SUPPORT FOR AGMEMOD MODEL, BASELINE AND DATABASE UPDATES 2017/2018

Specific Contract Number 154208.X40 AGMEMOD technical documentation – stage 1 (Deliverable D6)

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1. Introduction

This Deliverable 6 on '*AGMEMOD technical documentation*' of project 154208.X40 provides the first stage of updating the technical reporting on the AGMEMOD modelling system. The report is a guide for current and new members of the AGMEMOD modelling team and contains consolidated information about the model. With help of the guide, they should be able to understand the AGMEMOD structure and its modelling approach, and be able to create and run scenarios by using the AGMEMOD software.

AGMEMOD (*Ag*riculture *Me*mber State *Mod*elling) was established in 2001 and it has been evolving since that time. Due to a continuous changing policy and economic context, the model needs 1) frequent updates of commodities, countries and activities, and 2) regular improvements of methodologies and techniques. These ongoing developments have resulted in guides, manuals and documents describing multiple aspects of the AGMEMOD system, such as mnemonics protocol, use of data sources, data building process, commodity flow charts, functional model descriptions, use of econometric and economic methods, programs to carry out simulations and ways how to present model results.

There is a need to review the full set of documentation that is available and to update and structure that in a harmonized and consistent way. As this updating process is a time consuming task, the work will be conducted in steps over time. This Deliverable 6 provides information on the first stage activities undertaken by the AGMEMOD consortium to update and harmonize the technical documentation. Its focus is on describing the key elements of the AGMEMOD system framework in Chapters 3 and 4. Aspects like folder and file structure, essential programs for operationalizing the framework, run and solving options under different scenario and data variants are addressed. Chapter 2 summarizes the AGMEMOD's background and explains how it has been developed and maintained since 2001.

2. Background of AGMEMOD model

2.1 Start in 2001

Since 2001, AGMEMOD has been developed and sustained by a partnership ([1]) comprising research institutes, government agencies and universities in European Union (EU) Member States, later extended to include partners in new Member States as well as other countries (such as the former Yugoslav Republic of Macedonia, Russia, Turkey and Ukraine). AGMEMOD has been funded under the European Commission fifth and sixth Framework Programmes ([2]) and by contributions from partner institutes. The AGMEMOD model is managed in a flexible manner as, depending on the specific task in hand, different AGMEMOD partners build up a consortium around the main developers of the AGMEMOD model. Moreover, the academic network has been extended to include broader society; the result is the AGMEMOD network, involving market experts and stakeholders interested in the results of the AGMEMOD Outlook. The development of the AGMEMOD model and partnership has been continuously supported by the European Commission's Joint Research Centre (JRC) as the AGMEMOD model is an integral part of the Integrated Modelling Platform for Agro-economic Commodity and Policy Analysis (iMAP) hosted by the JRC (Salamon et al., 2017).

The primary objective in developing and maintaining AGMEMOD is to have a partial equilibrium modelling system with the capacity to undertake model-based economic

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([1]) The AGMEMOD Partnership was formulated by a Memorandum of Understanding signed by all Partners. The Memorandum continued in full force until 31 December 2015.
([2]) Projects QLRT-2001-02853 and SSPE-CT-2005-021543.

analysis of the impact of policy or other changes on the agri-food sector of each EU Member State and the EU as a whole. The AGMEMOD Partnership's approach is a bottom-up one based on country-level models, using a common country model template, and their subsequent combination in a composite EU model (Chantreuil et al., 2012). The general structure of the AGMEMOD country and composite models is based on the so-called GOLD template that can be found in Hanrahan (2001). A more detailed model description can be found in Chantreuil, Hanrahan and Levert (2005). The form of the model template varies across four different groups of commodities, i.e. grains, oilseeds and root crops; permanent crops; livestock; and dairy products.

Based on a set of commodity specific model templates, country specific models were developed to reflect the detail of agriculture at Member State level and at the same time to allow for their combination in an EU model. This approach allows the inherent heterogeneity of the agricultural systems existing across the EU to be captured within the model's parameterisation, while the analytical consistency across the country models is ensured through an adherence to the agreed commodity model templates. The maintenance of analytical consistency across the country models is essential for the successful aggregation of country models to the EU level. It also facilitates the meaningful comparison of the impact of a policy change across different Member States.

In the ideal case, the country models are updated, maintained and used by economic modellers in the relevant countries. This is a unique approach, as other agricultural sector models are maintained within one or a few institutions. The AGMEMOD Partnership also aims to establish an advisory circle of market experts in the agricultural sector in each country to review model projections. In total, the combined process intends to provide a core competency in the economic modelling of agricultural commodity markets and agricultural policy analysis, enhancing the quality of analytical results available for policymaking and decision-making at all levels (Chantreuil et al., 2012).

While policy reform remains a political process, policy makers increasingly use evidence based decision making in policy negotiations. Within the EU, Member States are free to adopt differing positions in respect of policy proposals, based on their assessment of the merits of the policy for their agriculture sector and wider economic and social interests. Those charged with developing policy proposals at EU level, need to have an appreciation for the likely impact of a particular policy in order to identify, at an early stage, any issues that would prevent a policy proposal's acceptance by the Member States. In this context, a model such as the AGMEMOD model, which can provide Member State level detail, will be highly useful for EU and Member State based policy makers.

2.2 Status in 2018

2.2.1 Commodities and countries

At its core, AGMEMOD is an econometric, dynamic, partial-equilibrium, multi-country, multi-market model, initially developed for EU agri-food markets covering most EU Member States (Luxembourg is combined with Belgium) at national level. Based on a set of commodity-specific model templates, country-specific models are developed to reflect the details of agriculture at Member State level and at the same time to allow their combination in an EU model. Later, the model has been extended to capture other countries and a stylised version of the rest of the world (ROW), which neglects any detailed representation and policies. A close adherence to templates assures analytical consistency across the country models, essential for aggregation purposes. In addition, the adherence to model templates and a common modelling approach also facilitates comparisons of the impact of a policy change across different countries (Salamon et al., 2008). Updated templates - flowcharts and functional equations - for commodity-specific models, the land allocation model and country-specific models will be captured in a next stage of the documenting process.

To ensure that each country model can be understood as easily as possible, and to avoid multiple versions of the same series name in different countries, AGMEMOD is following a Mnemonic Protocol that takes account of the increasing geographical coverage as well as the increasing commodity coverage of the AGMEMOD model in the course of time. The AGMEMOD mnemonic (or code) convention is straightforward. Variable names (of 7/8 letters in length) can be broken into three parts, roughly 2 – 3/4 -2:
-   The first part indicates the *commodity* or *commodity product* by two letters;
-   The second part indicates the *activity* (or economic aggregate, ratio, etc.) that is being described. This part of the variable name comprises 3/4 letters.
-   The final part of the variable name comprises two letters and indicates the *country* or *aggregate of countries* (e.g. EU28) that the data described through the first two components.

Note that AGMEMOD has an option to include regional data, e.g. for Germany and Ukraine so far. In such a case, the country code must be extended with a regional code, e.g. West Ukraine is indicated as *UA_WE.*

In the course of time, AGMEMOD has been extended with extra commodities, activities and countries. Tables 2.1 and 2.2 depict the state of art of *commodities* and *countries* that are involved in the current AGMEMOD system (version of July 2018), in combination with its mnemonics or codes used.

Table 2.1 Commodity names and codes in AGMEMOD

Grains and Oilseeds		Root crops, fruit, other		Livestock, Meats and Fish		Milk and Dairy	
Soft wheat	WS	Potatoes	PT	Cattle	CC	Cow's milk	CM
Durum wheat	WD	Sugar beets	ST	Dairy cows	DC	Other milk	OM
Barley	BA	Sugar	SU	Suckler cows	BC	Whole milk	WM
Maize	CO	Isoglucose	IS	Bovine animals<1y	CV	Skim milk	NF
Oats	OA	Sweetener	SE	Beef and veal	BV	Butter	BU
Rice	RE	Molasse	MO	Pigs	HP	Cheese	CD
Rye	RY	Tobacco	TB	Sows	SW	Casein	KA
Triticale	TR	Cotton	ST	Pig meat	PK	Drinking milk	DM
Other grains	OG	Olive oil	OO	Sheep	LM	Cream	CE
Rapeseed	RS	Tomatoes	TO	Ewes	EW	Other fresh	FM
Sunflower	UF	Tomato paste	TP	Broiler	BR		
Soybeans	SB	Citrus fruit	CF	Other poultry	OP		
Rape meal	RL	Oranges	OR	Poultry	PO		
Sun meal	UM	Apples	AP	Eggs	EG		
Soya meal	SM						
Rape oil	RO	Cotton	CT	Fish	FH		
Sun oil	UO	Cotton lint	CL	Cephalopods	FH_c_		
Soya oil	SO	Tobacco	TB	Crustaceans	FH_r_		
		Table wine	WT	Demersal Fish	FH_d_		
Teff	TF	Coffee	CX	Freshwater Fish	FH_f_		
Quat	QQ	Tea	TE	Other Marine Fish	FH_m_		
Beans	BN	Sugarcane	SC	Other Molluscs	FH_o_		
Sorghum	SG	millet	MI	Pelagic Fish	FH_p_		
		Yam	YM	Plaice Fish	FH_l_		
		Plantain	PL	Flatfish	FH_t_		
				Whitefish	FH_w_		
				Salmonidae	FH_s_		
				Fish meal	FHml_		
				Fish oil	FHol_		

Table 2.2 Country names and codes in AGMEMOD

EU countries		EU countries		EU countries		Non-EU countries	
Austria	AT	Finland	FI	Malta	MT	Macedonia	MK
Belgium	BE	France	FR	Poland	PL	Turkey	TR
Bulgaria	BG	Greece	GR	Portugal	PT	Russia	RU
Cyprus	CY	Croatia	HR	Romania	RO	Ukraine	UA
Czech R.	CZ	Hungary	HU	Sweden	SE	Rest of World	RW
Germany	DE	Ireland	IE	Slovenia	SI	Iceland	IC
Denmark	DK	Italy	IT	Slovakia	SK	Norway	NO
Estonia	EE	Lithuania	LT	United Kingdom	UK	Ethiopia	ET
Spain	ES	Latvia	LV	UE	EU28	Ghana	GH
						Kenia	KE
						Rwanda	RD
						Tanzania	TA

2.2.2 Activities

The key part of the variable name, and consequently of any attempt to construct a standardised variable naming convention, is the middle 3/4/5 letters: *the activity*. The middle 3/4/5 letters denote the mnemonics for economic activity, aggregate, or variable of concern. When combined with the two-letter commodity and country codes, the activity code should make clear to all other researchers involved in the project what is the meaning of the series concerned. Activities are grouped into macro variables, policy instrument variables, price variables, and supply and use variables. Table 2.3 gives an overview of the main activities used in current AGMEMOD version.

Note that all mnemonics/codes used in the AGMEMOD model are stored in the Excel file *ListOfBasicMnemonics-OriginalOrder.xlsx* (see section 3.3.2). It contains sheets with mnemonics for respectively *Countries, Regions, Commodities (or Products)* and *Activities*. New mnemonics for new commodities, new countries and/or new must be added to the corresponding lists in the *ListOfBasicMnemonics-OriginalOrder.xlsx* file.

Table 2.3 Activity names and codes in AGMEMOD

Macro		Policy instruments		Prices		Supply and Use	
Population	PO	Budgetary national envelope	ENV	Nominal farm price	PFN	Area harvested	AHA
Real GDP	RGDPD	Ecological focus area	EFA	Nominal wholesale price	PWN	Production	SPR
Real GDP/capita	RGDPC	Voluntary coupled support	VCS	World market prices	WMP	Domestic use	UDC
$/€ exchange rate	EXRD	Coupled payments	CPT	5-yr average price	PF5	Imports	SMT
NC/€ exchange rate	EXRE	Tariff rate quota	TRQ	3-yr average price	PF3	Exports	UXT
Deflator	GDPD	Price support component	PRC	Real farm price	PFR	Ending stocks	CCT
		Subsidized export limits	SXL	Real wholesale price	PWR	Beginning stocks	ITT
		Historical payments in ceiling	HPT	Price in euros	Peuro	Factory use	UFA
		Regional payments in ceiling	RPT			Other factory use	XFA
		Total support	TSU			Death loss	UDL
		Export taxes	XTX			Food use/cap	UFC
		Ad valorem import tariffs	STX			Food use	UFD

		Export ban	XBAN			Total feed use	UFE
						Industrial use	UOT
						Net exports	UXN
						Seed use	UFS
						Biofuel use	UOD
Economy		**Technology**		**Resources**		**Livestock**	
Real crushing margin	CMR	Products fat %	FPP	Area harvested	AHA	Calf slaughter	KCV
Gross margin returns	EGM	Products protein %	PPP	Share area harvested	ASH	Lamb slaughter	KLM
Adjusted Gross margin returns	EGA	Fat use	FPC			Other slaughter	KOT
Total expenditures	TEX	Protein use	PPC			Slaughter	KTT
Feed costs	FCO	Extraction rate	XTR			Other animals available	OCA
Input costs	ICI	Yield/ha	YHA			Pigs avail. less piglets	OPA
Adj. cost index	ICIA	Yield/cow	YCO			Cows per capita	CPC
Quota rent	RENT	Yield/ewe	YPE			Calf slaughter % total slaughter	CVS
		Yield/sow	YPS			Cow slaughter % total slaughter	CWS
		Feed conversion coefficient	FCA			Slaughter weight Kg per head	SLW
		Feed demand index	FIN			Sow slaughter on total slaughter ration	SWS

3. AGMEMOD system framework

3.1 Installation process

The AGMEMOD model system is offered to users as a *zip file* that can be downloaded from a web-linkage or USB stick. Box 3.1 gives the steps for installing the model on a laptop or computer.

Box 3.1 Installing the AGMEMOD system

1. Download the file **AGMEMOD.zip** to your root directory (C: drive or D: drive)

2. Unzip this AGMEMOD.zip in this root directory so that **C:\AGMEMOD** or **D:\AGMEMOD** is generated

3. AGMEMOD runs under the program **..\AGMEMOD\GamsTools*GsePro.exe***. The easiest way to apply the tool is by creating a shortcut on your desktop:
- go to **..\AGMEMOD\GamsTools*GsePro.exe***
- right click (mouse) on the program *GsePro.exe* and select 'Create Shortcut'
- move the shortcut from the **..\AGMEMOD\GamsTools**folder to your desktop
- put the cursor on the icon, right click (mouse), select 'rename' and give it a name, e.g. 'AGMEMOD-*date*'

4. Start the AGMEMOD program by clicking on the shortcut icon.

IMPORTANT:
    1) No spaces allowed in names of AGMEMOD folder structure, but underscores (_) can be used.
    2) AGMEMOD folder names can be in Latin letters only.

3.1.1 Computer system requirements

To run and solve the AGMEMOD processes smoothly, the laptop or computer needs:
- Central Processing Unit (CPU): intel i5 or intel i7 processor; and
- Internal memory of at least 4 Gigabytes.

Additional requirements for the control system of the laptop and computers are:
- Operating System:
  o Microsoft Windows 7 Professional or Enterprise, 64-Bit
  o Microsoft Windows 10 Home, Professional or Enterprise, 64-Bit
- Office:
  o Microsoft Office 2010, 2013 or 2016, 32-Bit
  o Microsoft Office 365, but then AccessDatabaseEngine of 2010 has to be installed on top of Office

IMPORTANT: Office 64-Bit is NOT compatible with AGMEMOD.

Before downloading the AGMEMOD framework, the **control systems** of laptop or computer must be checked. First, go to the *Start* icon (left end of toolbar) and click on **Control Panel/System -** then select **Security/System**. Information of Figure 3.1 appears:
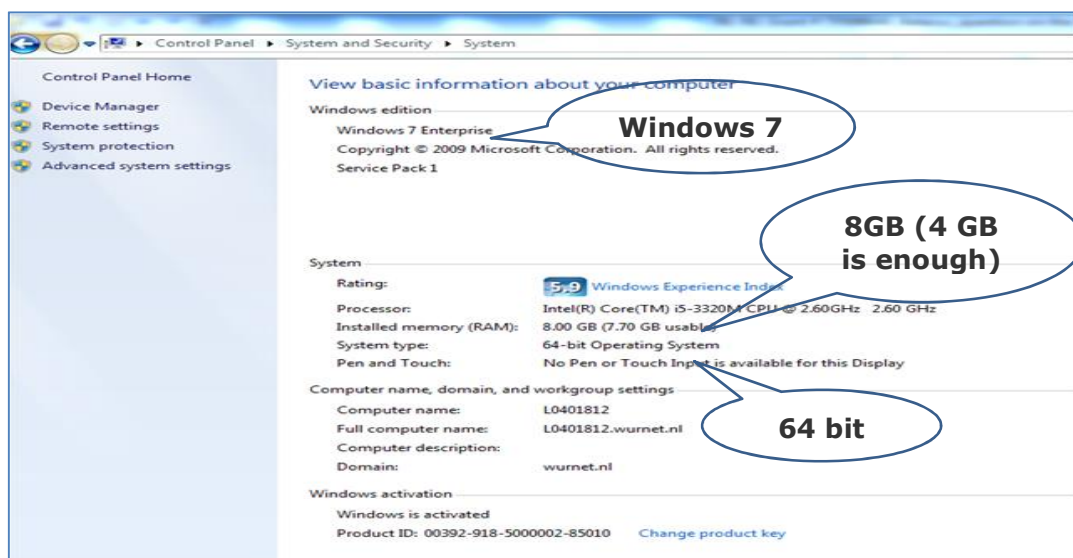
Figure 3.1 Information on computer system

Second, the version of the **MS Office system** of laptop or computer must be checked**:** *open MS-Excel* and select *File/Help.* Then information about the system appears (Figure 3.2).
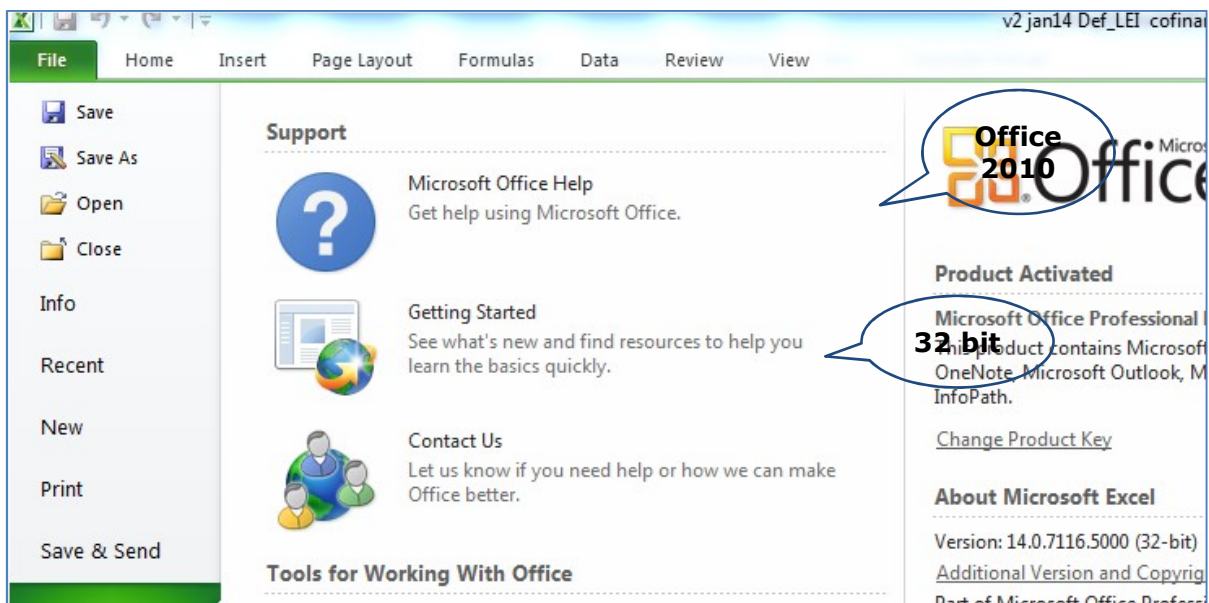
Figure 3.2 Information about MS Office version

3.1.2 Software requirements

For developing, adjusting and running the AGMEMOD system, the computer needs the following software installed:

- Microsoft Office software: MS-Excel, MS-Word.
- GAMS programming software with *conopt solver* (licence based).
- Gtree software (Gtree stands for GAMS tree, which is an alternative of the GAMS-IDE); it is included in the AGMEMOD.zip file for downloading.
- R or another econometric package (e.g. Eviews, Stata).
- Adobe Acrobat.

3.3 Folder and file structure

3.2.1 Root folder

Figure 3.3 presents the AGMEMOD directory structure as depicted by the Windows Explorer of the **AGMEMOD.zip** file to be downloaded.
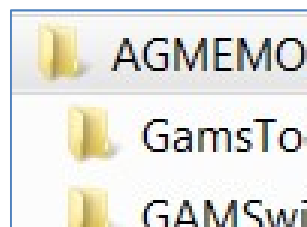
Figure 3.3 AGMEMOD directory structure

AGMEMOD runs and solves under GAMS. The **GAMSwin32 folder** with the necessary programs (GAMS 24.2 version) also includes a **temporary GAMS license** file**.**

Note that the GAMS license works for 3 months. Hereafter the computer needs an own GAMS licence file, to be provided by your company/organisation.

The **GamsTools folder** contains the necessary materials needed to manage the AGMEMOD framework (*by GsePro*), to run the model (*by Gtree*), to estimate the model (*by R or Eviews*), to analyse the modelling results (*by MS-Excel* or *DataExplorer*) and to make graphs and maps (b*y MS-Excel and GIS*).

The **MODEL folder** is the main folder of the AGMEMOD system and contains respectively country related data input files, modelling program files and result files necessary to run, solve and analyse AGMEMOD (see section 3.2.2).

3.2.2 MODEL folder

Figure 3.4 depicts following subfolders of the MODEL folder, i.e.:
- *AgmemodGamsCodeGenerator*: country data files (variant dependent) and country model files (scenario dependent).
- *Documents*: documentation on data and model descriptions, manuals, course material, publications, etc.
- *Prog*: central GAMS source used for any scenario and any data variant.
- *Results*: MS-Excel files and GDX-files with country based results per scenario.
- *Scenarios*: scenarios and country specific data and assumptions.
- *Submodel*: scenarios and country specific gams code.
- *XX_GRAPH*: graphs useful for analysing scenarios and country specific commodity markets.
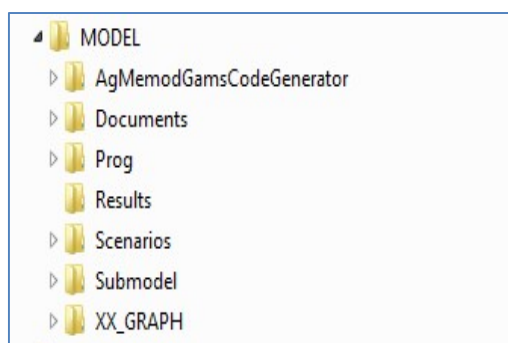
Figure 3.4 Model subfolders

In a nutshell, country based observed data (stored under *..AgmemodGamsCodeGenerator subfolder*; see section 3.3.2), macro and policy assumptions (stored under *... Model/Scenarios subfolder*, see section 3.3.2), and country based model equations (stored under *...AgmemodGamsCodeGenerator subfolder*; see section 3.3.3) are offered to the AGMEMOD model by the **[Scenarios]** menu option of the GsePro user interface (see section 3.3.1). The Baseline scenario is the reference scenario that takes account of a) observed country data, b) projections for macro variables and policy instruments based on current knowledge, and c) country based model equations. Scenario variants can be defined and added to the model, i.e. its results can be compared with those of the Baseline and/or other scenarios (see section 4.1).

3.2.3 Naming conventions

Figure 3.5 shows the naming conventions of AGMEMODs folder and file structure. Files with:
- country's observed commodity market data are *Data Variant* dependent;
- econometrically estimated country equations are *Scenario* dependent;
- world price, macroeconomic, policy and other assumptions are *Scenario* dependent.

With each creation of a new data variant (see section 4.2) and/or new scenario (see section 4.1), its associated subfolder and file naming structures are automatically integrated in the entire AGMEMOD system framework.
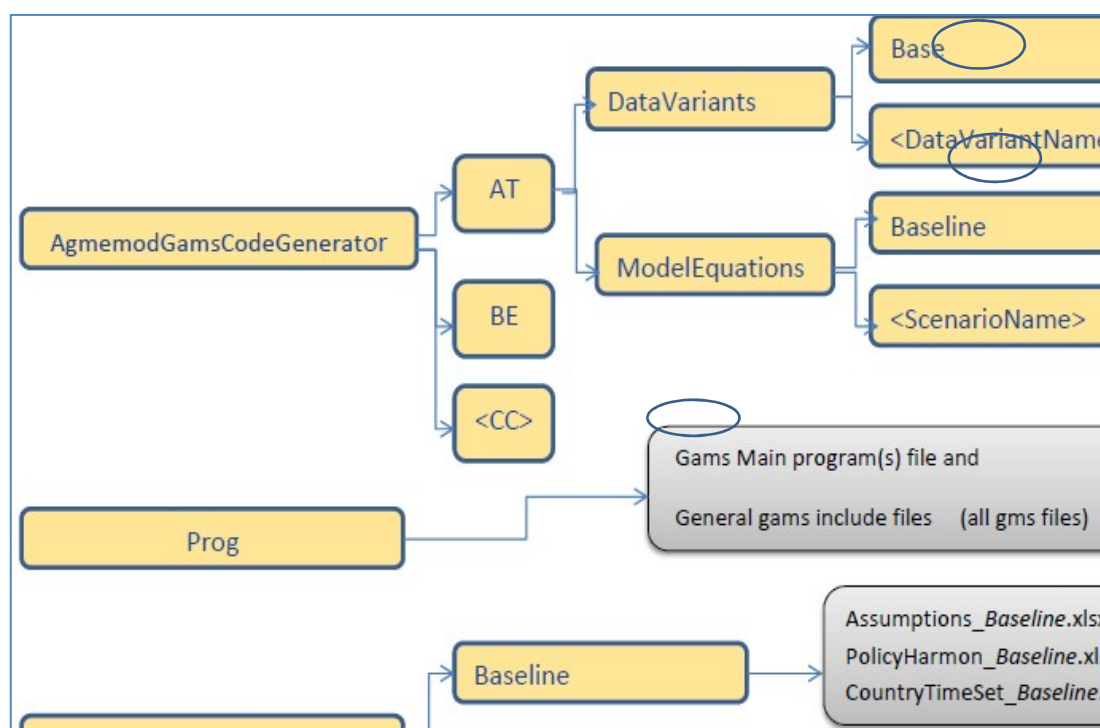
Figure 3.5 AGMEMOD's internal structure on data and scenario

3.3 Programs

3.3.1 GsePro for user interface

The AGMEMOD framework works under a researcher and user-friendly interface. Click on the created **AGMEMOD icon** that has appeared on your desktop following the installation procedure of Box 1. Figure 3.6 depicts the opening screen of the **AGMEMOD user interface**.

