”, then no GAMS code change is required. Potentially, new scenario and scenario names could be added in the input file.

If new scenario names are defined, they should be included in “sets.gms” for “simul”, and this new data should be added to parameter “tariff” and mapped properly to each scenario name.

7.2 Applying the Model to Another Dataset

Users can wish to apply the model to a different set of countries or use a different base year. If that is the case, the model requires information on trade value and tariffs at a bilateral level, provided for each importing country in the model.

The new bilateral tariff and trade value input should be at a detailed product nomenclature such as HS6, as it is currently used in the model. However, any other user-defined nomenclature, or international nomenclature (e.g. revised HS nomenclature) can be used. Practically, nomenclature can be importer dependent.

Specifically, the tariff and trade value data are imported into the model through “Data_input.txt”. Input data currently is organized as follows: [relevant HS6 code for the commodity].[the importing country code]. [the exporting country code].[the relevant Baseline or Scenario name for tariffs (EAVx) or Trade label] followed by space and [value]. Please note that in PETS, due to trade policy changes, some tariff rates are defined for 2 separate solution years for the scenarios (as described above).

Beyond the data inputs, the GAMS code needs to be revised. First, new data is added with relevant scenario name (for example EAV7). Next, new scenario name should be defined in “sets.gms” for “simul”, country names in “r(reg)” and commodity names in “listehs6.gms”, mapping of sectors at different levels to each other through sets “mapX”. Next, this new data should be added to parameter “tariff” and mapped properly to each scenario name. The model user should also edit “Other_input.gdx” that includes elasticities if new commodities are added. To run the scenario, please add the country code and relevant GAMS lines in “bat.gms” if a new country is added. Please pay attention to “model.gms” for scenario analysis and change if necessary like the base year definition in (like t(“2007”)=YES).

Practically and for trade policy analysis, an important source of bilateral tariff and trade data is World Integrated Trade Solution (WITS) database provided by World Bank at < http://wits.worldbank.org/>.

8 References

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