Figure 3.6 Opening screen of AGMEMOD user interface

Table 3.1 summarizes the meaning of each menu option in the toolbar of the user interface.

Table 3.1 Menu options of AGMEMOD user interface

Menu option	Meaning
File	Contains: 1. Ini-files with settings on initialisation and installation 2. File and map definitions for adjusting the AGMEMOD user-interface (GSEpro) 3. To exit the AGMEMOD user-interface
Processes	Captures the steps from data reading, model running to output writing: 1. Runs selected scenarios 2. Creates Excel output for selected scenarios 3. Calculates Scenario differences, Creates Tables and Maps
Scenarios	Place where to select and define scenario(s). AGMEMOD contains a Baseline and is extendible with alternative scenarios
InputData	Shows the data and equations input of the AGMEMOD tool: 1. Commodity balance (historical, observed) data 2. Scenario data: model assumptions for baseline and scenarios
ModelSources	Shows the sources of the AGMEMOD model: 1. *Agmemod2Gams tool*: to transfer the estimated country equations from Excel files into GAMS files 2. AGMEMOD source GAMS code 3. Eviews estimation software
Results	Shows the results of the AGMEMOD model: 1. Tables and maps 2. Country and EU based results
Documents	Captures background information on the AGMEMOD model: 1. Getting started with AGMEMOD tool (this document) 2. Manuals and articles 3. Help desk
Presentations	Contains presentations on AGMEMOD topics

3.3.2 MS-Excel for storing data

Before addressing the main data and model file types of the AGMEMOD model system, it is important to explain the naming (coding) of the variables used.

3.3.2.1 Mnemonic codes

Each variable used in AGMEMOD has a unique **code name** (or **mnemonic**), build up from a Product code (2 letters), an Activity code (3/4 letters) and a Country code (2 letters). Each mnemonic is unique and commonly used across the series of country models in AGMEMOD.

New mnemonics are automatically added to the AGMEMOD framework according to a two-step procedure. Use the **AGMEMOD interface** to open the **Agmemod2Gams tool** by selecting the menu option **[ModelSources]***Agmemod2Gams Tool and EQUATIONS Files\Baseline\Agmemod2Gams Tool* (Figure 3.7).
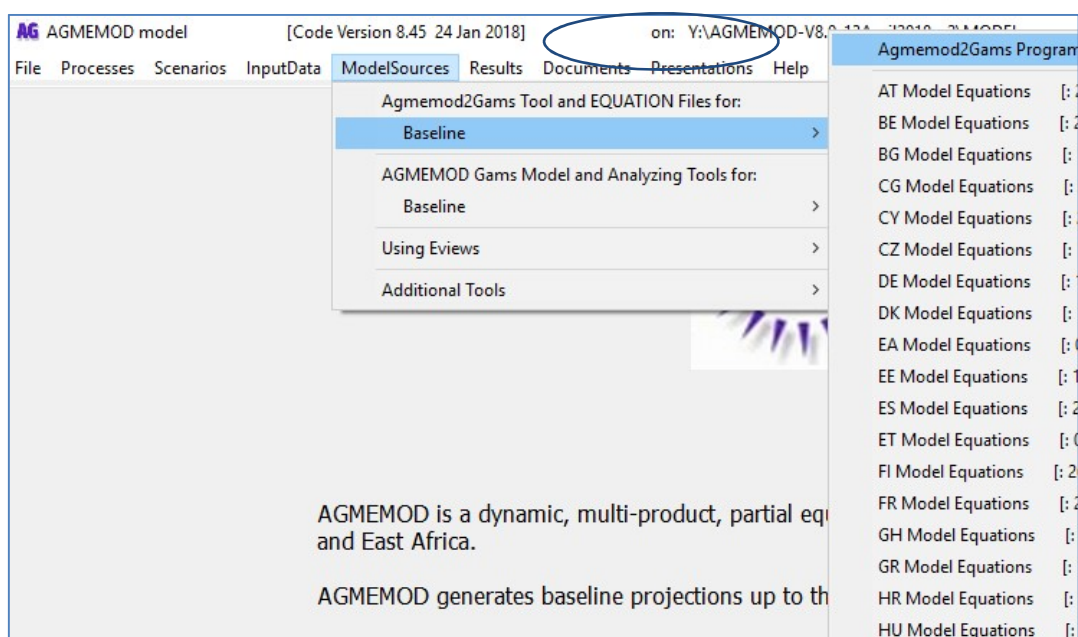
Figure 3.7 Opening the Agmemod2Gams Tool via menu option [ModelSources]

Select the option *Open ListOfBaseMnemonics File* under the menu option [**Extensions**] (Figure 3.8), and an Excel file with the name *ListOfBasicMnemonics-OriginalOrder.xlsx* opens. It contains sheets with mnemonics for respectively *Countries, Regions, Commodities (or Products)* and *Activities* used in AGMEMOD. For example, the *Products* sheet has a code *WS* for the product *Soft Wheat*; the *Countries* sheet has a code *AT* for *Austria*.

New mnemonics introduced in AGMEMOD structure
New mnemonics for new commodities, countries and/or activities that enters the AGMEMOD system, must be added in the *ListOfBasicMnemonics-OriginalOrder.xlsx* file. When included, save and close the file and the screen of Figure 3.8 appears again. Then next essential step is to integrate the new mnemonic(s) in the AGMEMOD folder and file structure by:

- Clicking on the [**Process all Base Mnemonics to GAMS Model**] button (Figure 3.8).
- After the message '*successful integration of mnemonics'*, the screen can be closed by clicking on the [**Close**] button.
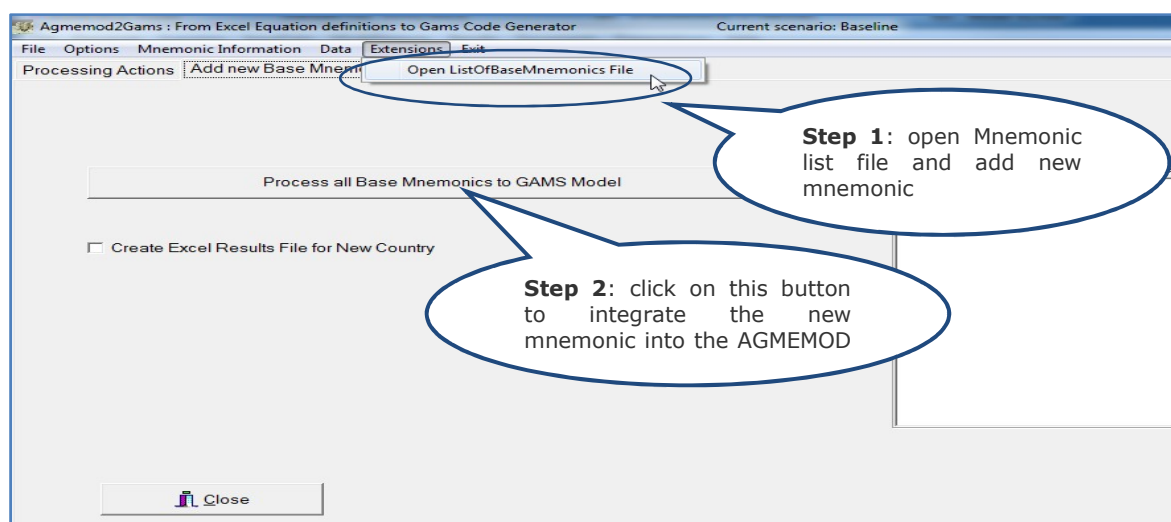
Figure 3.8 Opening the Mnemonic List file by using the Agmemod2Gams tool

3.3.2.2 Data file types

AGMEMOD needs four MS-Excel data types to populate, run and solve the model:

1. *CC-Datagmemod_Base.xlsx*: observed country data for agricultural commodity markets (Data variant dependent).
2. *AssumptionsInput_Baseline.xlsm*: historical and projected data on world prices, macroeconomics and policy instruments (Scenario dependent).
3. *CountryTimeSet_Baseline*.xlsm: historical and simulation time periods per country CC (Scenario dependent).
4. *PolicyHarmon_Baseline*.xlsm: harmonised policy data on budget enveloped for EU member states (Scenario dependent).

Ad 1. Country data files: CC-Datagmemod_Base.xlsx
The _**Base** in the file name refers to the Base data variant for the agricultural commodity market data. There are two ways to look at the figures in the *CC-Datagmemod_Base.xlsx* file, by:

- Windows Explorer *..\MODEL\AgMemodGamsCodeGenerator\CC\DataVariants\Base*.
- **Agmemod user interface:** select option [**InputData**]*Country Data (Excel DataVariants)\Base\CC-Datagmemod* (Figure 3.9).

CC-Datagmemod_Base.xlsx includes worksheets with data for econometric estimations of the Country model to be developed. This file is formatted along *description* (column A), *unit* (column B), *mnemonic* (column C), and *annual data series* (from column H) for each variable included.
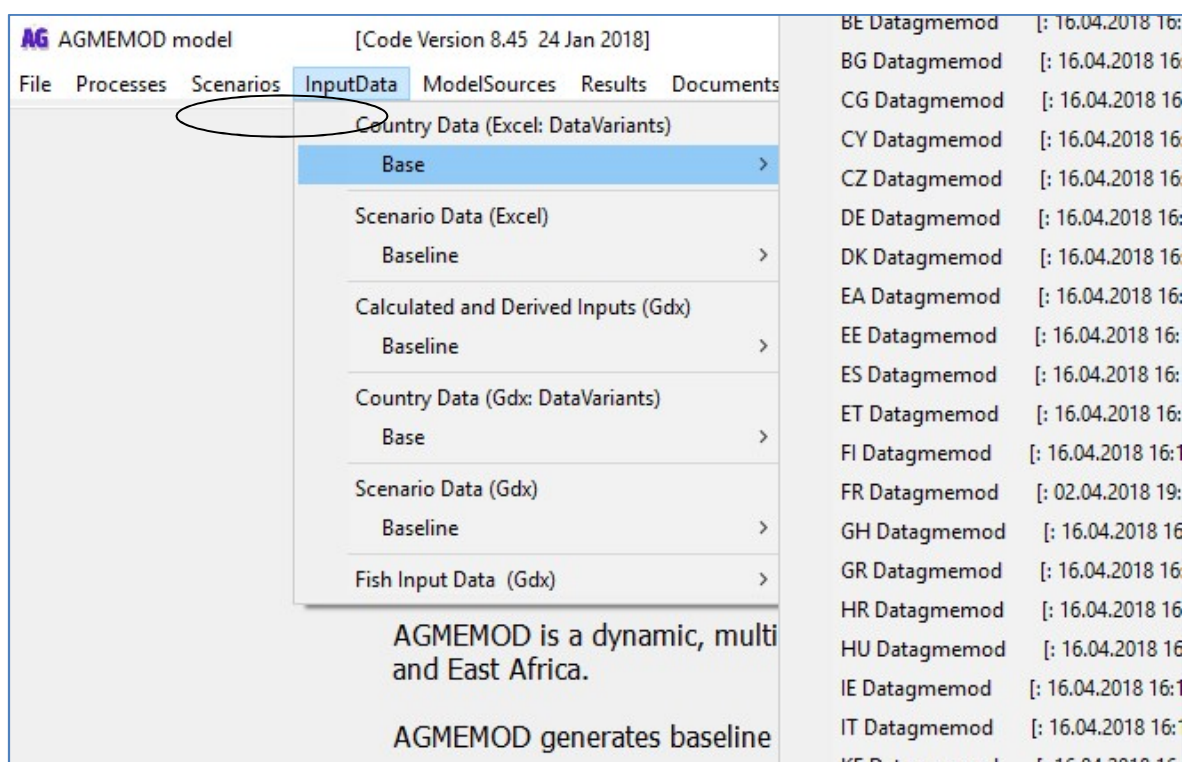
Figure 3.9 Examining Country Data files, via menu option [InputData]

Ad 2. Macroeconomic and EU policy assumptions: AssumptionsInput_Baseline.xlsm
The second part of the file name (**_Baseline**) indicates that assumptions have been set for the Baseline version of the Assumptions Input data. There are two ways to look into it, i.e.:

- open the file in Windows Explorer via *..\MODEL\Scenarios\Baseline* folder.
- **Agmemod user interface** by selecting menu option [**InputData**]*\ScenarioData \Baseline\Assumptions Input Data* (Figure 3.10).
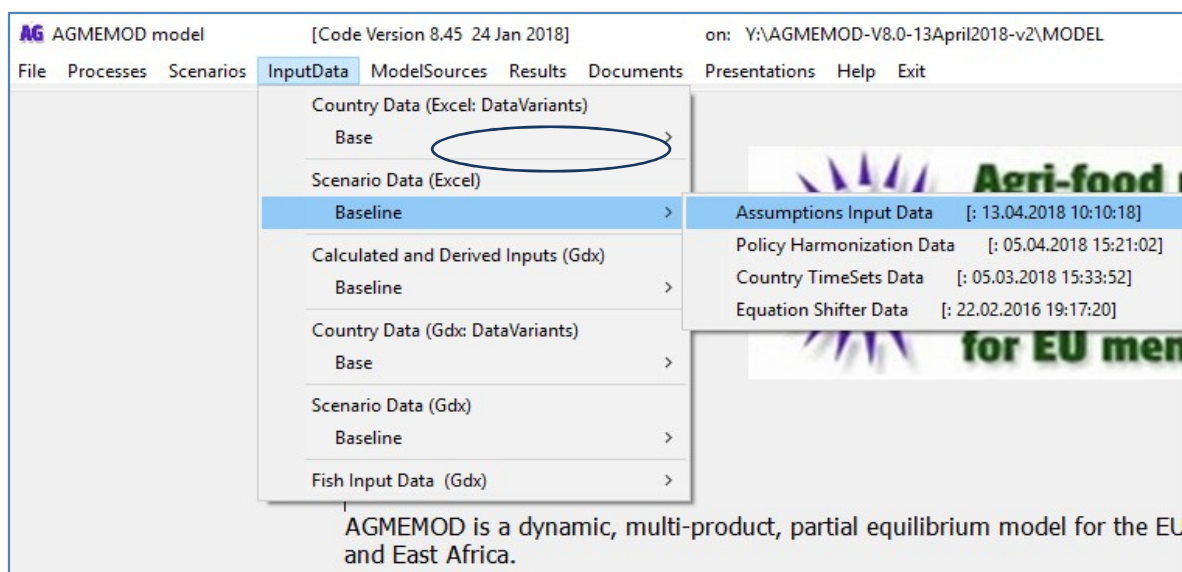
Figure 3.10 Examining the AssumptionsInput file by menu option [InputData]

The file *AssumptionsInput_Baseline.xlsm* opens and shows the following worksheets of importance:

- *World*: world price projections for commodities captured in AGMEMOD (USD, NC, €).
- *Macro*: macroeconomic projections per country.
- *EU_policy*: common EU policy measures on CAP and trade measures.
- *CC_policy*: country specific policy measures.
- *Trend*: trend variables.
- *Dummy*: dummy variables.

These sheets contain values for the exogenous variables driving the outcomes of the run and solve process of the AGMEMOD model.

Ad 3. Country dependent policy assumptions: PolicyHarmon_Baseline.xlsm
This file is Scenario dependent. The second part of the file name (**_Baseline)** shows that this example uses the values of the Policy Harmon data as assumed in the Baseline. There are two ways to examine this file:

- open it directly in the Windows Explorer via *..\MODEL\Scenarios\Baseline* folder.
- **Agmemod user interface** by selecting menu option [**InputData**]*ScenarioData \Baseline\ Policy Harmonisation Data* (Figure 3.11).
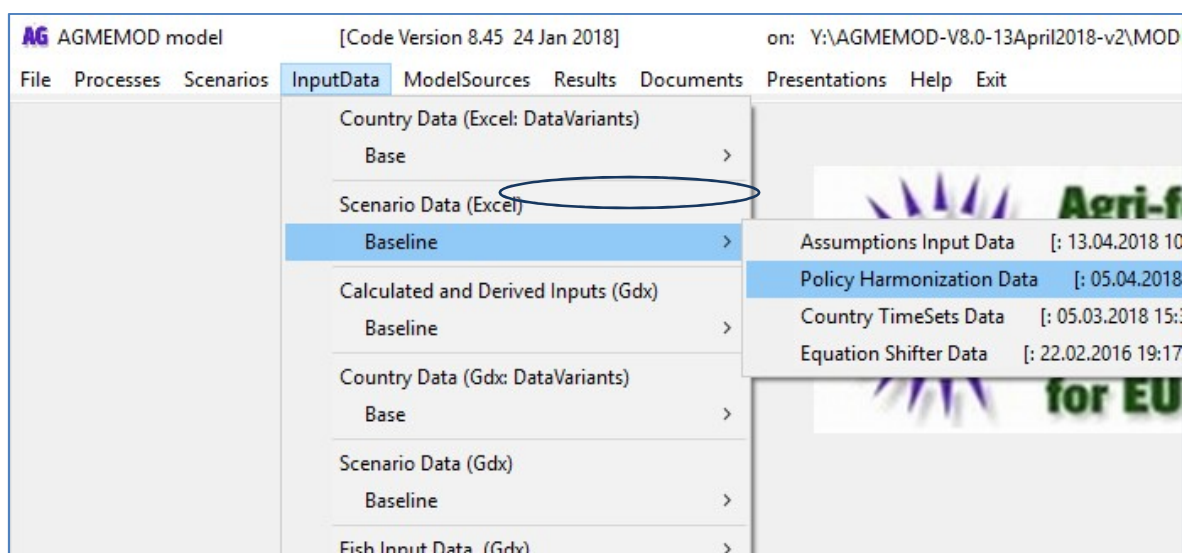
Figure 3.11 Examining Policy Harmonisation file, via menu option [InputData]

Ad 4. Initialization and settings: CountryTimeSet_Baseline.xlsm
This file is Scenario dependent. The second part of the file name (**_Baseline)** shows that this example takes the Baseline version of the Country Time Set data (Figure 3.12). There are two ways to examine this file, by

- open it directly in Windows Explorer via *..\MODEL\Scenarios\Baseline* folder.
- **Agmemod user interface** by selecting menu option [**InputData]***ScenarioData \Baseline\ CountryTimeSets Data* (Figure 3.12).

The file *CountryTimeSet_Baseline.xlsm* opens and shows following worksheets of importance:
- *HistoryData*: observed data set per country; associate with lengths of data series in CC-Datagmemod.xlsm files.
- *RealSimulationPeriod*: length of the simulation period per country.
- *GroupMembership:* countries in a Membership, e.g. EU28, with entering and/or leaving year.
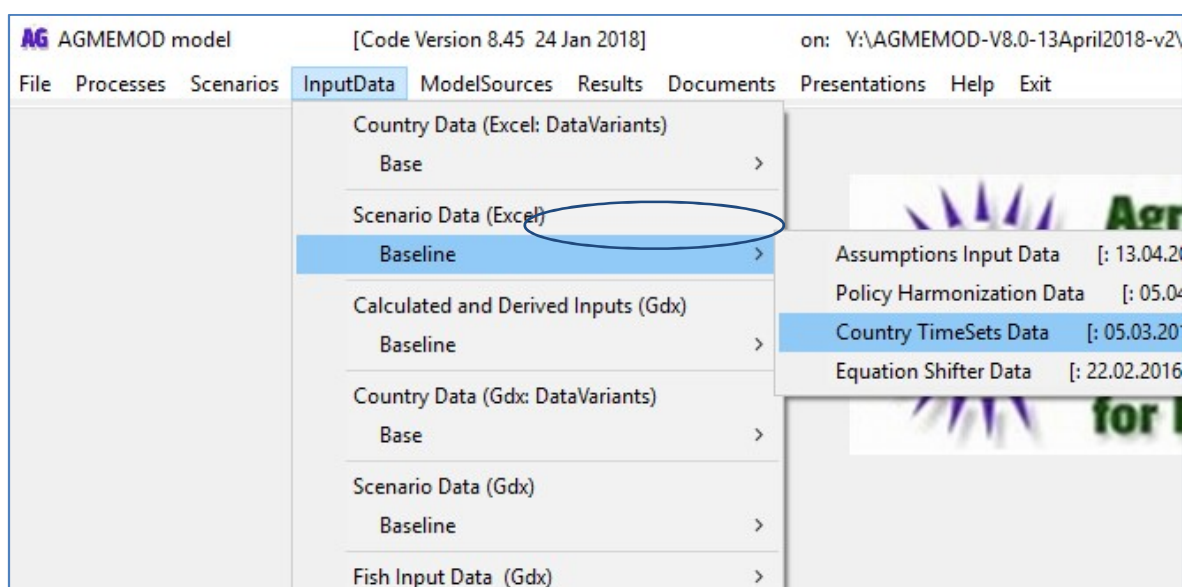
Figure 3.12 Examining CountryTimeSet file, via menu option [InputData]

3.3.2.3 Parameter types

Previous section addressed the four main types of MS-Excel data files that must be filled with a) country specific data and b) general assumption data in line with the data building protocol of the AGMEMOD systems framework (will be described in the next stage of the technical documentation process). All endogenous and exogenous variables appear in the AGMEMOD model with a **unique mnemonic code,** and thus can only enter once in a specific data file. Further, each mnemonic code has been linked to a **unique parameter** type in the AGMEMOD system (Table 3.2).

Table 3.2 Parameter types used in AGMEMOD

Parameter type	Meaning
V2(P_A,C,T1)	Product P and Activity A in Country C in year T1; endogenously calculated; *endogenous* in model
V(P_A,C,T1)	Product P and Activity A in Country C in year T1; fixed on the last observed year; *exogenous* in model
VWP(P_A,T1)	World market price for Product P and Activity A in year T1; *exogenous* in model
VPOL(P_A,T1)	EU dependent Policy variable for Product P and Activity A in year T1; *exogenous* in model
VPOLC(P_A,C,T1)	Policy variable for Product P and Activity A in Country C in year T1; *exogenous* in model
VMAC(A,C,T1)	Macroeconomic variable for Activity A in Country C in year T1; *exogenous* in model
V_PH(A,C,T1)	Policy variables on budgetary envelopes in Country C in year T1; *exogenous* in model
TREND(T1)	Trend variable in year T1, *exogenous* in model
DUM(D,T1)	Dummy variable in year T1; *exogenous* in model

3.3.2.4 Data reading

In a next step, information from the four main data file types must be integrated into the AGMEMOD system model by a data reading procedure. This process is managed through the **AGMEMOD tool** by selecting menu option **[Processes]** / *Run selected Scenarios*. Next click on the **[Start AGMEMOD processes and Scenarios]** button.

Note that the instructions in the rights side box indicate that a scenario – in order to open the correct files - needs to be selected first as data files are scenario dependent. Therefore, if not already done, open the menu option **[Scenarios]** and select *Baseline*. When done, return to the menu option **[Processes],** click on **[Start AGMEMOD processes and Scenarios]** button and it imports all necessary data files related to the selected **Baseline** scenario. In the same process, the model will be run and solved for the selected **Baseline** scenario (details of this second stage are in chapter 4).

At the end of this process, a text box with information on the reading and model running process appears on the screen, together with a note whether the process has been executed successfully or unsuccessfully (Figure 3.13).
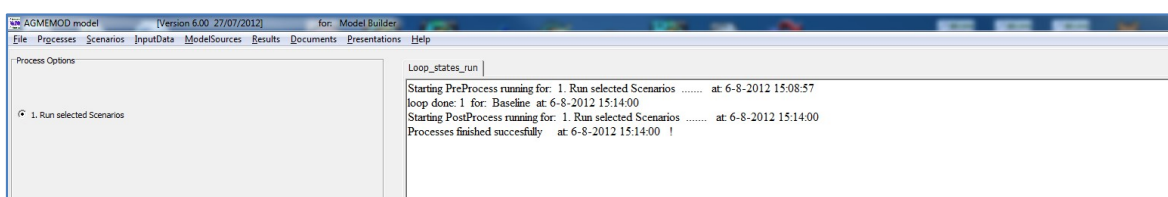
Figure 3.13 Message on the status of the reading and running process

When the reading process was unsuccessful, the error type message(s) can be found in the *Agmemod.lst* file, which is in the *..\AGMEMOD\MODEL\Prog* folder.

3.3.3 MS-Excel for storing equations

Along with the set of country and assumptions data, AGMEMOD needs a set of equations that represent the main agricultural commodity markets in a country. These country-based equations are stored in the MS-Excel file *CC_ModelEquations_Baseline.xlsm*. In principle, the equations are *Scenario* dependent and *Country* dependent. The second part of the file name (*_Baseline*) shows that the model equations represent the Baseline version (Figure 3.14). There are two ways to examine this file, by using:

- Windows Explorer via *..\MODEL\ AgMemodGamsCodeGenerator\CC\ModelEquations\ Baseline* folder.
- **Agmemod user interface** by selecting menu option **[ModelSources**]*\Agmemod2Gams Tool and EQUATION Files\Baseline\CC Model Equations* (Figure 3.14).
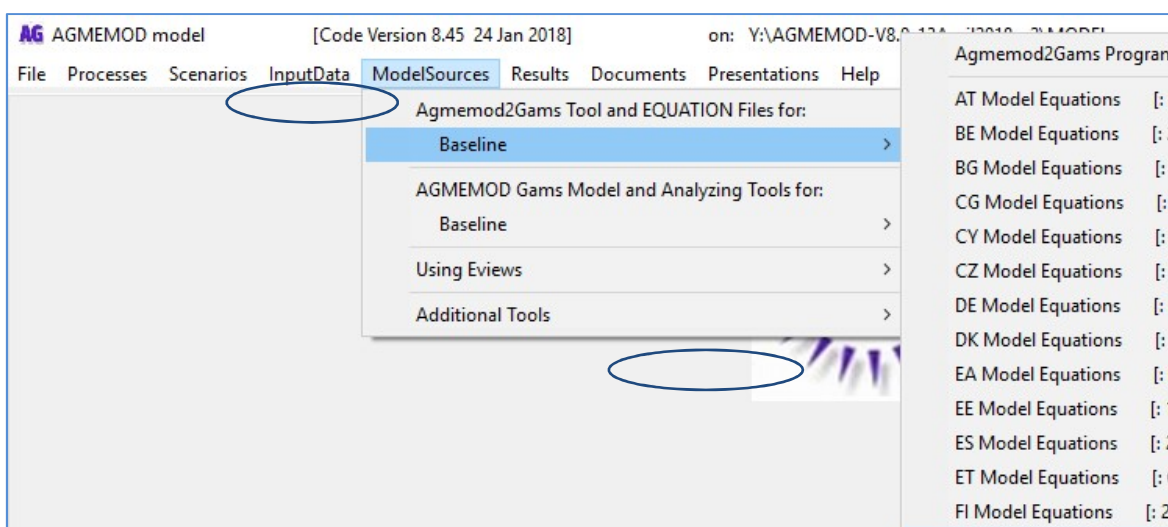
Figure 3.14 Examining AGMEMOD equation files, via menu option [ModelSources]

For example, select the French equation file in the Baseline scenario and *FR_ModelEquations_Baseline.xlsm* will open (*FR* is the country mnemonic for France). It shows rows with variables that are similarly structured as the rows in the associated *FR-Datagmemod_Base.xlsx* file. Moreover, the content of columns A-G is similar in both files. Apart from that, columns H and I in *FR_ModelEquations_Baseline.xlsm* cover specific equation information on the variable:

- *Column H* identifies **the type of equation** that is used, i.e.:
    - *EQ* (stands for *Equation*) type, which means that the variable has been estimated or calibrated
    - *IDEN* (stands for *Identity*) type, i.e. variable has been derived from other variables
    - *FX* (stands for *Fixed*) type, i.e. variable has been fixed on its last observation
    - *EQ_HFX* (stands for *Equations with Fixed data*), i.e. variable has been simulated, but overrules estimations with observed data when available
    - *SUM_PROD* (stands for *Summing Products*), for summation of sub-products to main product; e.g. sum of fish species to a fish family

- *Column I* presents the **specification** of the estimated, calibrated or derived equation, expressed in mnemonic codes.

3.3.4 Agmemod2Gams tool for generating GAMS model

3.3.4.1 Role of tool

AGMEMOD systems solves in GAMS (conopt solver), which means that the equations covered in the *CC_ModelEquation_Baseline.xlsm* need to be transferred into **GAMS code**. To get a consistent modelling framework, the one-to-one relation between information from data files (like CC-*Datagmemod_Base.xlsm and AssumptionsInput_Baseline.xlsm*) and model equation files (CC-*ModelEquations_Baseline.xlsm*) must be guaranteed. To achieve this, the **Agmemod2Gams tool** plays a key role in ensuring a **consistent, transparent and error free GAMS program.** The tool has as main objectives:

- To check if all country data have been entered to the database files, when specified in the country model equation file.

- To check if foreign country data (e.g. key prices) used in the own country model is captured by the corresponding foreign country data file *CC-Datagmemod_Baseline.xlsm*.

- To check the use of mnemonics and the use of equation types.

- To report errors and problems regarding miscommunication between database and equations.

- To re-estimate a complete country model in case of new data or new equations.

- To write the GAMS code of the country Model equations, inclusive sets and parameter declarations of products, activities, countries and time.

- To automate the integrating of new mnemonics into the AGMEMOD framework.

If the specifications of the country model equations have been correctly implemented in the *CC_ModelEquation_Baseline.xlsm* files, then the **Agmemod2Gams tool** will transfer these from these MS-Excel files into GAMS code. I.e. related *Equations_CC.gms* files (extension *.gms* refers to *GAMS*) are automatically generated and fully integrated into the overall AGMEMOD system framework. This GAMS code generation procedure holds for new and/or updated equations.

3.3.4.2 Application of tool

The **Agmemod2Gams tool** transfers country's model equations into GAMS code by selecting the user interface's menu option **[ModelSources]***AGMEMOD GAMS model and Equation Files\Baseline\Agmemod2Gams Program* (Figure 3.15).
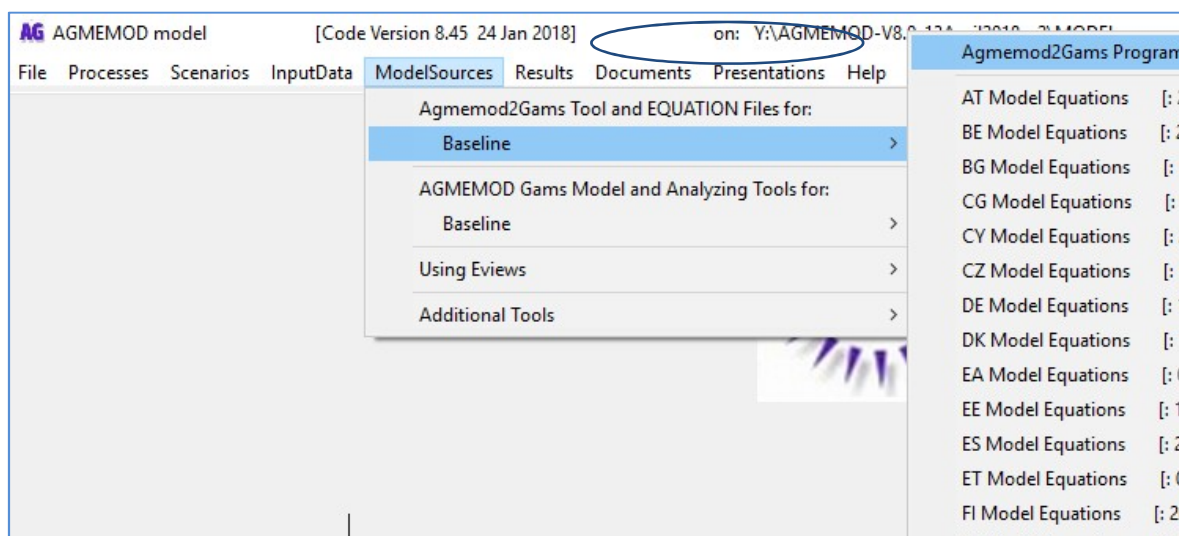
Figure 3.15 Access to Agmemod2Gams tool by menu option [ModelSources]

In Figure 3.16 select *FR* (mnemonic country code for *France*) in the **[Choose country/Country to process]** box. Then, click on the **[Start Processing]** button and the Agmemod2Gams tool starts to check the data and equation conditions related to the French case. If all the conditions are fulfilled, then the *CONGRATULATIONS!!* message appears on the screen.

Further, the **Agmemod2Gams tool** will have transferred all equation specifications of *FR-ModelEquations_Baseline.xlsm* into GAMS code (Figure 3.17) by creating a new *Equations_FR.gms* file. To exit the Agmemod2Gams tool, click on the **[Close]** button.
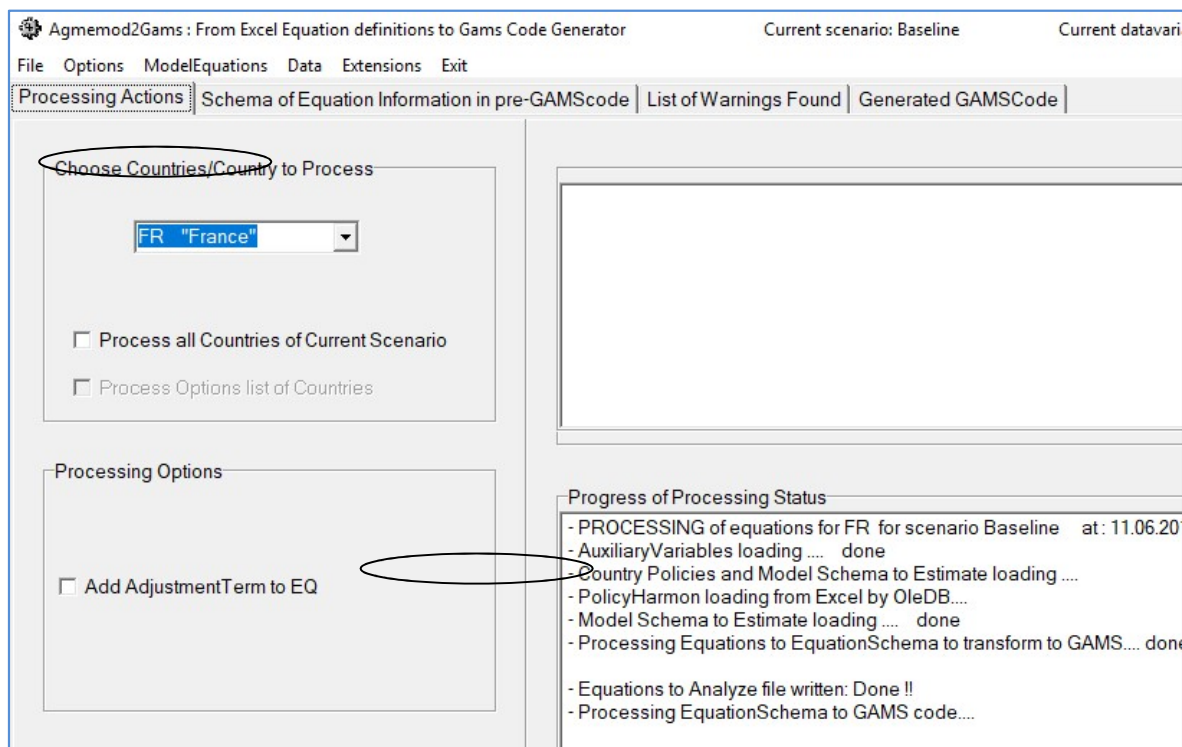
Figure 3.16 Checking data and equations of French model and generating GAMS code

3.3.4.3 GAMS files in Gtree

Use the **AGMEMOD tool** for opening the model source file *Agmemod.gms* by selecting the menu option **[ModelSources]***AGMEMOD GAMS model and Analyzing Tools\Baseline\ AGMEMOD GAMS model*

Search for the French GAMS file by clicking on the following ⊞ - boxes in screen's left column:

⊞ *MainModel.gms –* ⊞*CountryListAllCountryModels.gms –*⊞*Equations_FR.gms*

The file *Agmemod.gms* opens in *Gtree* (GAMS tree, which is an alternative for the GAMS-IDE) and the screen shows two columns. The left-hand side column displays the breakdown of the AGMEMOD source code in sub-files for respectively settings, parameter and variable definitions, data reading, model calculations and output savings. In practice, this *Gtree* framework enables the AGMEMOD user to manage the model. The code of the French AGMEMOD model will display on the right-hand side of the screen (Figure 3.17).
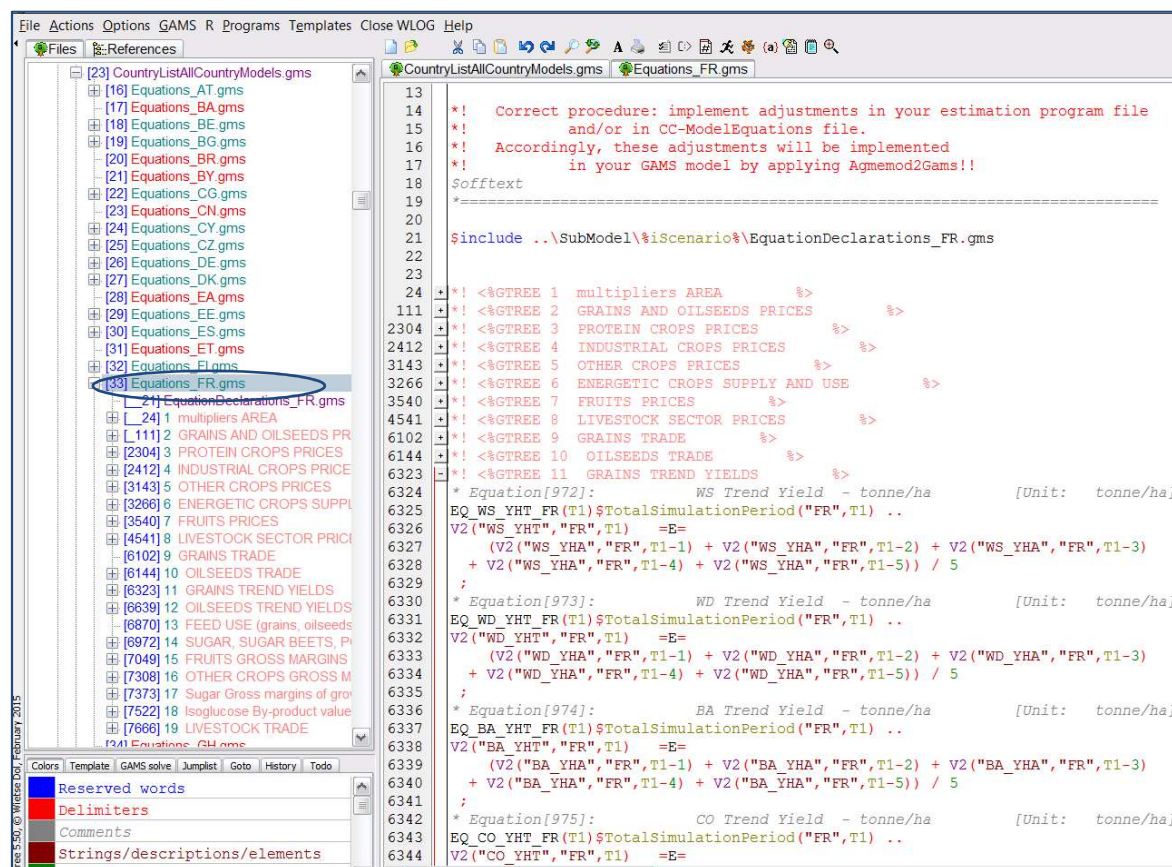
Figure 3.17 GAMS code of French AGMEMOD model

GAMS code for all equations used in all country models has automatically been generated by the **Agmemod2Gams tool**, with a standard setting of the equation description. The econometrically **estimated/calibrated parameters** are in **green**, whereas the **headings of sub-topics** are in **red**. The country models have been split up into various sub-topics, which can be easily found through the tree structure on the left-hand side of the screen.

Exit *Agmemod.gms* by selecting *File\exit* in the upper tool bar or by clicking on the ◪ in the upper right-hand corner of the screen.

3.3.5 R software for estimations

The AGMEMOD model is built on econometrically estimated functions and identities, in combination with the use of calibrated and adjusted functions (Chantreuil et al, 2012). To perform a smooth estimation process for (new) commodities, countries or activities, following practical guidelines are useful:

- Think about the economic or policy relationship of the variable to be estimated (e.g. the logic sign of parameter; expected size of parameter).
- Look how it has been done in other countries, or for other sectors.
- Do not use too many variables in case of a short time series.
- Do not leave important variables out.
- Avoid lags of the same variable.
- Try estimations without trends first (except yields).
- Make sure the independent variables have the expected sign.
- Start with estimating only one equation at a time, and then check the results.

Equations can be estimated with R software[3], which has been integrated as application tool in the AGMEMOD system framework.

AGMEMOD's estimation process contains three stages. First, providing new data updates from *CC-Datagmemod, AssumptionInput and PolicyHarmon* files to the R tool (section 3.3.5.1). Second, defining the equation to be (re-)estimated and executing the estimation in R (section 3.3.5.2). Third, transferring the estimated equations into the AGMEMOD system framework (section 3.3.5.3).

3.3.5.1 Data in R

Go to the **R estimation tool** via the scenario in which (re)-estimations need to be executed, e.g. in the Baseline scenario. First, in the AGEMMOD user interface select menu option **[ModelSources]***AGMEMOD GAMS model and Equation files\Baseline\Agmemod2Gams Program.* Second*, select the country from the list, e.g. *Czech Republic (CZ)*, that needs a (re-)estimation, and third, take the option **[ModelEquation]***/Estimate Equation in R* (Figure 3.18).

Step 1: go to Agmemdo2Gams

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[3] See https://www.r-project.org/. R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS.

Figure 3.18 Steps to enter the R estimation tool

Next screen appears (Figure 3.19), including an information box with the message that data in the Excel files have recently been updated. This is based on checking the date of each data file used. It is recommended to click on *yes*, as it is important to insert most recent data in the (re-)estimation procedure.
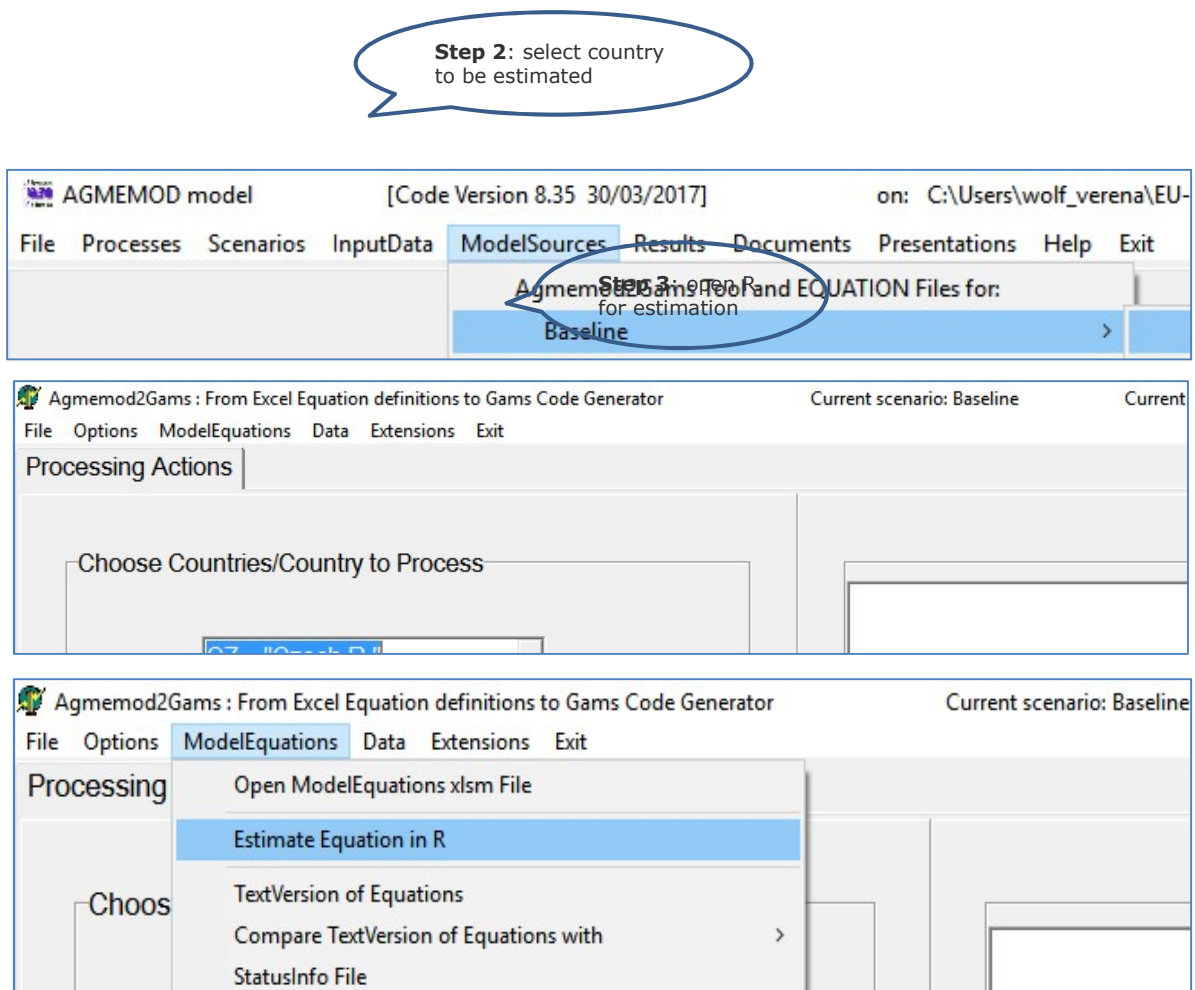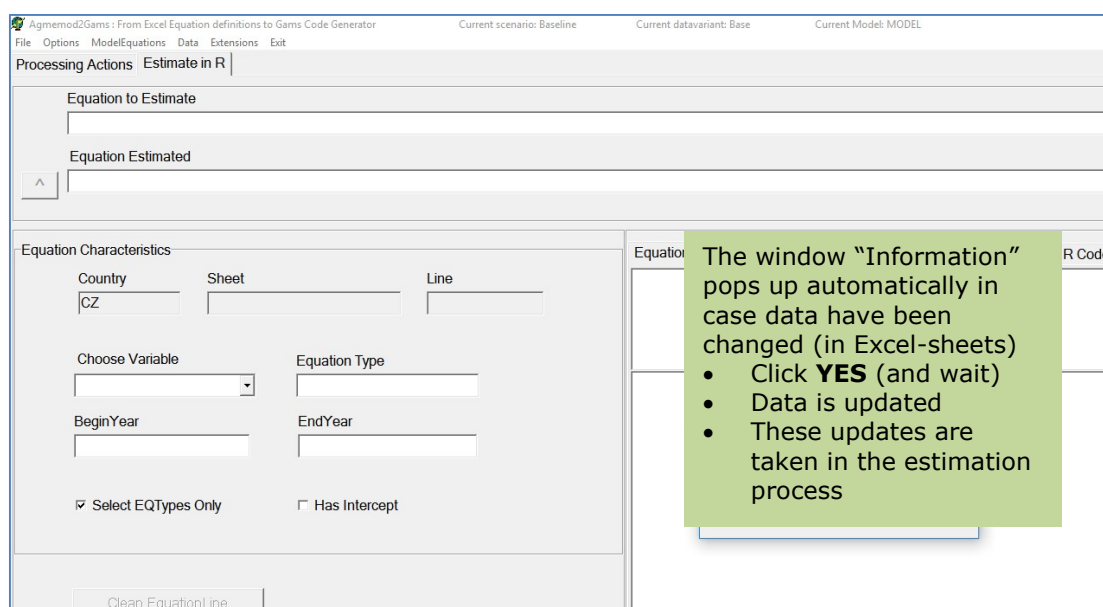
Figure 3.19 Opening screen of R estimation tool

A new window pops up with information on which files have been updated and transferred to the R tool. Close it – by clicking on ▬ - after the statement *Succesfully updated R_Data for Estimations* has appeared (Figure 3.20).
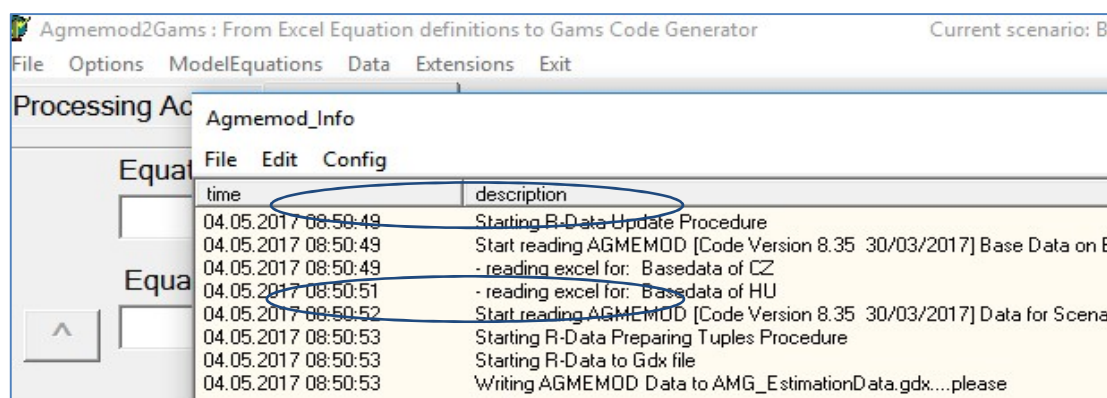
Figure 3.20 Successful update of R data for estimation

Warning: **if the information box does not pop up, despite a recent data update, there are two options to get the data updates anyway:**

- *Option 1:* close the Agmemod2Gams tool. Then open the changed assumptions and/or CC-DataAgmemod_base.xls file(s) and save it/them again (so the files get a new date!). Apply again the steps as described in Figures 3.18 to 3.21.
- *Option 2:* force the update of R-data by selecting the **[Options]** menu in Agmemod2Gams and activating the option *Force Update Data for R* (Figure 3.21).
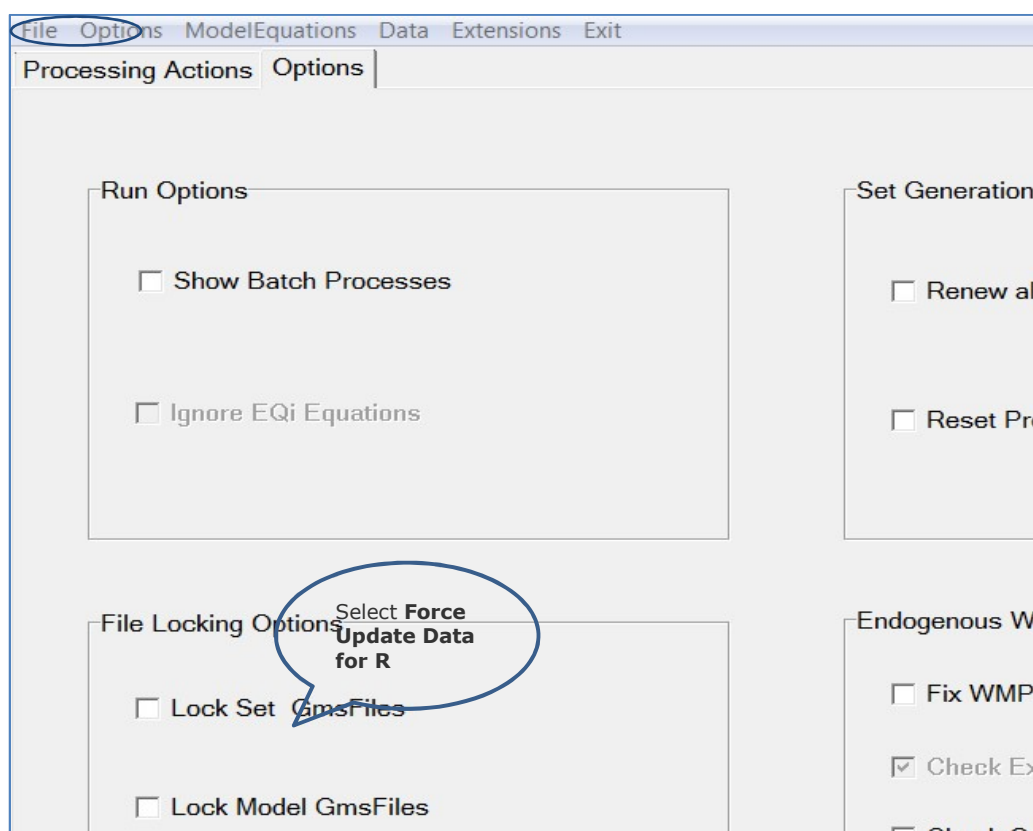
Figure 3.21 Option to force data update for R estimations

Warning: if the R program informs about an error when reading the equations of the selected *CC-ModelEquation_baseline.xls* file (Figure 3.22), then the solution is:

- Process the country for which the estimation has to be done: **[ModelSources]**\
AGMEMOD GAMS model and Equation files\Baseline\Agmemod2Gams Program.
Then select the *country* from the list that gave the error message, and press the **[Start Processing]** button.
- Restart R and it will load the updated equation information.
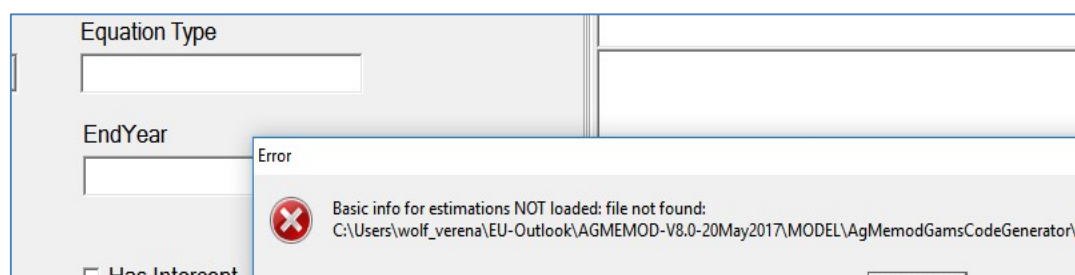
Figure 3.22 Error message during data updating process

3.3.5.2 Estimations in R

Having most recent data from the *CC-DataAgmemod_base, As*sumptionInput and PolicyHarmon files successfully transferred into the R program (Figure 3.23), the estimation procedure can start. Next screen appears (Figure 3.24) with information on the country, *CZ* in the example, for which (re-)estimation(s) needs to be conducted. Next step is to select the variable to be (re-)estimated by typing the mnemonic in the *Choose*

Variable box; the estimation as currently exists in *CZ-ModelEquations_baseline.xls* will be displayed in the *Equation Estimated* box. Then press the **[Clean EquationLine]** button.

Figure 3.23 Selecting the variable to be (re-)estimated

The **[Clean Equation Line]** option is important in order to get the (existing) equation in a correct format for being (re-)estimated in R, which means, it can have:
- No intercept or only one intercept.
- Left side variable to be explained by more than one variable, which are recognized by parameter value(s).
- No 'min' or 'max' functions included.

An error message will appear if this rule do not hold in the already estimated equation under reconstruction (Figure 3.24). For example, the *UFASHCZ* equation to be re-estimated contains a calibration term at the end (*0.052333-0.087204*), which in fact must be regarded as another intercept term apart from the *0.00572* intercept term.

Figure 3.24 Error message if current estimated equation has wrong format

Therefore, the equation in fact contains three intercepts, while it may have only one. Solution:

- Correct the equation in the *Equation Estimated* box by deleting the calibration term; and press **[Clean EquationLine]** button again. Or
- Write the mnemonics by hand in the *Equation to Estimate* box (Figure 3.25).

Figure 3.25 Determination of equation to be estimated

When pressing the **[Estimate Equation]** button, the summary of the equation estimation results is depicted in the right hand side box (Figure 3.26).

Figure 3.26 Summary of estimated equation in R

Next important step it to validate the outcome of the estimation results:

-   Check if the specification makes sense, such as expected sign and size of parameter, based on literature, expert knowledge, own experience, etc..
-   If necessary, adjust the specification of the equation. For example, delete the trend variable and then press the **[Estimate Equation]** button again.
-   Either R estimates the equation or it will gives an error. In both cases go to the *Data input* option and check if full series of data have been used (Figure 3.27).
-   If necessary, e.g. when there are zeros for variables in the equation to be estimated in specific year(s), adjust the data series for the estimation in the *BeginYear* and *EndYear* boxes according to what is available, which are 1995 to 2016 in this example (see right box). Then press the **[Estimate Equation]** button again.

Figure 3.27 Check the data used for the estimation

Now click on the *Equation Summary* option (right side box) again to get the estimation results depicted (Figure 3.28). *Eq.Term_1* refers to the variable term used UFEGMCZ/RSEGMCZ. Check if the estimated parameters have the correct sign. In this example, a higher economic return of sunflower seeds compared to economic returns of

rapeseeds will increase the land allocation to sunflower seeds (positive sign, which is logic).
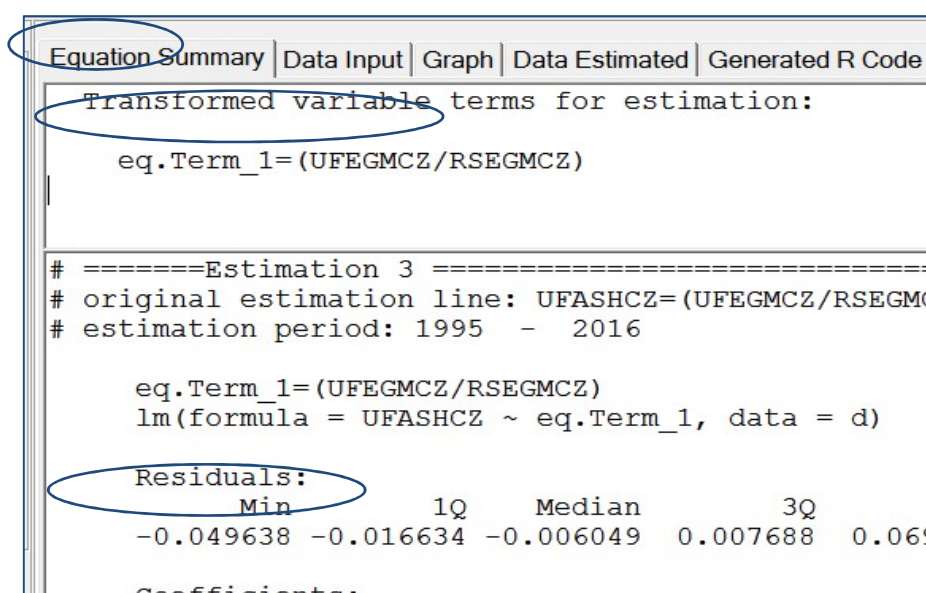
Figure 3.28 Summary of estimation results

The output of the estimated values versus original values of the equation can be viewed in a graph. Select the *Graph* option in the right box (Figure 3.29) and check if estimations fit with original data.
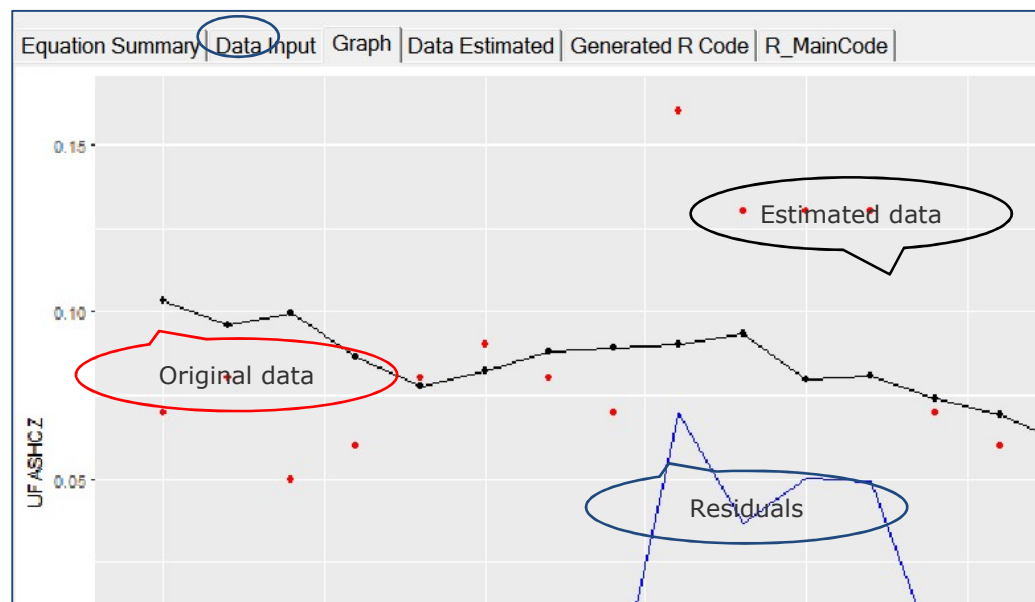

Figure 3.29 Estimated versus original data in Graph option

Note that the information of the *Data Estimated* option is similar as in the *Data Input* option, but with additional figures on *Agm_Yfitted*, i.e. dependent variable as in estimation; and *Residual*, i.e. difference between observed and estimated values for dependent variable (Figure 3.30).

Figure 3.30 Estimated versus original data in Data Estimated option

3.3.5.3 Transfer of equations into Excel and GAMS

If estimation results are satisfactory. First, they need to be integrated in the AGMEMOD system framework, and second its simulation results need to be tested. Therefore, the estimated equation must be inserted in the corresponding *CZ-ModelEquation_baseline.xls* file (Figure 3.31) by:

1. Pressing the **[Put Equation in Equation File]** button, which will replace the old equation in the *CZ-ModelEquation_Baseline* file by the new one. In this example, UFASHCZ equation of line 391 in the *database* worksheet is replaced.

2. A text box appears with the question of the old *CZ-ModelEquation_Baseline* file should be kept: *yes/no*.

3. Optionally, all versions of the newly estimated variable can be stored by pressing the **[Save All Files of Estimation]** button.

Figure 3.31 Transferring estimated equation into CC-ModelEquation file

Next, open the *CZ-ModelEquation_baseline.xls* file and check whether the new equation has been inserted. Add a comment, in column L. For example, note the *date of change* and *person* who made the change (Figure 3.32). Then save and close the Excel file.
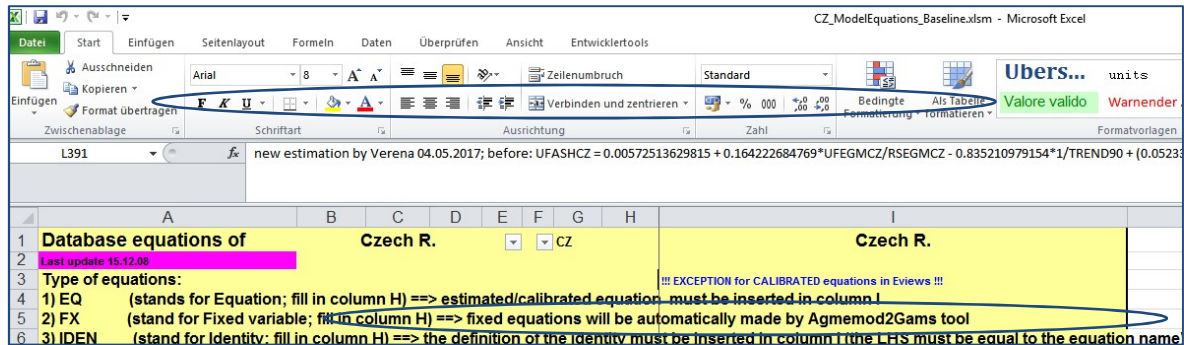
Figure 3.32 New estimated equation inserted in CC-ModelEquation file

The usual next steps are (see Chapter 4):

- To process the adjusted equation file in Agmemod2Gams (Figure 3.33).
- To run and solve the full AGMEMOD model.
- To compare the results (Figure 3.34).

If necessary, e.g. if projections are implausible, there is a need to adjust the equation, re-estimate it, integrate it in the AGMEMOD system, run and solve the model, and validate the results. This is an **iterative process**.
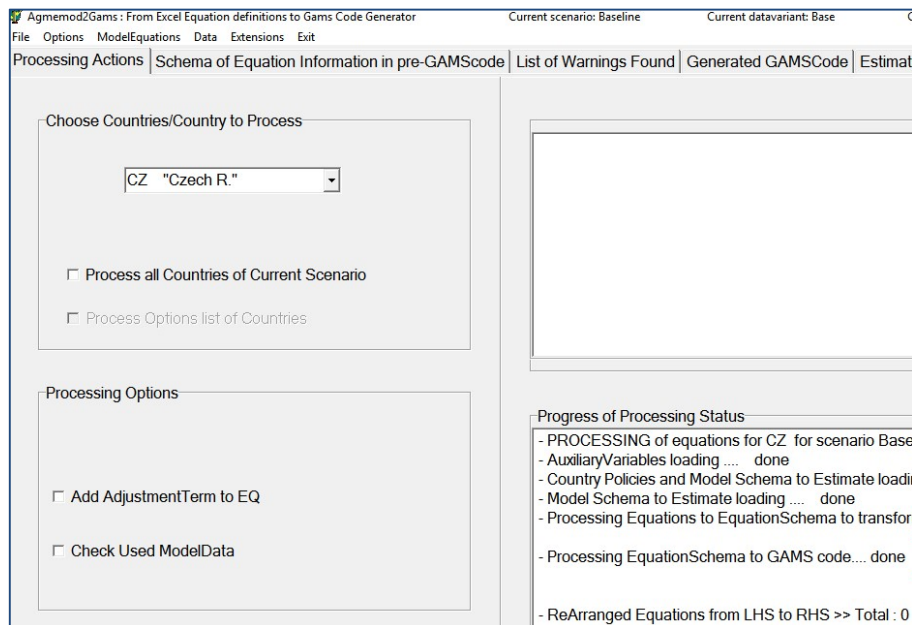
Figure 3.33 Process the adjusted model in Agmemod2Gams
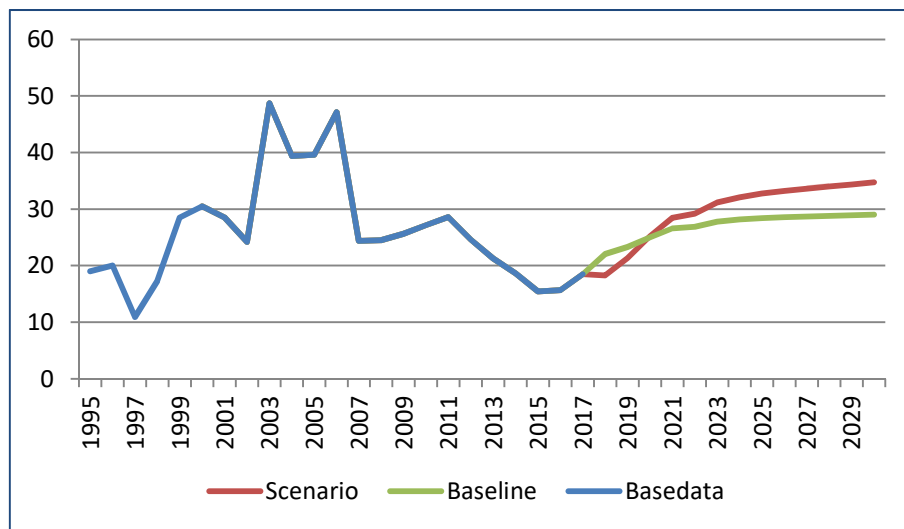
Figure 3.34 Simulation results of old and new sunflower seed area (UFASHCZ)

3.3.6 XXGraph tool for presenting results

3.3.6.1 Output files

AGMEMOD outcomes are scenario dependent and are sent to:

- Country Output Tables for a specific scenario (Gdx files).
- Output Tables for all Scenarios combined (Gdx files).

GDX files can be viewed through the DataExplorer, which is the data reading program linked to GAMS. More information on the DataExplorer is available under menu option **[Documents]/***Agmemod manuals/DataExplorer manual (*Figure 3.35*).
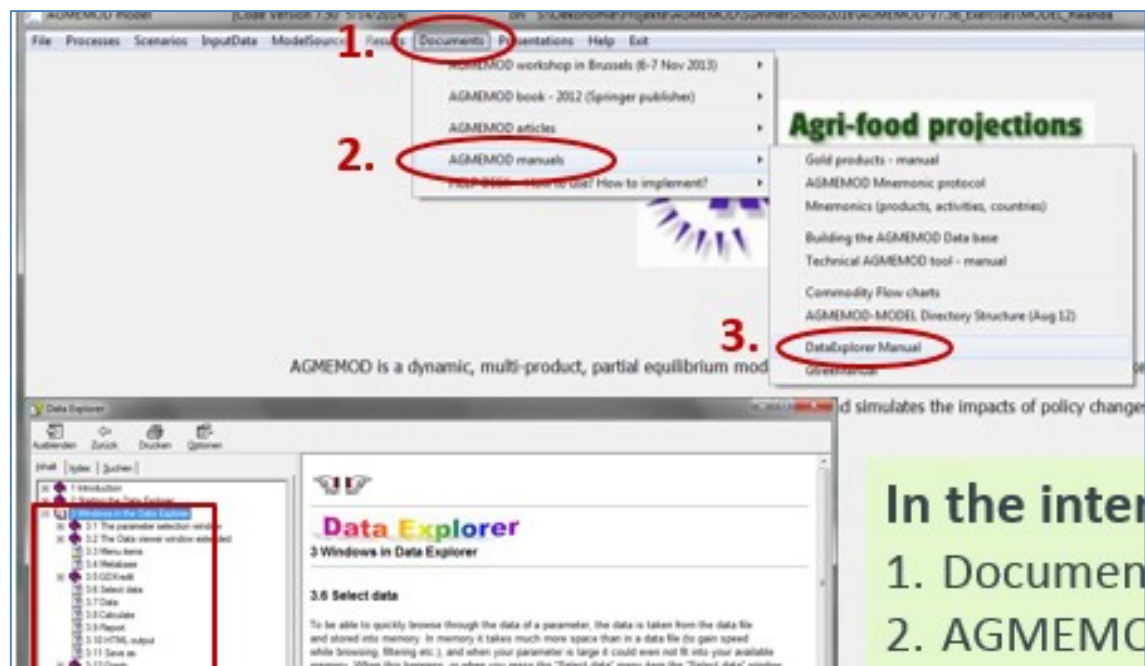
Figure 3.35 Documentation on DataExplorer manual

The scenario dependent country output tables – e.g. for Germany (DE) in the baseline scenario - can be opened by selecting menu option **[Results]/***Country Output Tables (Gdx)/Baseline/DE output (Gdx)* (see Figure 3.36).
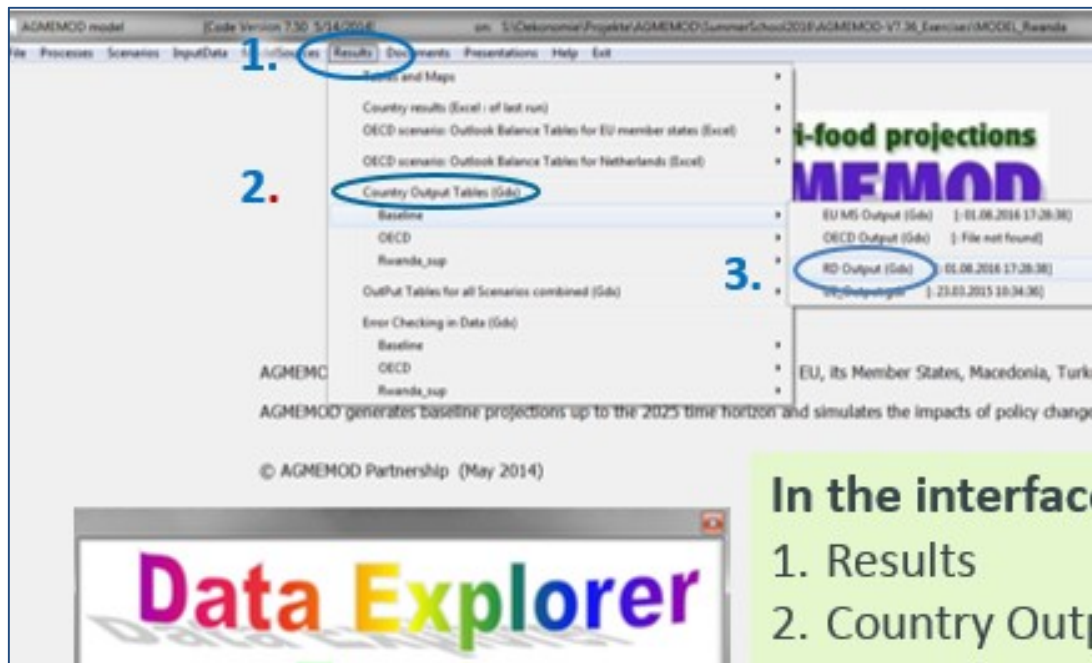
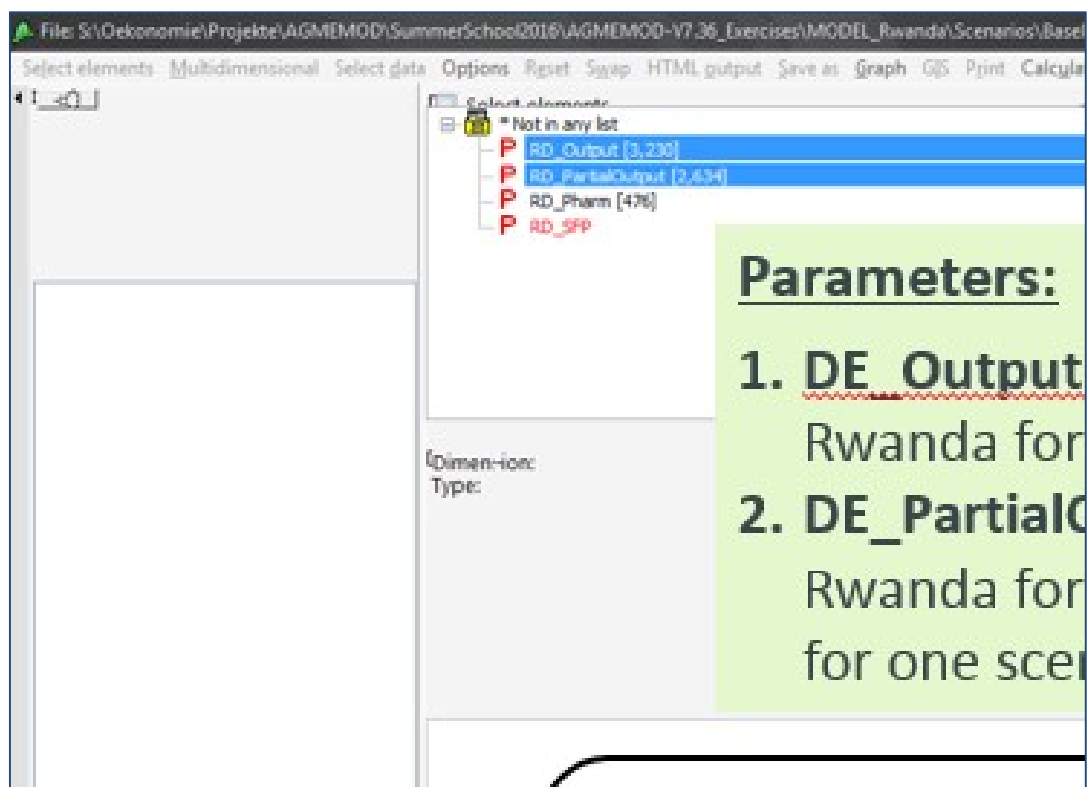*Figure 3.36 Access to Output file under menu option [**Results**]*

Figure 3.37 Country output file (Gdx) for one scenario

Figure 3.37 provides scenario dependent output, while Figure 3.38 shows how to get access to all scenario results by selecting **[Results]/**Output Tables for all scenarios combined (Gdx)/Output for all scenarios.
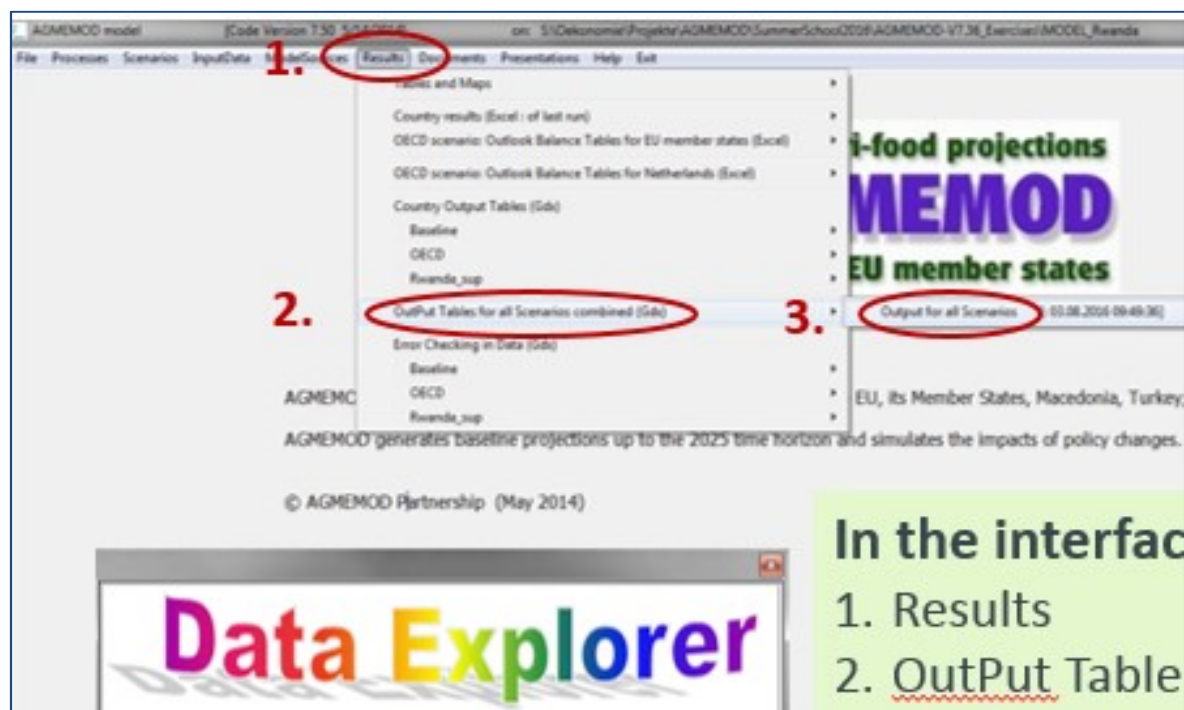
Figure 3.38 Output file (Gdx) with results for all scenarios

3.3.6.2 Results analysing tool

AGMEMOD's scenario results can be depicted by the **TI Graph tool**. Select menu option **[ModelSources]/**AGMEMOD Gams Model and Analyzing Tools for/Baseline/TI Graph Tool (Figure 3.38). Then an Excel file opens with the name GDX2Graph.xlsm.
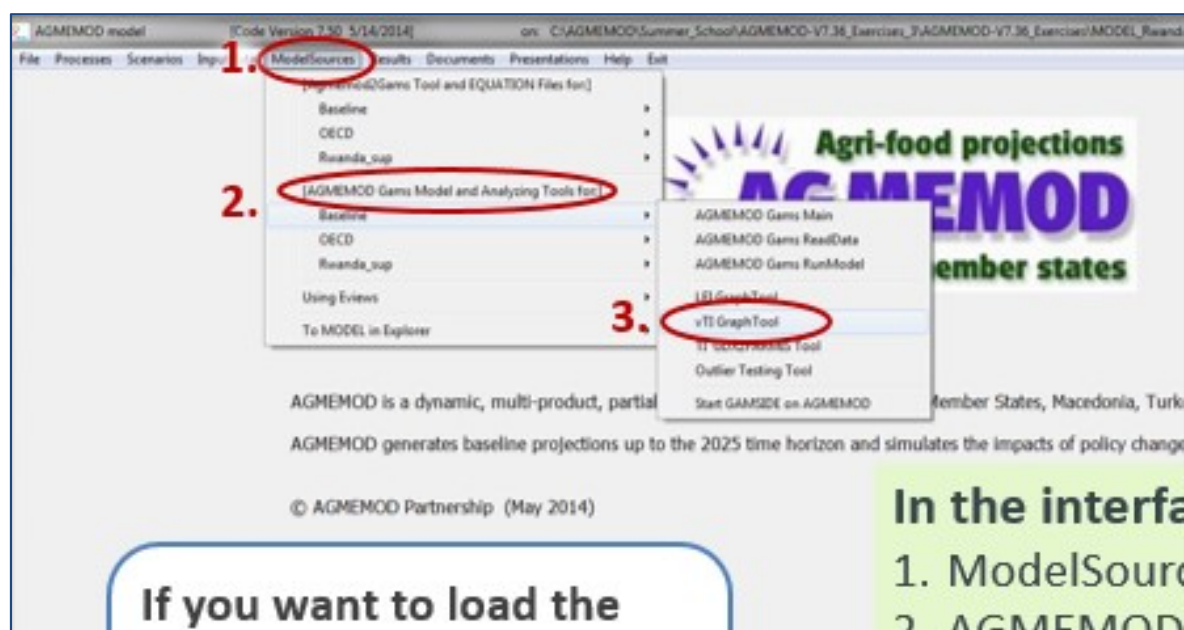
Figure 3.39 Opening the TI Graph analyzing Tool

In the *GDX2Graph.xlsm* file, go to worksheet '*Settings*' and select the country to be analysed (Figure 3.40).
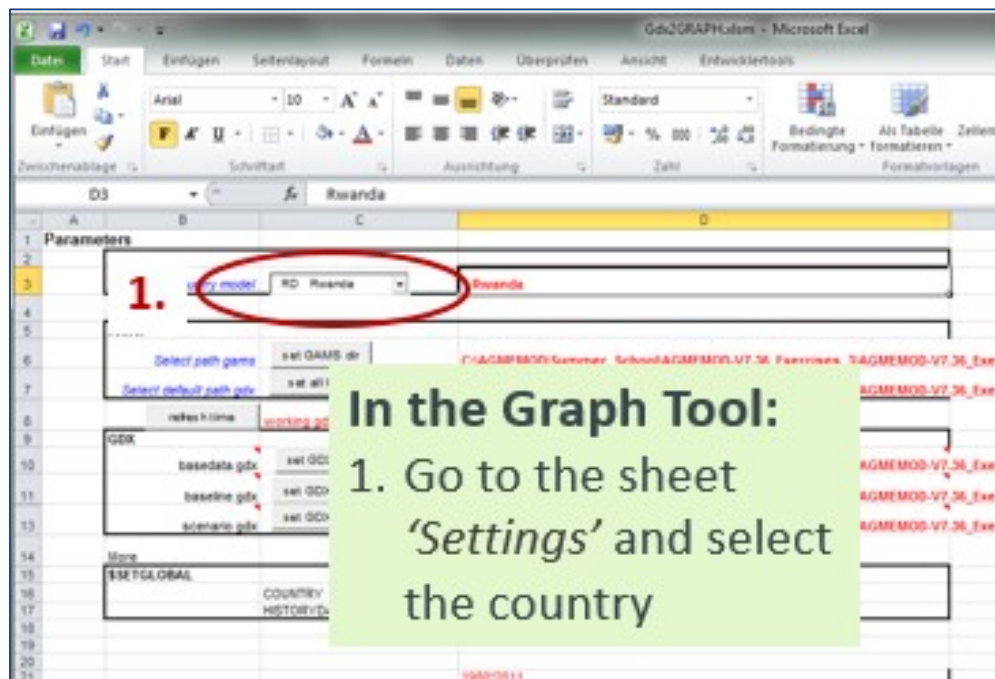

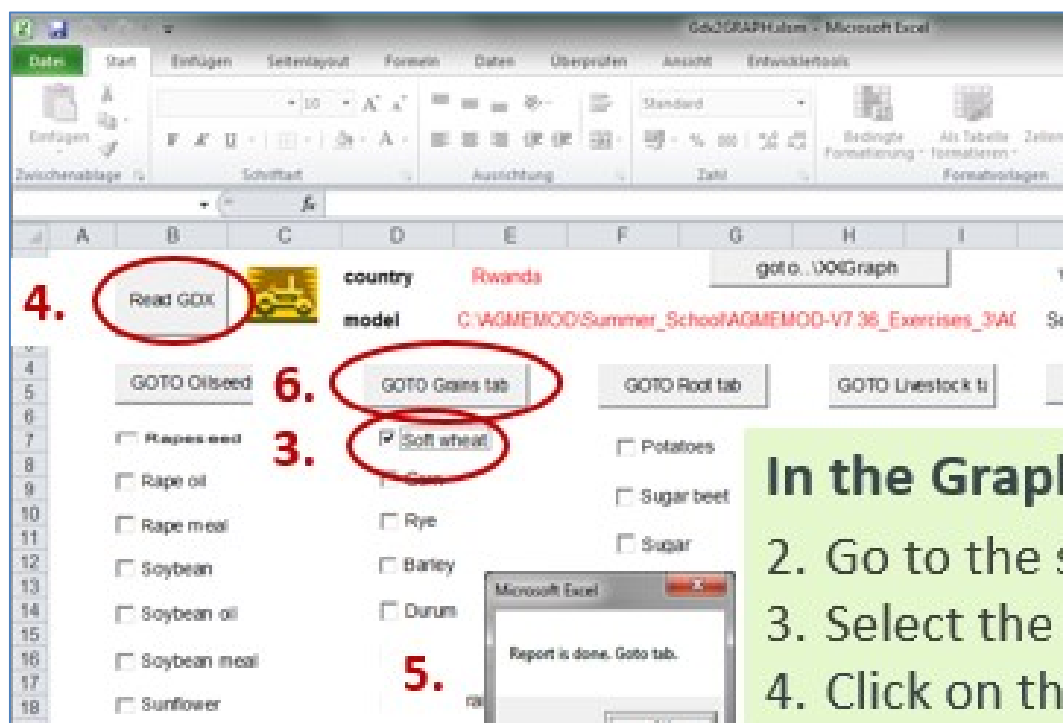*Figure 3.40 Selecting country to be analysed in Graph analyzing Tool*

Figure 3.41 Selecting product(s) to be analysed in Graph analyzing Tool

Next, go to worksheet '*Report'* and select the product(s) to be analysed, e.g. Soft wheat (Figure 3.41). Then, click on the [**Read GDX**] button, wait until the *Report is done message* pops up and click on *OK*. Then click on [**GOTO grain tab**] button and a second

Excel file will open, named *Graph_grains.xlsm*. Go to worksheet *Report WS* and a number of graphs are shown for validating and analysing purposes (Figure 4.42).
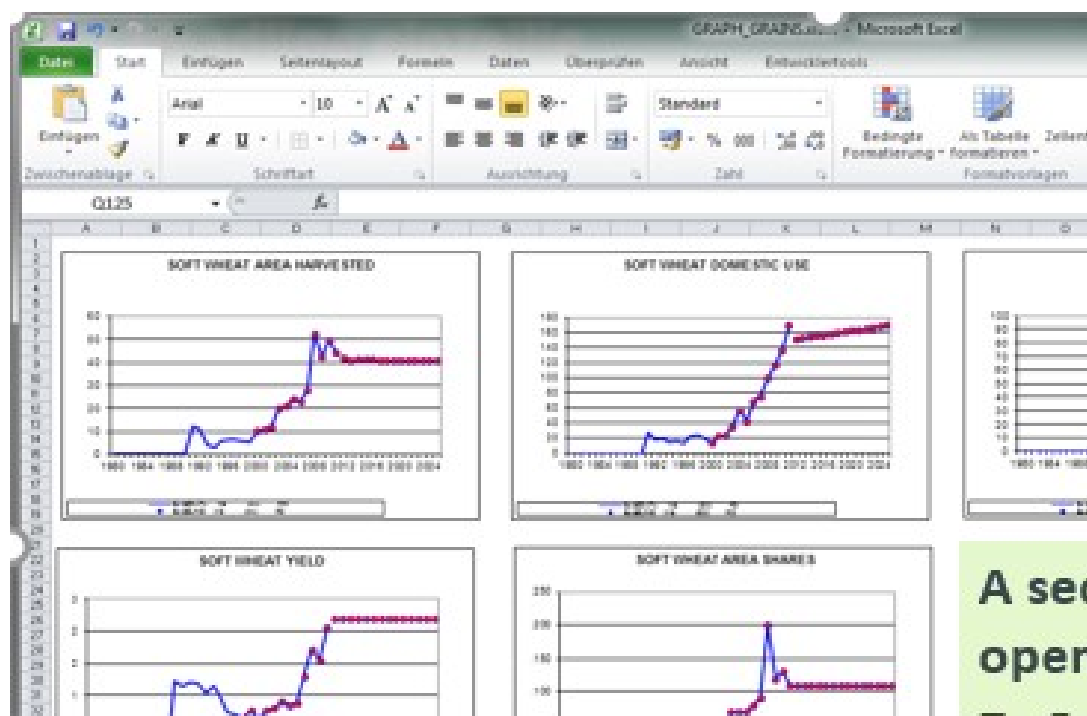

Figure 3.42 Graphs for analysing AGMEMOD results

4. AGMEMOD run and solving options

4.1 Selecting scenario

4.1.1 Baseline

This chapter deals with running and solving the AGMEMOD system for a specific scenario. A scenario is built up from a defined set of information, i.e.:
- Commodity balance data in *CC-datagmemod_[Data Variant].xlsm* files.
- *Assumptions* in *AssumptionInput_[Scenario].xlsm* and *PolicyHarmon_[Scenario].xlsm* files.
- The *country (group)* of interest.

Before starting the AGMEMOD solving process, the system needs to know which scenario(s) should be taken to be run. The following screen appears when the menu option **[Scenarios]** of the user interface is selected (Figure 4.1).
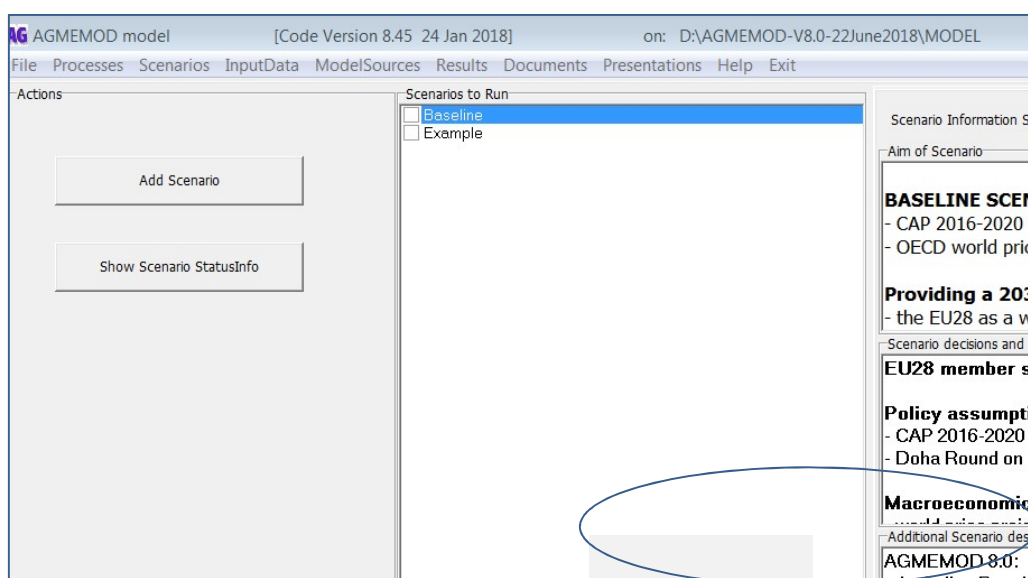
Figure 4.1 Menu option [Scenarios] to select the scenario(s) to be conducted

Scenarios can be selected in the *Scenario to Run* box, e.g. the **Baseline** scenario and/or the **Example** scenario. Scenario narratives are in the three-project-information boxes on the right-hand side of the screen. In addition, there appear three buttons (on the right hand, bottom side of the screen), of which the *Edit Scenario Run Setting* button is used to define the narratives of the selected scenario in the *Scenario to Run* box. For example, when selecting the **Baseline** *scenario*:

1. **[Show Scenario RunInfo]** button provides background information on the last scenario run, such as Scenario name, the output files that were generated, and the countries that were included in the model run.

2. **[Edit Scenario Run Setting]** button provides options to define the Scenario narratives:
    a. *Options for AGMEMOD scenario*
    - define the countries in the model (section 4.3)
    - define the data variant (section 4.2)
    - define Excel and GDX output files
    b. *Editable data for AGMEMOD scenario:*
    - *edit Assumptions data*: opens the *AssumptionsInput_Baseline.xlsm* file and provides possibility to change assumptions for the selected scenario
    - *edit Policy Harmonization data*: opens the *PolicyHarmon_Baseline.xlsm* file and provides possibility to change policy assumptions for the selected scenario
    - *Edit CountryTimeSet data*: opens the *CountryTimeSets_Baseline.xlsm* file, and provides possibility to change the length of observed and simulated for the selected scenario.

3. **[Start Agmemod2Gams tool]** button, which is another way to operationalize the **Agmemod2Gams tool**.

After having selected the **Baseline** scenario and adjusted one/more of aforementioned Excel files, press the **[To Processes]** button and following key Process option appears (Figure 4.2):

1. Run selected Scenarios: this process option runs the selected scenario in steps:
- Reading scenario data from Excel files, only if new (based on file *date* checking).
- Running and solving the model for the selected baseline scenario.
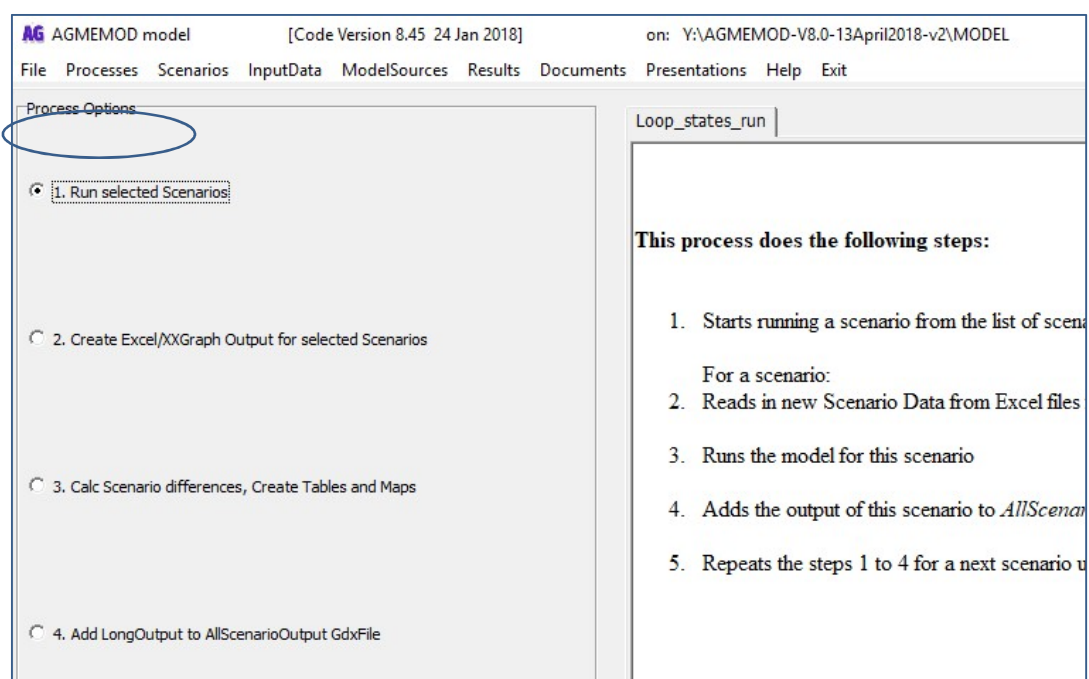- Writing the output of the selected baseline scenario to Excel and Gdx output files.

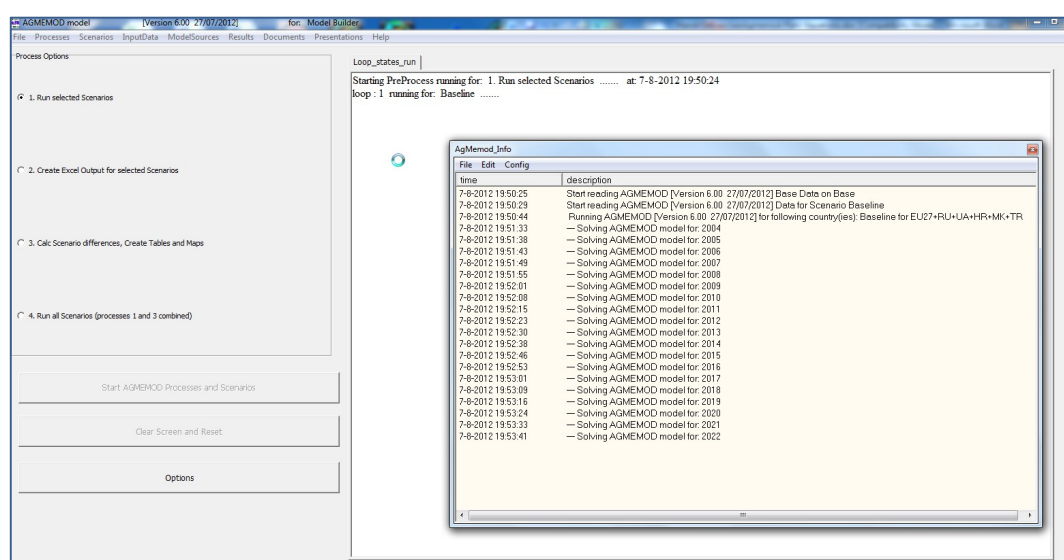*Figure 4.2 Menu option [Processes] to run AGMEMOD scenarios*

Figure 4.3 Information screen of menu option [Processing]

The description box highlights a message whether the process had been successfully or unsuccessfully executed. If the solving process was:

- *Unsuccessful*: error message(s) can be found in the Agmemod GAMS list file, i.e. *Agmemod.lst*, under the *..\AGMEMOD\MODEL\Prog* folder in the Windows Explorer. After having solved the GAMS problem(s), the processing can be re-activated.
- *Successful*: model results can be examined in the results files under the menu option **[Results]** of the user interface.

4.1.2 Create new scenario

This section describes how to create a new scenario. Select the menu option **[Scenarios]** of the user-interface and click on the **[Add Scenario]** button on the left hand side (Figure 4.4).
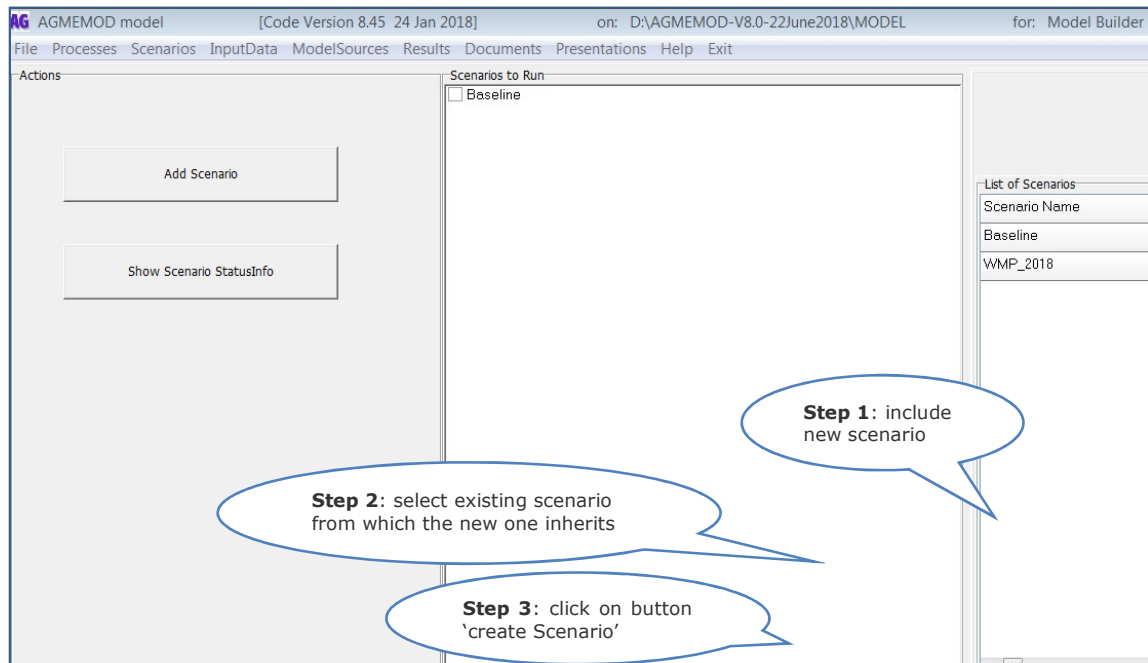

Figure 4.4 Menu option to add a new scenario

Two empty boxes will appear in the bottom part of the right hand side of the screen, and a 3-steps approach must be followed:

- *Step 1*: include the name of the new Scenario (for example, ***Example***).
- *Step 2*: select the Scenario from which the new scenario must be inherited (here from the ***Baseline***).
- *Step 3*: click on button **[create New Scenario].**

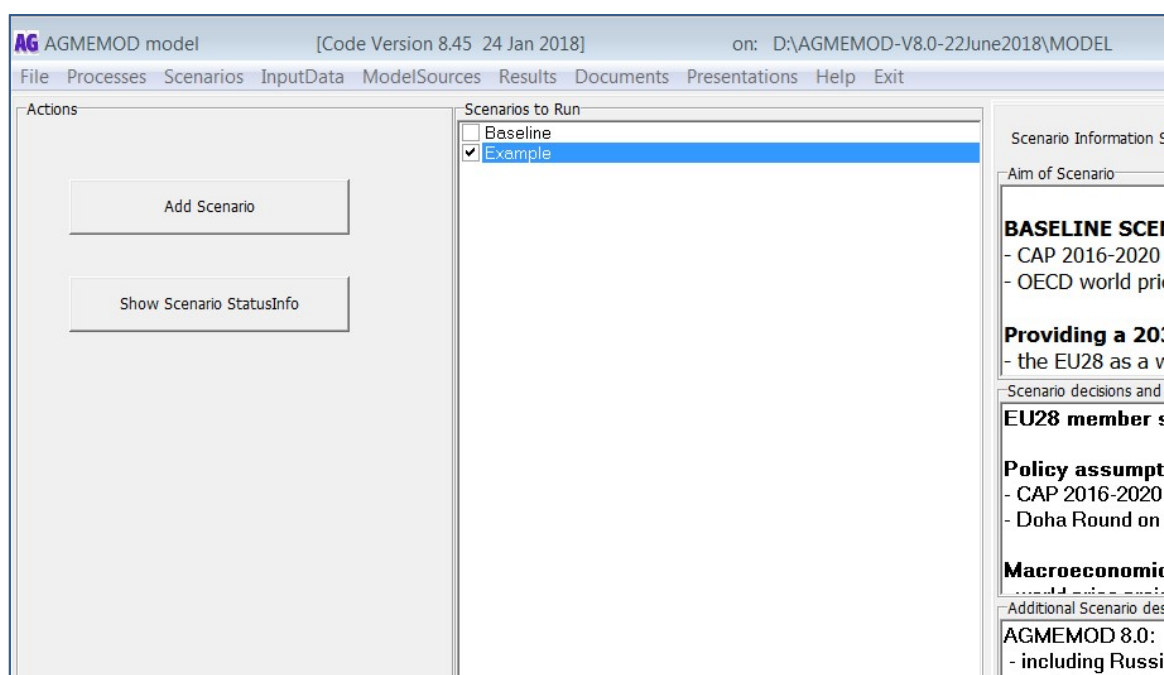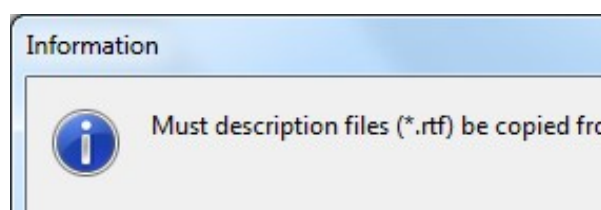Next, the scenario screen will show the new scenario, named **Example** (Figure 4.5).

*Figure 4.5 Menu option with new **Example** scenario*

Select *Yes* when the following question appears: *Must description files (*.rtf) be copied from inherited scenarios?*

In this case the narrative information on the new **Example** scenario will exactly be copied from the inherit scenario **Baseline**. The text can be adjusted for the specific narratives of the **Example** scenario as follows:

- Select the menu option **[Scenarios]** of the user-interface and the Example scenario
- Right click on a text box, which still contains Baseline information, and select the *Edit information in rtf file* option (see Figure 4.6)
- The text file opens and the Baseline text can be adjusted for specific Example text information (see example text in Figure 4.7).
- Then save and close the file, and the Example text appears from now in the box (Figure 4.8).
- Same procedure to be applied for the other two text boxes.
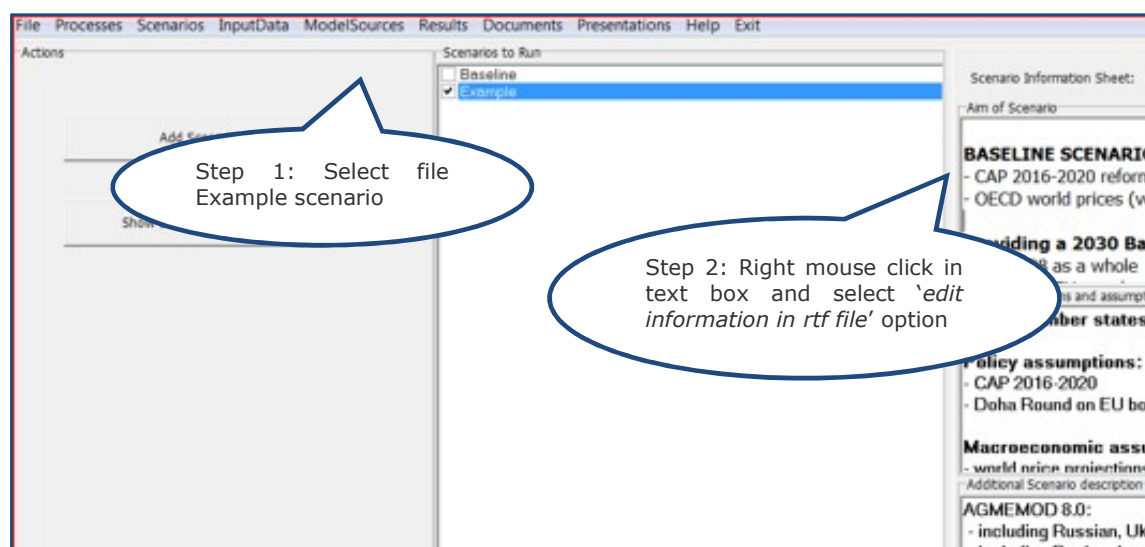
*Figure 4.6 Select **Example** scenario and text box to be adjusted*
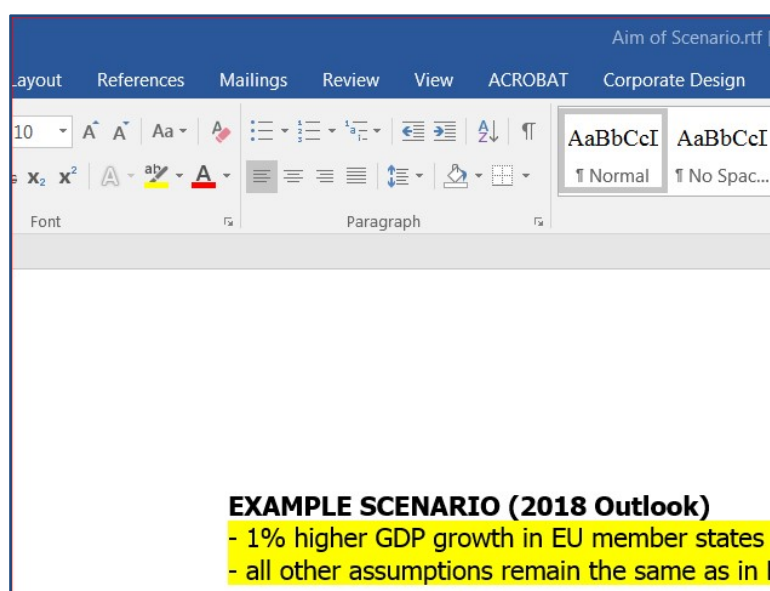
*Figure 4.7 Write text on narratives and assumptions of **Example** scenario*
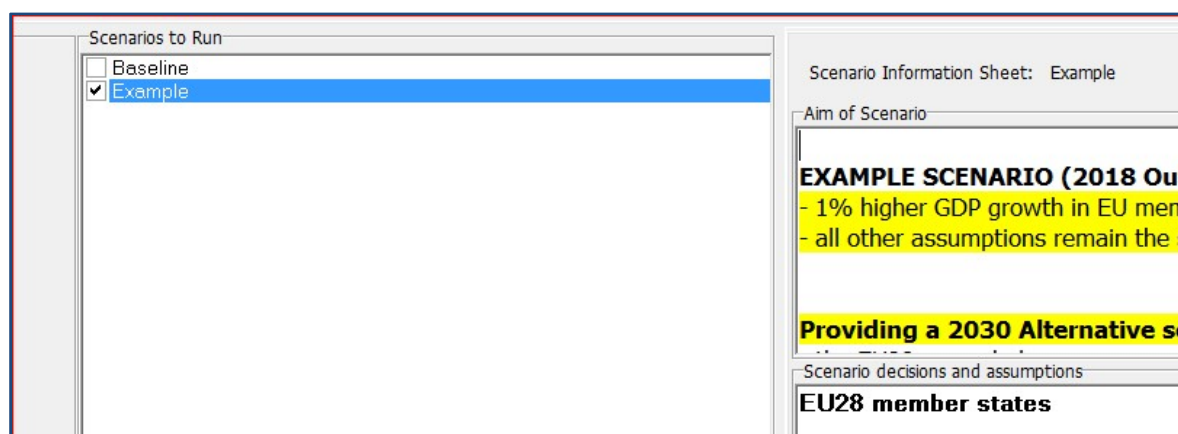
*Figure 4.8 **Example** scenario and adjusted text box*

Due to these three steps, AGMEMOD's system technical infrastructure has been automatically adapted and constructed according to the needs for running and solving the model for the new **Example** scenario and to calculate it's impacts compared to another scenario. First, given the folder and file naming convention explained in section 3.2, subfolders *...AgMemodGamsCodeGenerator\CC\ModelEquations**Example*** have been generated for each AGMEMOD country. On top of that, each *..\CC* subfolder contains the *CC-ModelEquation_**Example***.xlsx* file (Figure 4.9).
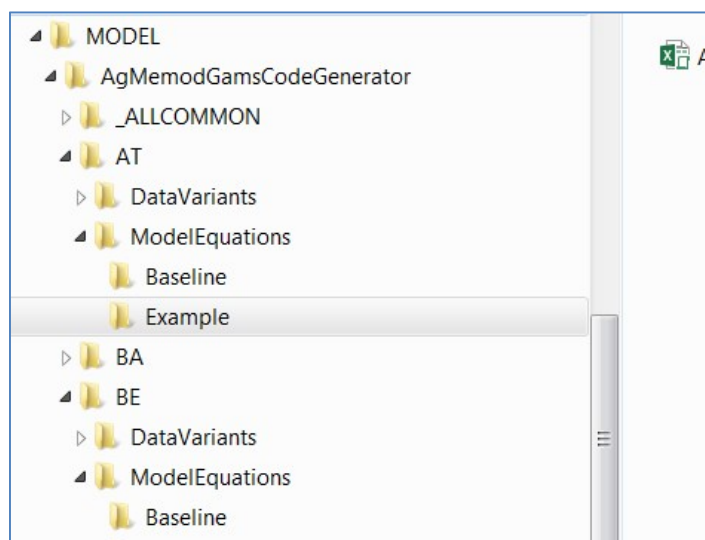

Figure 4.9 New folder structure of ..\Model\AgMemodGamsCodeGenerator

Second, in first instance the assumptions of the Example scenario are exactly similar as those in the baseline scenario because they have been inherited from it (Figure 4.10). Next step is to adjust the assumptions according to the narratives of the new **Example** scenario.
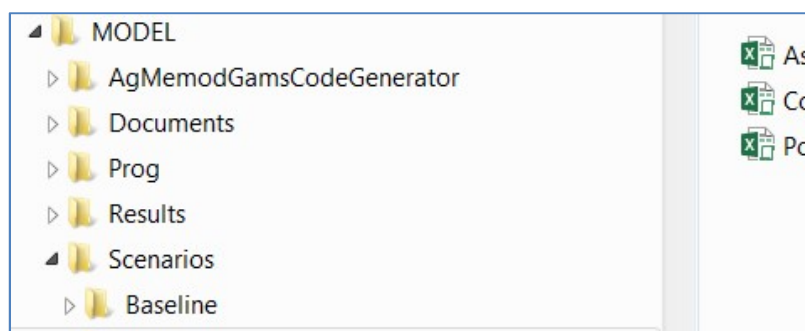

Figure 4.10 New folder structure of ..\Model\Scenarios

Adjusting assumptions of the Example scenario
An option to change the assumptions of the ***Example*** scenario is by clicking on the **[Edit Scenario Settings]** button in the *Scenario to Run* box under the **[Scenarios]** menu option:

- *Edit assumptions data*: access to the *AssumptionsInput_Example*.xlsm file, in which values for assumptions can be changed.
- *Edit country time sets data:* access to the *CountryTimeSets_Example*.xlsm file, in which the length of observed and simulated periods can be changed.
- *Edit policy harmonization data:* access to the *PolicyHarmon_Example*.xlsm file, in which policy assumptions can be changed.
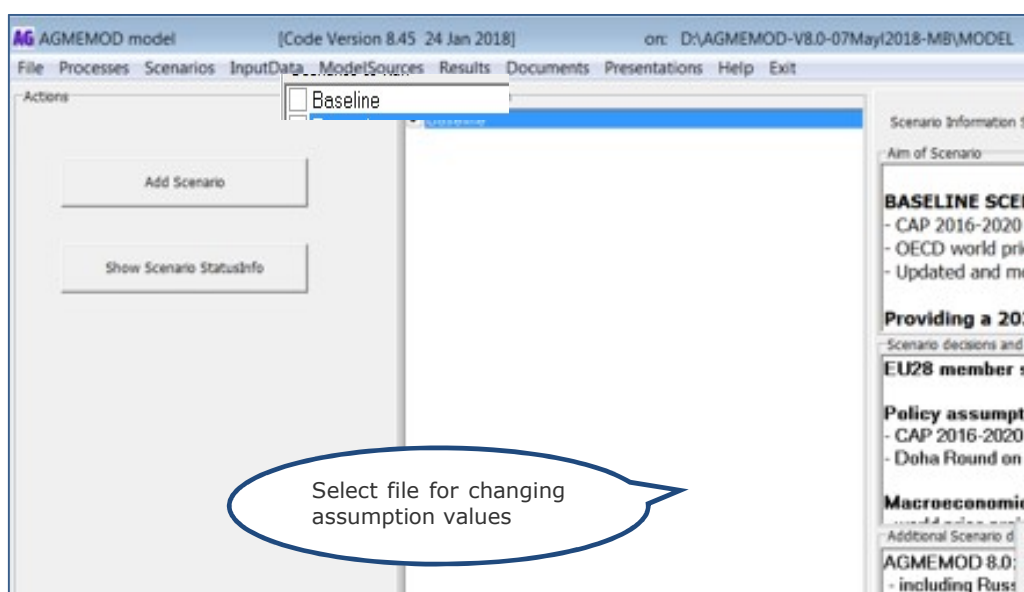
Figure 4.11 Selecting assumption file for changing values in selected scenario

For example, select *Edit Assumptions data* and then the *AssumptionsInput_example.xlsm* file will open (Figure 4.11). As mentioned in section 3.3.2.2, it contains the following worksheets of importance:

- *World*: world price projections for commodities captured by AGMEMOD (in USD and in Euros).
- *Macro*: macroeconomic projections per country.
- *EU_policy*: common EU policy measures on CAP and trade measures.
- *CC_policy*: country specific policy measures.
- *Trend*: trend variables.
- *Dummy*: dummy variables.

Depending on the narratives of the scenario, values for one or more variable could be adjusted.

4.1.3 Delete a scenario

As discussed in the previous section, the full integration of new scenarios in AGMEMOD GAMS system's framework has been automatically done. Consequently, removing a scenario from the system's framework needs also be undertaken with care. It takes three steps to delete a scenario (Figures 4.12 to 4.15):

- *Step 1*: go to **[Scenarios]** menu option of the AGMEMOD tool. Click on **[Add scenario]** button, select the 'Status' column of the scenario to be deleted, e.g. the *Example* scenario, in the box in the right column. Then right click on the mouse and select *Delete*. Now the *Example* scenario will disappear from the scenario list in the *Scenario to run* box. Leave the screen by clicking on **[To Process]** button.
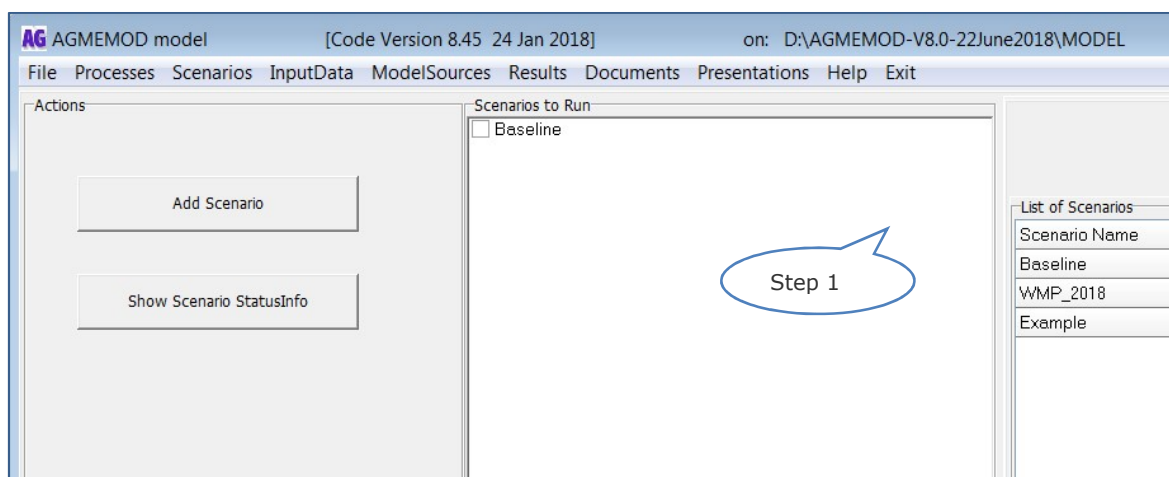
Figure 4.12 Step 1 in deleting a scenario

- *Step 2*: Click on menu option **[ModelSources]** and select *Agmemod2Gams Tool and Equation files - Baseline – Agmemod2Gams*. In the **Agmemod2Gams tool** go to the [**File**] tab in the main menu (Figure 4.13), then select *Clean up Scenario/DataVariant*. Then a screen appears from which the scenario can be selected that must be deleted (Figure 4.14). Then click on **[Delete Scenarios]** button and all directories of the AGMEMOD framework will be cleaned for linkages referring to the scenario to be deleted. All *CC-Results.xlsm* files will be cleaned as well, though it takes some time to adapt the cleaning process of these country dependent files.
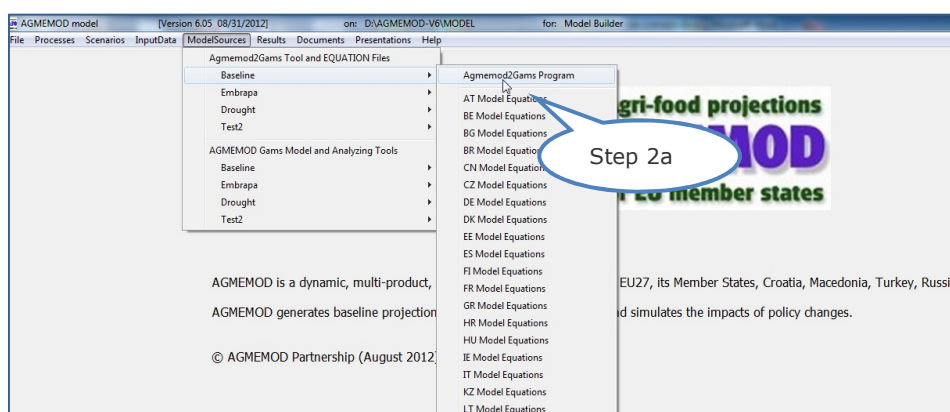

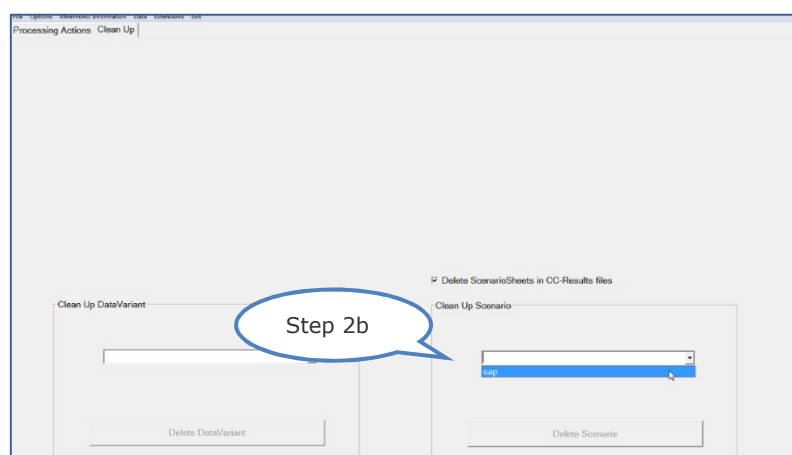*Figure 4.13 Step 2a in deleting a scenario*

Figure 4.14 Step 2b in deleting a scenario

- *Step 3*: Leave the screen by clicking on ![x button] and go to the main screen of the AGMEMOD tool and select **[File]***options*. Then click on the button [**Delete Scenarios from DB if no ScenarioDirectory exists].** The entire AGMEMOD framework has been cleaned now for linkages to the deleted scenario.
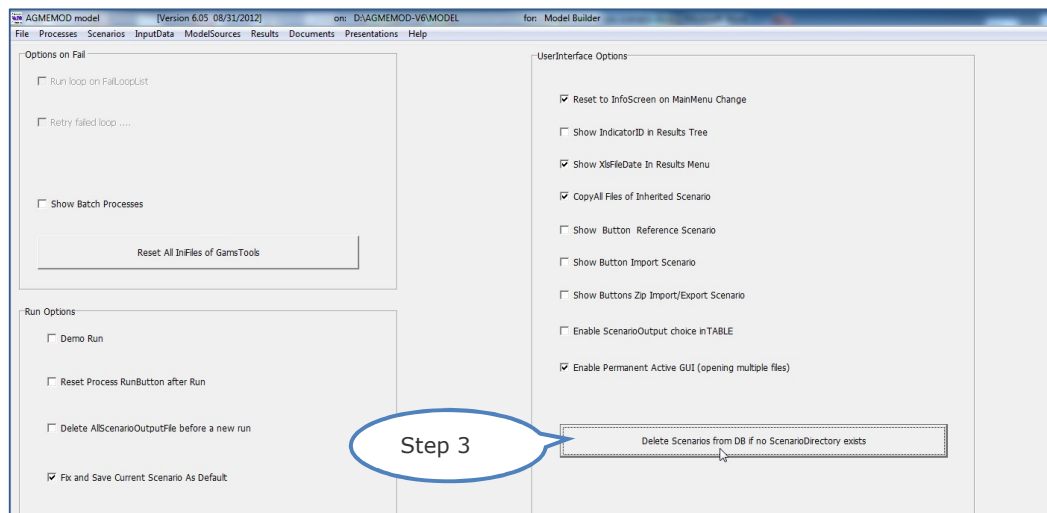

Figure 4.15 Step 3 in deleting a scenario

4.2 Selecting data base

4.2.1 Base variant

As mentioned in Section 3.2.3, country data files are **Data Variant** dependent, which is useful when comparing data for the same variable, which are different because they originate from different statistical sources. By convention, the data variant used in the baseline has the name ***base***, which is visualized by the extension ***_base*** in *CC-Datagmemod_**base**.xls* files.

4.2.2 Create new variant

The **Agmemod2Gams tool** is used to create a new Data Variant:

- Select menu option **[ModelSources]** *\AGMEMOD GAMS model and Equation Files\ Baseline\Agmemod2Gams Tool* (Figure 4.16).
- Click on the **[Data]** tab in the upper tool bar and select *Manage DataVariant*. Then apply following three steps (Figure 4.17):
  o Include name of the new Data Variant, e.g. ***DataNew***.
  o Select Data Variant from which the new variant is inherited; here the ***Base***.
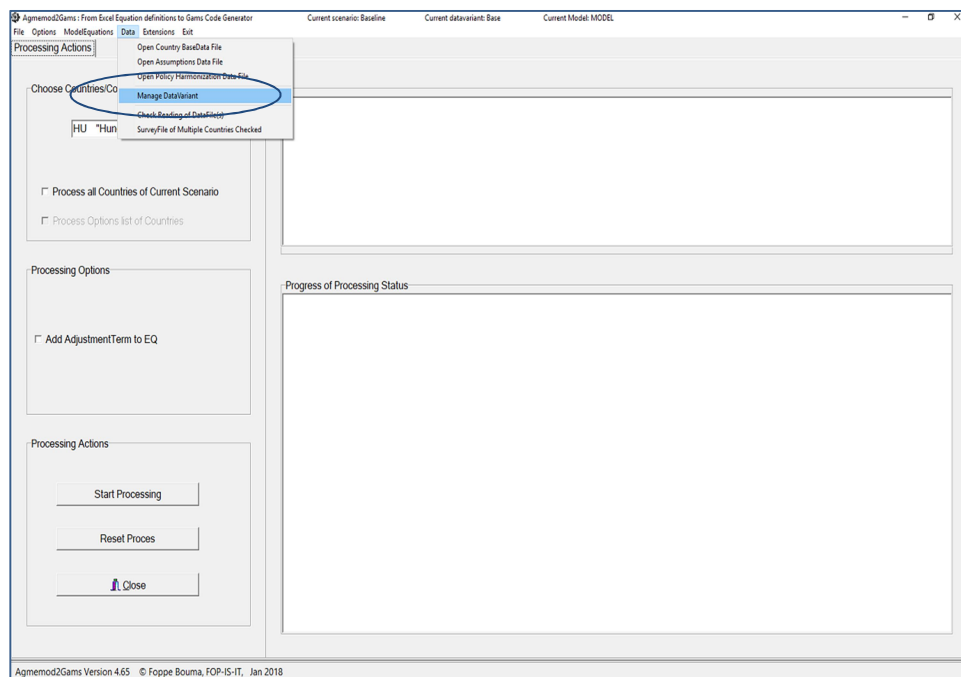 o Click on **[create Data Variant]** button.

Figure 4.16 Generation of new Data Variant

Figure 4.17 Naming new Data Variant and selecting Data Variant it is inherited from

According to the folder and file naming conventions as explained in section 3.3, the subfolder *DataVariants\DataNew* has been generated under *.. AgMemodGamsCodeGenerator\CC.* In addition, this subfolder contains the data file *CC-Datagmemod_DataNew.xlsx* (Figure 4.18).
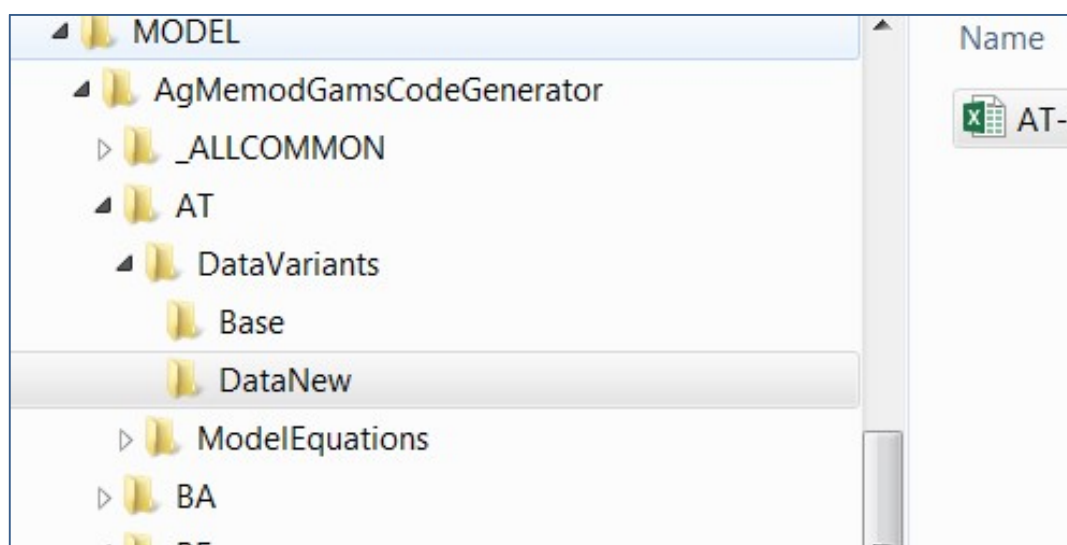
Figure 4.18 New folder structure of ..\AgMemodGamsCodeGenerator

As it is inherited from the ***Base*** data variant, the ***DataNew*** data variant has exactly the same contents but can be adapted now. The **Agmemod2gams tool** has a flexible option 1) to automatically adapt and construct the technical infrastructure of the AGMEMOD GAMS system needed to run and solve the model; and 2) to compare the results of the two different data sets.

4.3 Selecting countries

The AGMEMOD Gams model can be run for a single country (section 4.3.1) or a group of countries e.g. the EU membership (section 4.3.2).

4.3.1 Single country

<mark>Due to a technical adjustment in AGMEMOD's country structure, this option is under reconstruction</mark>.

4.3.2 EU membership

AGMEMOD modelling system can deal with a flexible EU member state coverage, which makes sense as countries could enter the group on one hand and others could leave the group on the other hand. The Brexit, i.e. the situation in which the United Kingdom (UK) will leaves the EU in the course of 2019, is taken as example for the steps that need to be undertaken to adapt the AGMEMOD model for the changed EU group level. In the baseline scenario of the current AGMEMOD V8, the UK is one of the individual member states of the EU28, while non-EU countries (like Russia, Ukraine, Turkey) belong to the group Rest of the World (RoW). When the Brexit will become in place, the UK must be separated from the EU group and will enter the RoW region. On the other hand, the EU will cover the remaining 27 member states. Consequently, the internal EU27 market will face structural changes in terms of aggregated production, domestic use, and net trade and price levels for its agro-food commodities.

Setting the EU28 membership level
AGMEMOD's technical framework has been set up as a modular system with so called 'initialization' files that contain initial settings for e.g. countries belonging to the EU and historical data availability ranges per country. The country coverage in the current EU membership (baseline scenario) is organized in worksheet *Groups* of the Excel file *CountryTimeSet_Baseline.xls*. Like *AssumptionsInput_Baseline.xls*, that file contains scenario specific information. Figures 4.16 to 4.19 provide the steps for getting access to *CountryTimeSet_Baseline.xls* in the AGMEMOD framework, and setting the EU28 group. The Baseline scenario is taken as starting point.

Step 1. Select the [**InputData**] menu option, and then go to *InputData\ Scenario Data (Excel)\ Baseline \ CountryTimeSets Data* (Figure 4.19).
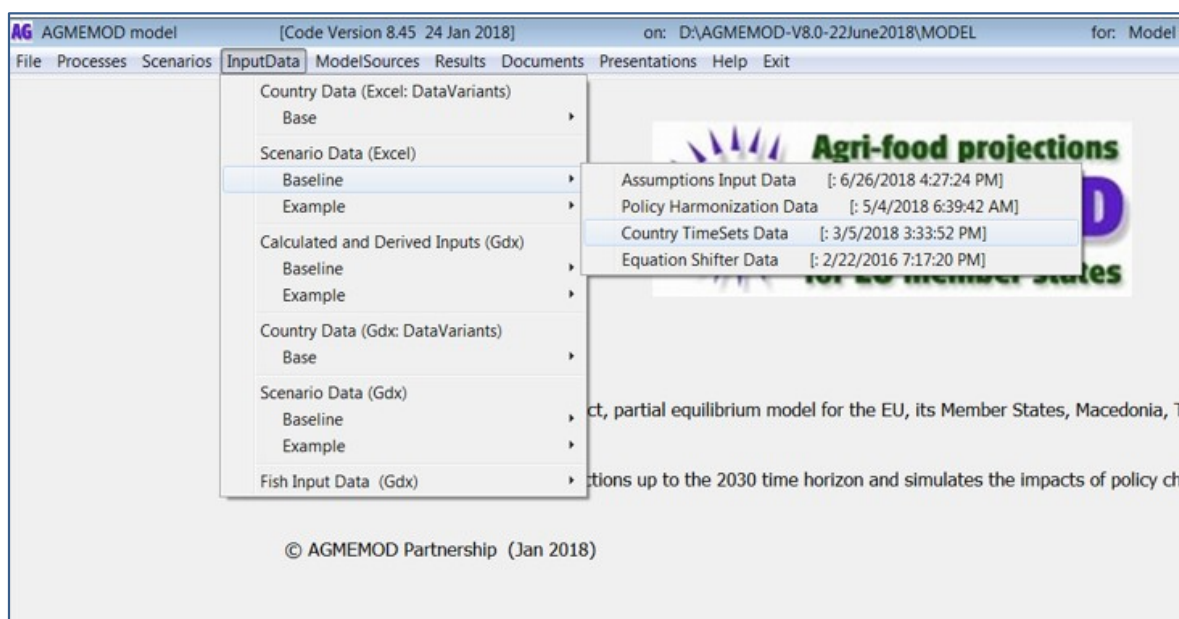

Figure 4.19 Selecting the CountryTimeSet file in Baseline

Step 2. CountryTimeSets_Baseline.xls opens and go to worksheet *GroupMemberShip* (Figure 4.20)*.* It contains information for all countries that are EU member and the start year they have entered or end year they have left. For example, Bulgaria (BG) and Romania (RO) entered the EU in 2007, while Croatia (HR) accessed in 2013. A new member state can be added in line 28 by putting in a '1' from the start entrance year onwards. On contrary, if a country is going to leave the EU, its '1' settings must be replaced by empty cells or a '0' from the year it will depart.

Figure 4.20 (Re-)setting the EU membership group in Baseline

Step 3. Save and close *CountryTimeSets_Baseline.xls*. For checking the contents of the EU membership group, select the menu option [**Scenarios**]*Scenarios\Baseline.* Then press the **[Edit scenarios run settings]** button and select *Define Countries in model* (Figure 4.18).
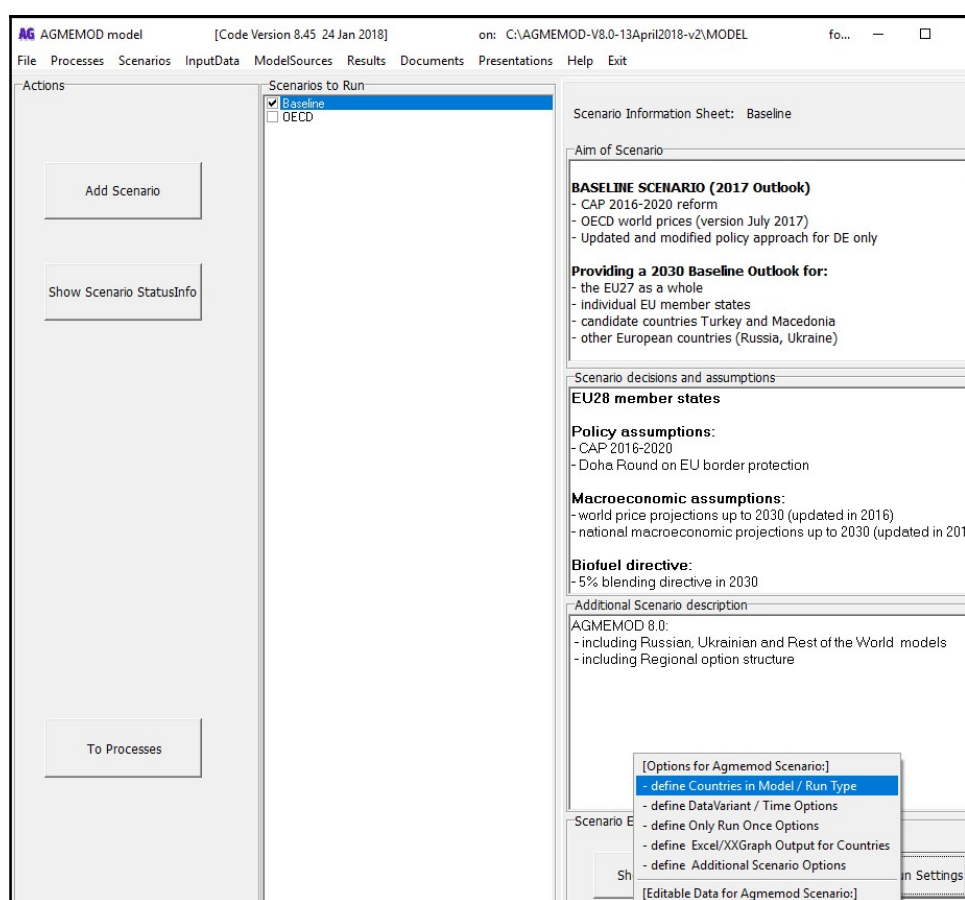
Figure 4.21 Checking the EU group membership

The left box in the appearing screen shows the AGMEMOD countries that belong to the EU membership, while the right box lists the countries that belong to the AGMEMOD countries as well, but as a non-EU member (Figure 14.22). As AGMEMOD is a bottom-up model, i.e. starting from member state models, the EU membership countries in place determine the values for EU28 indicators as those are calculated as aggregates or (weighted) averages of individual member states, such as EU self-sufficiency rate, EU beef consumption/head.
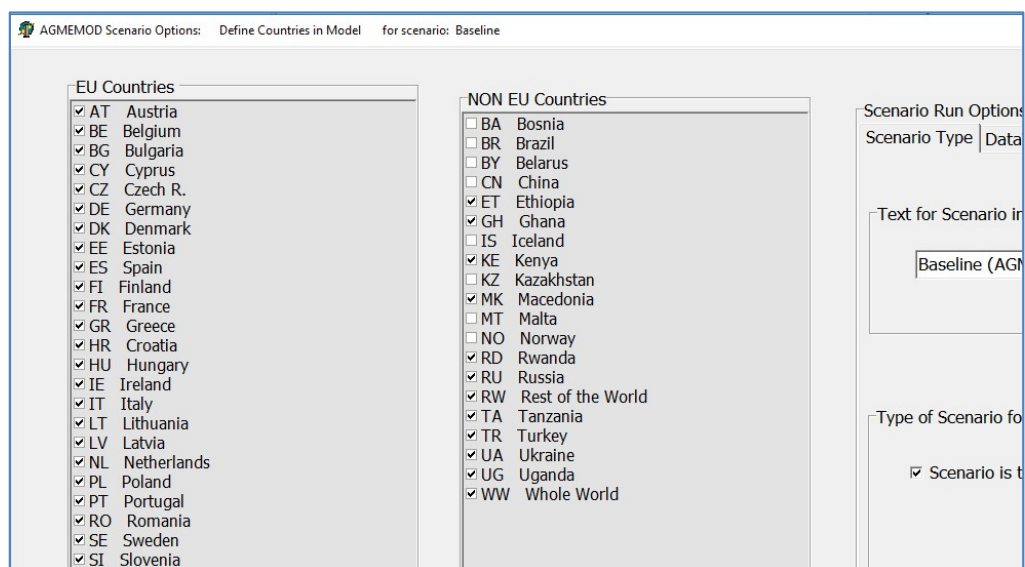

Figure 4.22 EU group membership in Baseline in left column

Step 4. Exit the screen by clicking on [**Close**] button

(Key) price equations
Key price equations are used to link country models within the AGMEMOD model together and to close the AGMEMOD model at the EU28 level (Figure 4.23).
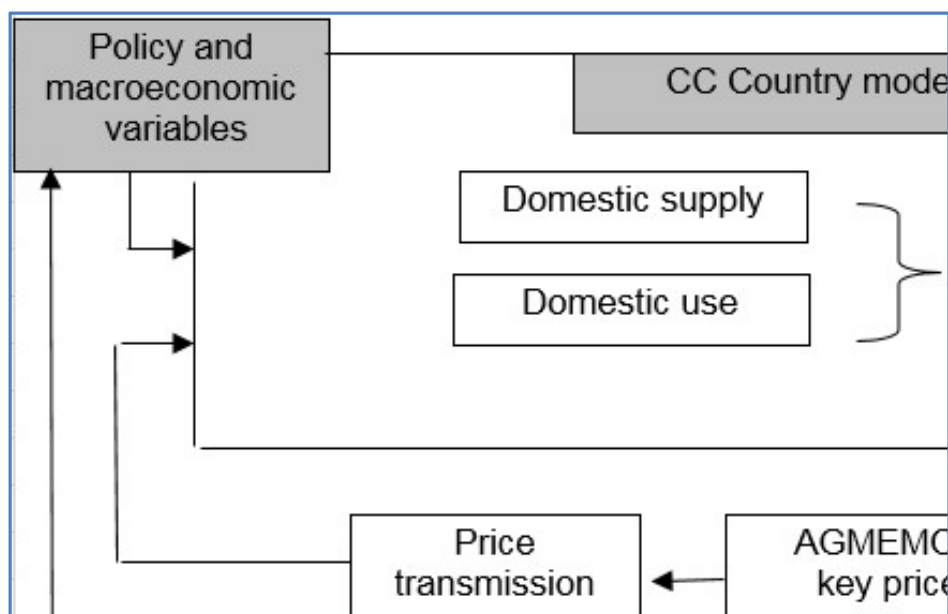

Figure 4.23 General structure of AGMEMOD's agricultural country model

AGMEMOD uses price formation equations (Chantreuil et al, 2012), where the price in a given country is driven by an external price, i.e. the *EU key price*. The key price (KP) country equation type is determined, for each commodity i in year t, in Equation 1, while the national price (P) equation type is defined in Equation 2.

KP(i,t) = f (World price(i,t), EU28 self-sufficiency rate(i,t), policy prices(i,t), trade measures(i,t), other)   (Eq 1)

P(i,t) = f (KP(i,t), country self-sufficiency rate(i,t), other)   (Eq 2)

If a country enters or leaves the EU membership, the EU self-sufficiency rate will change dependent on the net-export position of the respective accessing or departing country for a specific commodity. This directly influences the key price developments over time, and consequently indirectly affects prices and commodity markets of individual countries in the new EU membership.

Setting the EU27 membership level
First, a new scenario has to be derived from the Baseline scenario (see section 4.1.2), e.g. named the **Brexit** scenario. Second, the new EU group setting for this scenario must be adjusted by following steps.

Step 1. Select the [**InputData**] menu option, and then go to *InputData\ Scenario Data (Excel)\ Brexit \ CountryTimeSets Data* (Figure 4.24).
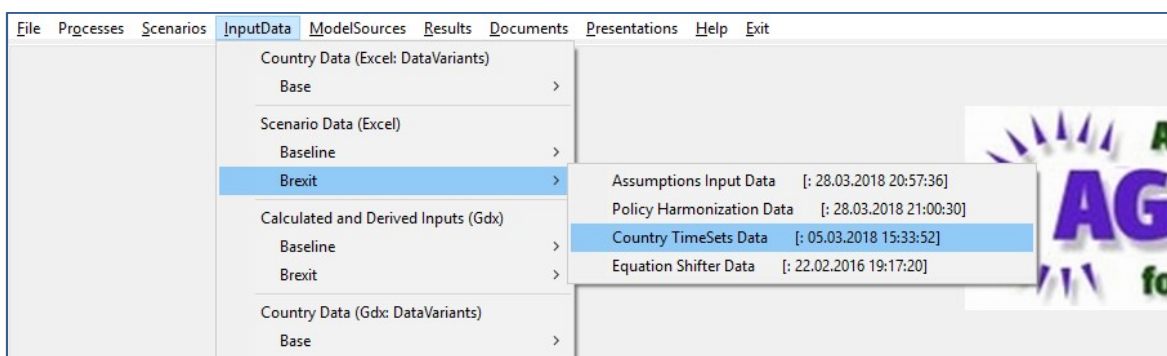
Figure 4.24 Selecting the CountryTimeSet file in Brexit scenario

Step 2. CountryTimeSets_Baseline.xls opens and go to worksheet *GroupMemberShip* (Figure 4.25)*.* Due to the withdrawal of the UK in 2019, the '1' settings of the UK in line 15 - meaning that UK is EU member - is replaced by '0' or an empty cell - meaning that UK is non-EU member - over the period 2019 to 2030 (2030 is last year of simulation period).

	A	B	C	X	Y	Z	AA	AB	AC	AD	AE	AF	AO
1	Description of Membership	Group	Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2
8		UE	FR	1	1	1	1	1	1	1	1	1	
9		UE	GR	1	1	1	1	1	1	1	1	1	
10		UE	IE	1	1	1	1	1	1	1	1	1	
11		UE	IT	1	1	1	1	1	1	1	1	1	
12		UE	NL	1	1	1	1	1	1	1	1	1	
13		UE	PT	1	1	1	1	1	1	1	1	1	
14		UE	SE	1	1	1	1	1	1	1	1	1	
15		UE	UK	1	1	1	1	1	1	1	1	1	
16		UE	BG								1	1	
17		UE	CY					1	1	1	1	1	
18		UE	CZ					1	1	1	1	1	
19		UE	EE					1	1	1	1	1	
20		UE	HU					1	1	1	1	1	
21		UE	LT					1	1	1	1	1	
22		UE	LV					1	1	1	1	1	
23		UE	PL					1	1	1	1	1	
24		UE	RO								1	1	
25		UE	SI					1	1	1	1	1	

Figure 4.25 (Re-)setting the EU membership group in Brexit scenario

Step 3. Save and close *CountryTimeSets_Brexit.xls*. For checking the contents of the EU membership group, select the menu option [**Scenarios**]*Scenarios\Brexit.* Then press the [**Edit scenarios run settings**] button and select *Define Countries in model* (Figure 4.26).
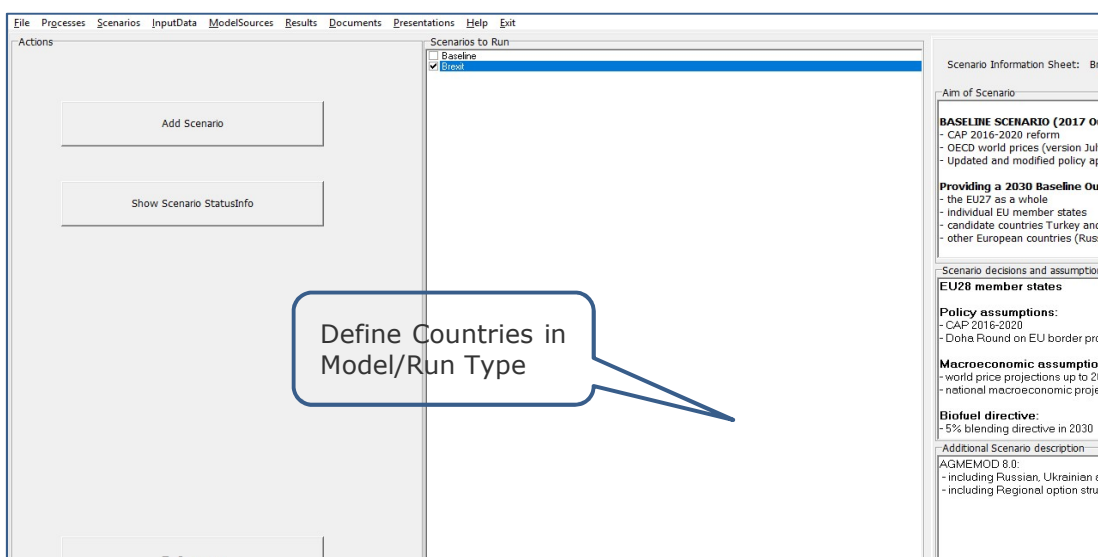

Figure 4.26 Checking the EU group membership in Brexit scenario

The left box in the appearing screen shows the countries in AGMEMOD that belong to the EU membership in the Brexit situation, while the right box covers the countries that are in AGMEMOD but as a non-EU member. The membership level, however, changes in time as the next screenshot shows: Until 2019, the UK is in the EU membership list, while it moves to the non-EU list from 2019 onwards (Figure 4.27).
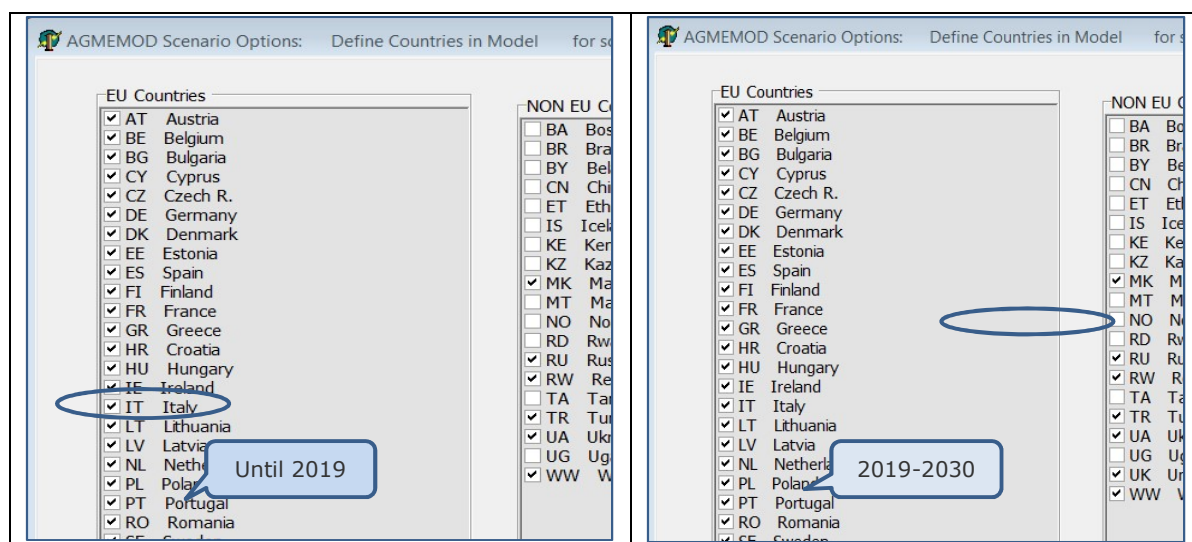

Figure 4.27 EU group membership in Brexit scenario in 2013-2018 and 2019-2030

Step 4. Exit the screen by clicking on **[Close]** button

Implication for (key) price equations
In the **Brexit** scenario, however, the model must be closed at the EU28 level until 2019 and at the EU27 level from 2019 onwards due to the departure of the UK. Due to the adjusted settings in the *CountryTimeSets_Brexit.xls* file*,* the key price formation equation will (automatically) include either the EU28 self-sufficiency rate (up to 2019) or the EU27 self-sufficiency rate (from 2019) as explanatory variable. Equation 3 shows the new key price (KP) model, for each commodity i in year t. Equation 4 shows that the national price (P) equation type remains the same.

For T< 2019: KP(i,t) = f (World price(i,t), EU28 self-sufficiency rate(i,t), policy prices(i,t), trade (i,t), other)   (Eq 3)
For T≥ 2019: KP(i,t) = f (World price(i,t), EU27 self-sufficiency rate(i,t), policy prices(i,t), trade (i,t), other)

P(i,t) = f (KP(i,t), country self-sufficiency rate(i,t), other)   (Eq 4)

4.4 World market prices

In principle, the AGMEMOD model applies the following procedure for capturing world market prices (WMP activity mnemonic):

- *Baseline scenario:* the projected world market prices are fixed on the projected FAPRI or OECD world market prices (respectively from FAPRI Outlook or OECD Outlook). The intercepts of the RW (Rest of World) supply and use equations are calibrated on an annual basis by adding year dummies.
- *Alternative scenarios*: world market prices are endogenously calculated, while the values of the year dummies are taken from/fixed on their baseline values

4.4.1 Exogenous in Baseline scenario

4.4.1.1 Settings

AGMEMOD countries versus RoW region
The current AGMEMOD version takes into account *EU members, Turkey, Croatia, Macedonia, Russia and Ukraine***,** which are current AGMEMOD countries at stake. In addition, there is the **Rest of the World** (*RW* country mnemonic) region representing the *World* minus the *AGMEMOD* countries.

In case world prices are used in country models, WMP mnemonics and equations have been implemented in the respective *CC-ModelEquations files* of the AGMEMOD regions. By running the **Agmemod2Gams tool**, the WMP equations will then be transferred into GAMS code.

(New) product markets in AGMEMOD and RoW regions
Phase 2 must guarantee that (new) product markets are correctly implemented in the RoW data and model files (respectively *RW-Datagmemod.xls* and *RW-ModelEquations.xls*). Further, the linkage with the AGMEMOD countries must be established, while country model misspecification must be checked for slacks in SPR and UDC variables. Steps to be undertaken:

- Provide data for calibrating the intercepts of SPR and UDC equations in the RoW by generating the RoW production and use quantities. FAO data are used:
    o The RoW production (SPR) is generated residually by subtracting the production of AGMEMOD countries from FAO values for the world.
    o The RW use (UDC) is derived by adding the net trade of AGMEMOD countries to the SPR of the RoW.
    o Data must be implemented in RW-Datagmemod.xls.
- World market prices (in dollars) must be implemented in RW-Datagmemod.xls
- SPR and UDC equations for commodities with endogenous world price generation are specified in RW-ModelEquations.xls, taking into account the world market price and elasticities for income, supply and demand.
- Closure equations for net trade and FAPRI/OECD world prices are specified in RW-ModelEquations.xls.
- The SPR (or UDC) of RoW region and the net trade are calculated by the AGMEMOD system framework as soon as a new product market is added to the RW module.

Closing AGMEMOD to FAPRI/OECD world prices
In the next step, AGMEMOD world prices (WMP) are automatically closed to FAPRI or OECD world prices. In the **Baseline** scenario:

- World market prices are calibrated/closed to the FAPRI (or OECD) world market prices as published in their respective Outlooks. They are presented in the *world* worksheet of the AssumptionsInput_baseline.xls file.
- The year dummies, in combination with the world price and the intercept, are calibrated on those amounts that close the gap between the EU net-trade and the RoW net trade (**EU net trade = - RoW net trade**).

Automated procedure to calibrate constant term in RoW supply and demand equation
The gap between FAPRI/OECD prices and endogenous WMP prices in AGMEMOD is closed in an automated manner. Example for CO (corn) in the RW equation:

Corn supply equation:
COSPRRW=((1+0.001)**(TT90-16))*COINTC_SUP*COWMPRW**COELAS_SUP + **COYEAR_DUMRW**

Corn world market price:
COWMPRW = (COFAPRIRW *DY_FAPRI) + (COWMPRW*(1-DY_FAPRI))

An equation for COYEAR_DUMRW, i.e. the year dummy that closes the net trades and the FAPRI world prices, has been automatically created:
COYEAR_DUMRW = (COYEAR_DUMRW * DY_FAPRI) + (COYEAR_DUMRW(-FX)*(1-DY_FAPRI))

where the year dummy CO_YEAR_DUM values are
- Calculated for the **Baseline** scenario and stored on disk.
- Kept similar to those in the Baseline for alternative scenarios. At the same time, annual world market prices are endogenously determined at the level that closes the gap between EU net trade and RoW net trade. In this way, the impacts of e.g. a wheat yield increase in FR and DE on the world price for wheat can be calculated by comparing it with the world price in the Baseline.

This is organised by the dummy *DY_ENDWMP*, which is in each world price equation of the RW_ModelEquation.xls file that is endogenously calculated with the value:
- DY_ENDWMP = 1 in the baseline; and
- DY_ENDWMP = 0 in the scenario.

4.4.1.2 Baseline scenario

In the Baseline scenario, the simulated world market price projections (up to 2030) are kept exogenously and fixed on the projected FAPRI or OECD world market prices. Corresponding values are in the *world* worksheet of AssumptionsInput_Baseline.xlsm.

Follow the procedure as described in section 4.1.1 for running and solving the AGMEMOD model in the baseline scenario.

4.4.2 Endogenous in alternative scenario

In an alternative scenario - to be compared with the Baseline - the year dummies DY_ENDWMP are kept equal to their values in the Baseline, but new endogenous world market prices are calculated for the alternative situation. The closure swap is organised by the dummy DY_ENDWMP.

Following steps must be conducted to calculate endogenous world market prices. First, start the AGMEMOD user interface and go to the **[Scenarios]** menu. Then select the alternative scenario *OECD* in box *Scenarios to Run* (Figure 4.28), click on the button **[Edit Scenario Run Settings]** and select *Define countries in Model/Run Type* (Figure 4.29).
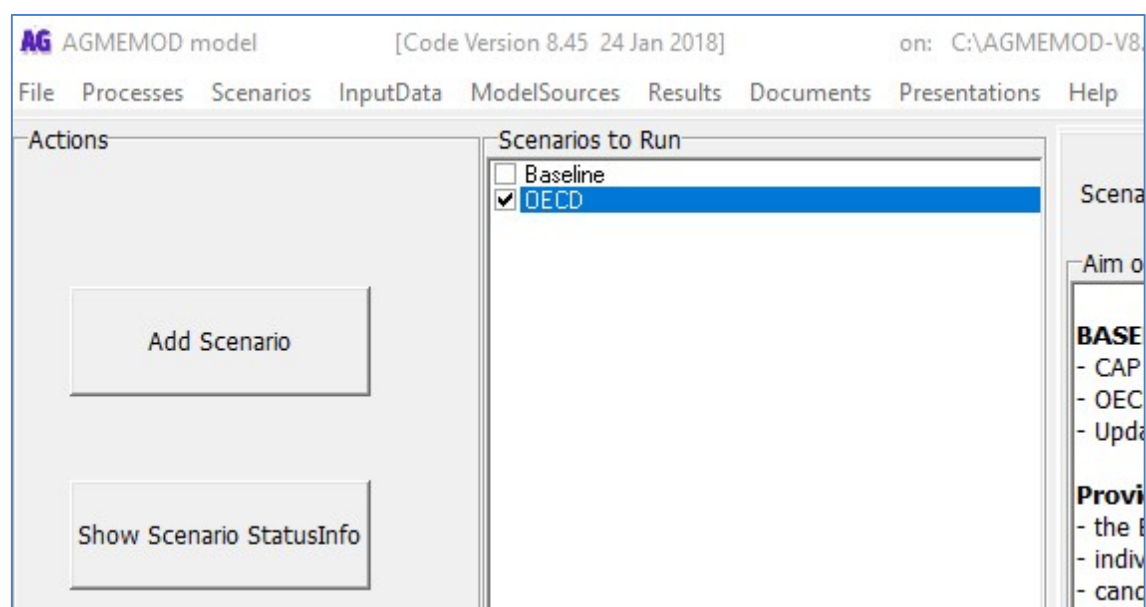
Figure 4.28 Menu item [Scenarios] and selection of scenario to run.
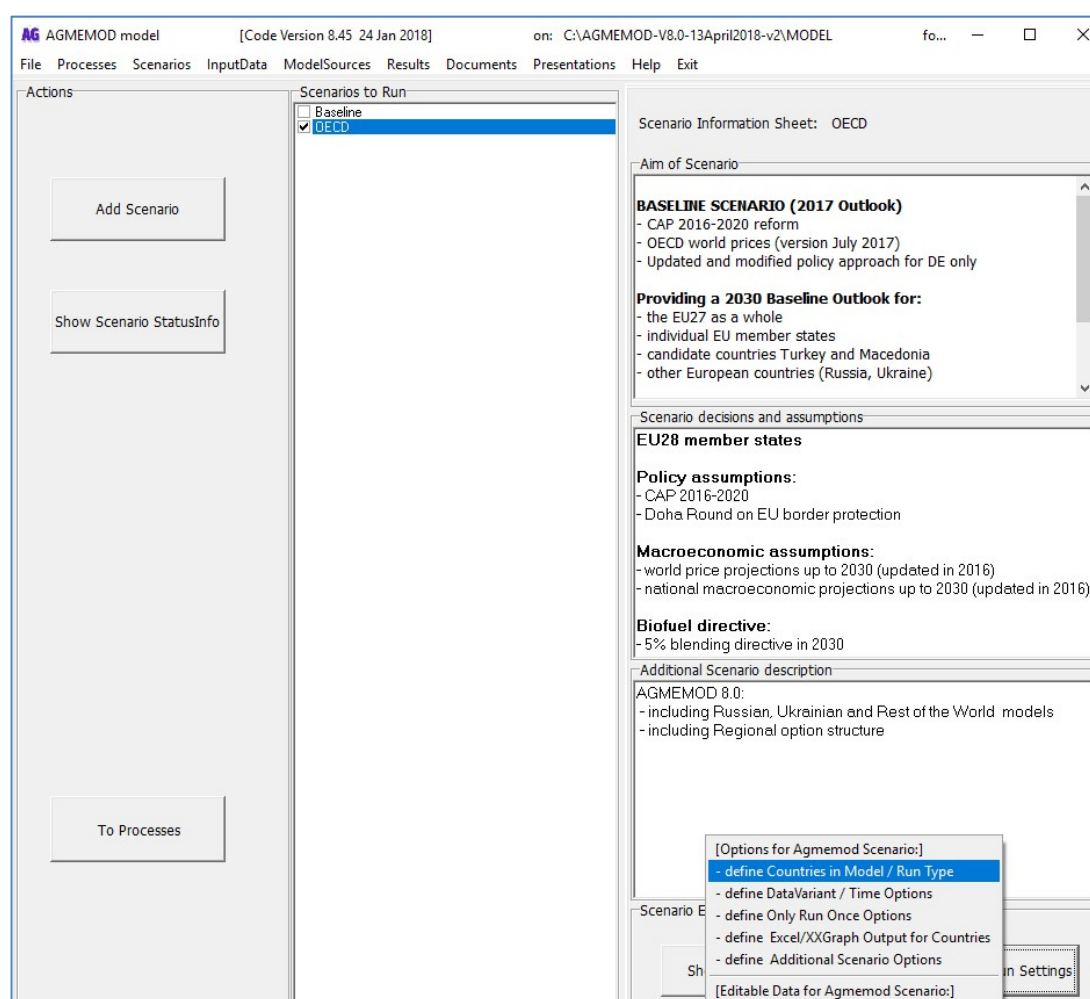

Figure 4.29 Button [Edit Scenario Run Settings] and option 'Define countries in Model'

For a proper comparison analyses, keep the selection of countries similar to in the Baseline. Go to the right under side of the screen and de-activate *Scenario to be used as a Baseline*. Then select **Baseline** as reference of the OECD scenario in the scroll box *Dependent on Baseline scenario* (Figure 4.30). This actually means:

> *In the OECD scenario, world market prices are endogenously calculated while the year dummies are kept the same at values in the Baseline.*

Then click on the **[Close]** button. Finally, run and solve the AGMEMOD model for the OECD scenario according to the process described in section 4.1.1. (similar as baseline scenario).
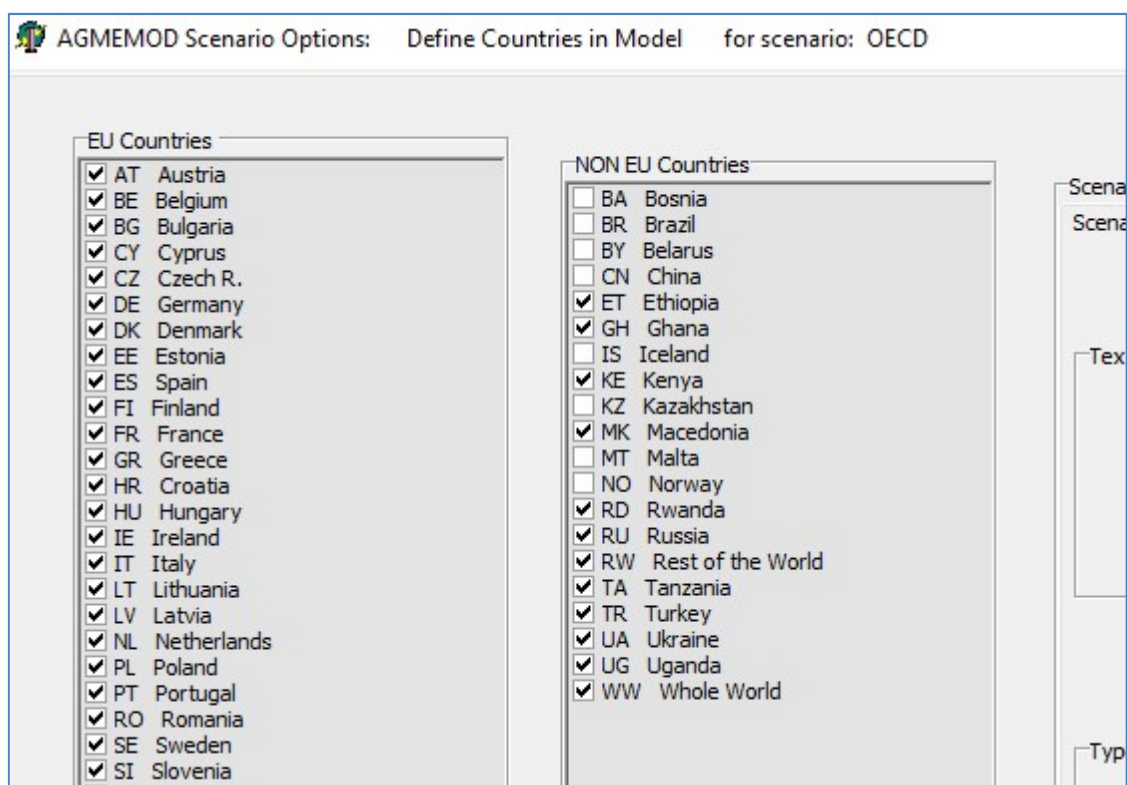
Figure 4.30 Select Baseline as 'Scenario to be used as a Baseline' for OECD scenario

Finally, Annex 1 addresses three ways to check whether the AGMEMOD system has really calculated endogenous world market prices.

References

Berkum, S. van, R.A. Jongeneel, H.C.J. Vrolijk, M.G.A. van Leeuwen and J.H. Jager (2016). Implications of a UK exit from the EU for British agriculture, Study for the National Farmers' Union (NFU), Warwickshire, UK.

Chantreuil F., Hanharan K., and M. van Leeuwen (eds) (2012) "AGMEMOD; the future of EU Agricultural markets by AGMEMOD". Springer.

Annex 1. Checking endogenous world market price calculations

Check 1: click on the button **[Edit Scenario Run Settings]** and select *Define Agmemod2Gams scenario options* (Figure A1.1). Open this file. It is filled with scenario specific options, e.g. on line 16, *BaseToReadAnnualDummies*, through the actions undertaken in section 4.4.2, this parameter has been set equal to **Baseline** (Figure A1.2).
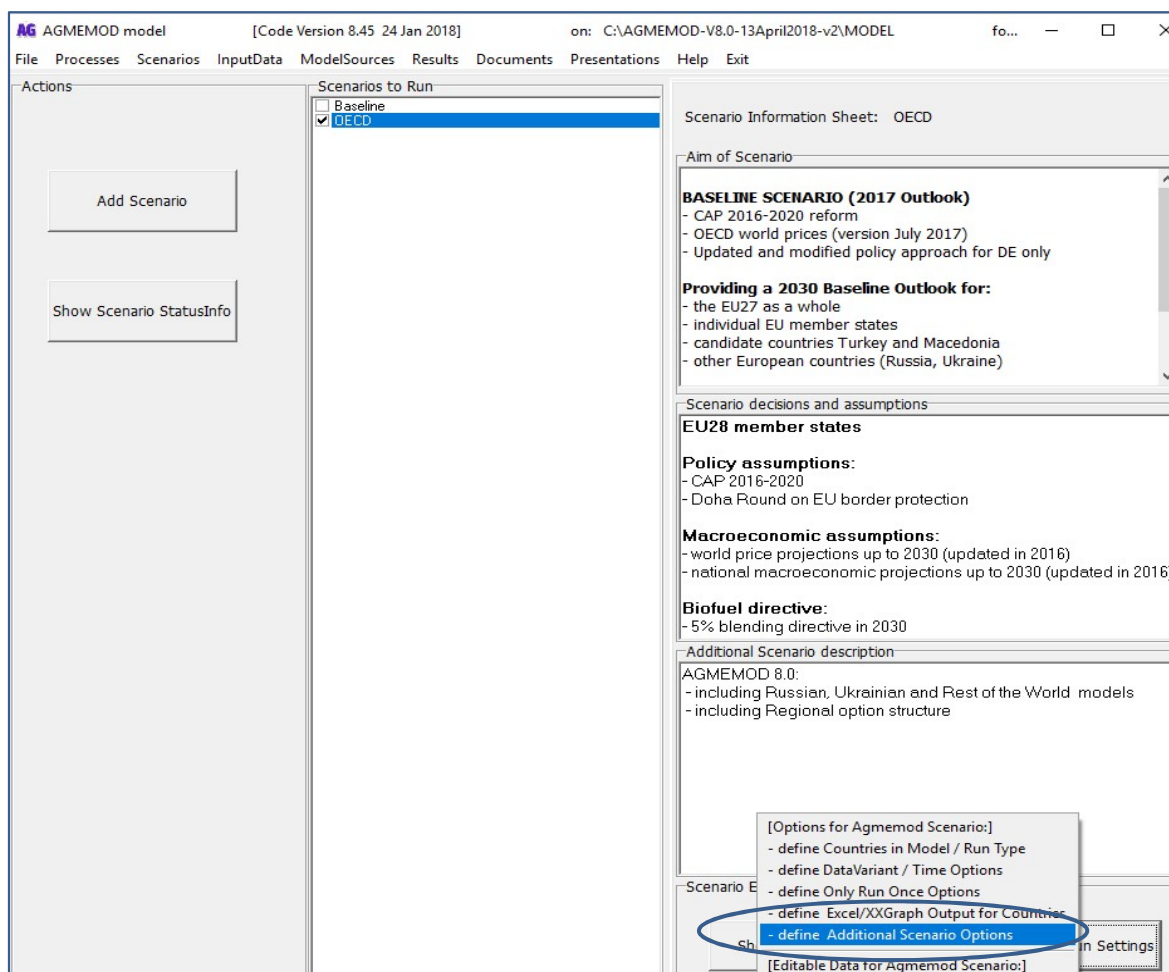
Figure A1.1 Defining scenario options for OECD scenario

Check 2: To check what has been (automatically) done in the GAMS model: go to main menu item **[ModelSources]**/*AGMEMOD Gams model/OECD/Agmemod GamsRun* model. Then open the GAMS program and select in left side part of Gtree: *Settings_RunModel.gms/ScenarioSettings.gms/ActiveCountriesInModel.gms*.

This file appears in the right side part of Gtree. Then scroll down to line `54 $SetGlobal BaseToReadAnnualDummies Baseline` (Figure A1.2). This means that the OECD scenario (see last line of left side tree: `[197] Scenario.gms OECD`) that is udner conduction takes the AnnualYearDummies from the Baseline as given in this scenario. Close the file .

Figure A1.2 Agememod2Gams scenario file: 'BaseToReadAnnualDummies' set to 'Baseline'.
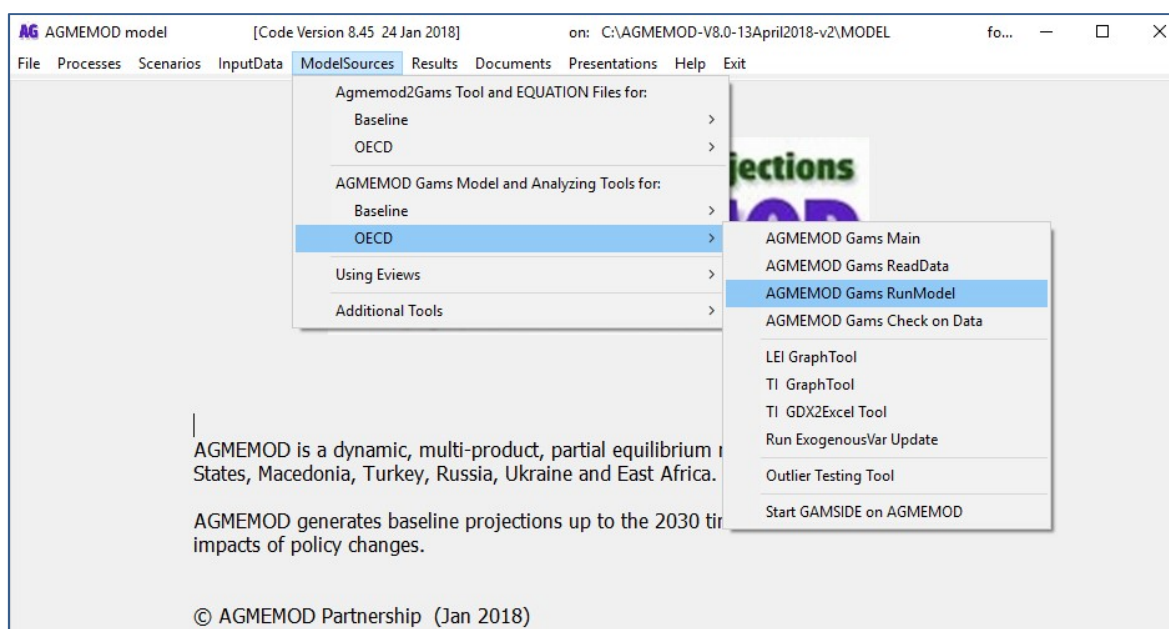

Figure A1.3 ModelSources-Gams Model – AGMEMOD GamsRunModel
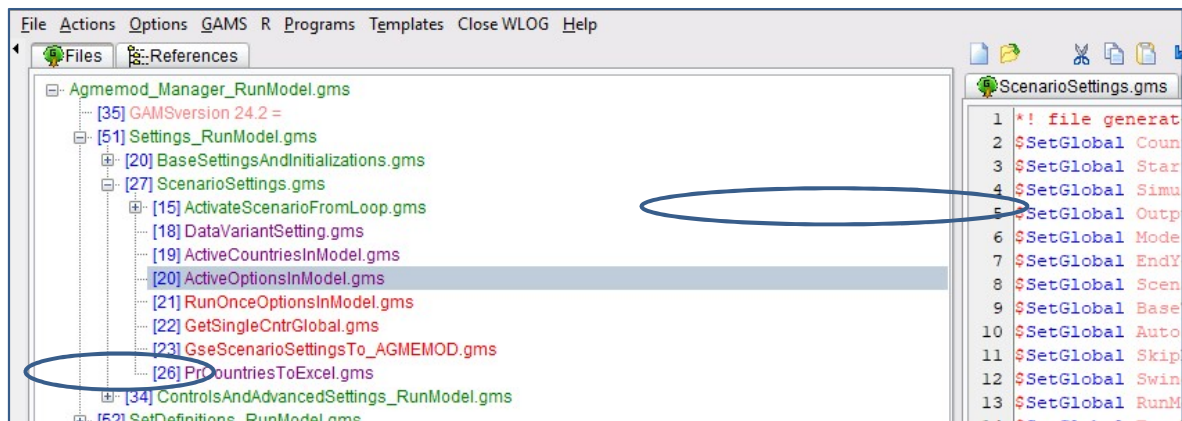
Figure A1.4 ScenarioSettings.gms-ActiveCountriesInModel.gms: OECD scenario with Baseline year dummies

Check 3: Second check what has been (automatically) done in the GAMS model: go to main menu item **[ModelSources]**/*AGMEMOD Gams model/OECD/Agmemod GamsRun* model. Open the GAMS program, and select in left side part of Gtree: *ReadExogenusData_RunModel.gms/PreprocessData.gms/BasedataPreprocessCalculated.gms.* This file appears in the right side part of Gtree (Figure A1.5). Then scroll down to lines 43 and 70.

The code in line 43 means: in case that 'DoExit = no' all AnnualDummies are taken from Baseline and these are loaded into AnnualDummy_OECD.gdx (line 46 in this file):

Line 70 means: the DY_ENDWMP=0 in this OECD scenario. The value 0 has automatically been set in GAMS code at the moment that the Model Type had been set (Step 1 – Figure A1.1: *Scenario to be used as a Baseline' for OECD scenario*). Close the file.
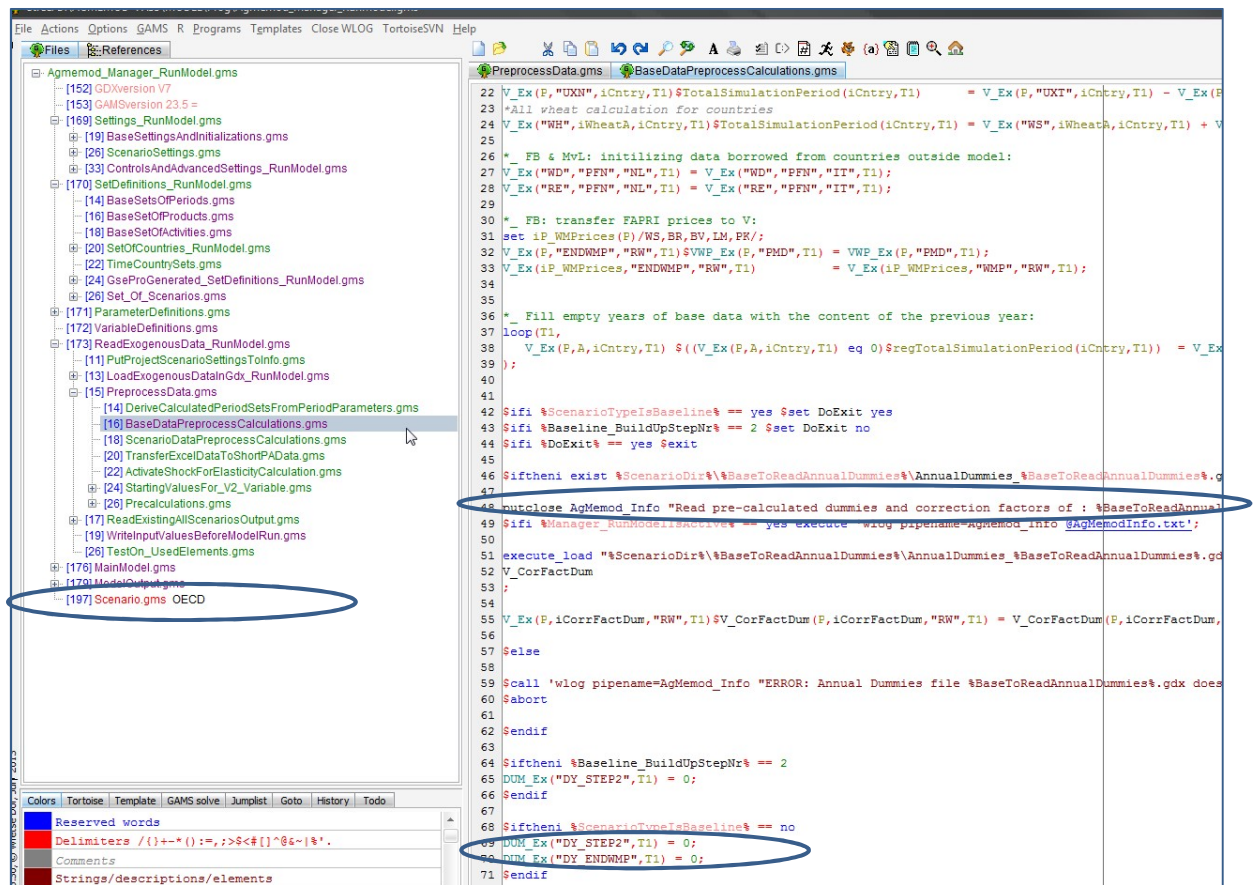
Figure A1.5 BasedataPreprocessCalculated.gms: with DY_ENDWMP dummy value (=0) in OECD scenario