Global CGE Modelling Course: ANARRES_t Project

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1. Introduction

CGE models are mostly used for policy analysis. A policy change, such as an increase in a tax in one sector will have direct impacts on the sector taxed as well as indirect effects on other sectors. Analysis using a general equilibrium model describes those effects and provides insight about the relative magnitudes of different effects. Hence a CGE model provides a 'laboratory' in which a researcher can explore the effects of policy changes and conduct sensitivity analysis to determine how model assumptions, e.g., closure settings, economic structures, and parameters such as elasticities of substitution impact the results. As such, the models are tools which can provide background information and guidance to policy makers who negotiate trade agreements, implement policies on climate change, determine migration policies, etc.

For this project you are an economic consultant hired to analyse policy issues that are relevant and current to the region(s) in your chosen global aggregation; these will be defined by the 'terms of reference' you have developed.

You must determine your target audience before writing a report. In general terms, reports for government policy advisors\makers will want information about the implications for welfare, consumption, taxation, factor markets etc., but may be less interested in the generic implications of the analyses and results. Reports for applied economics, and related disciplines, may want the same information about the implications but may also seek information about the generic implications of the analyses for economic policy formulation. Contrastingly, reports for academic journals, with a stronger focus on economic theory, may emphasise contributions that extend the theoretical aspects of GE models and/or extensions to the range of policy issues that can be addressed by GE models.

Throughout the course exercises, you have implemented a variety of policy shocks and progressively extended your abilities to interpret results. So far you have always worked with databases that have been prepared for you, set up in an Excel workbook and tested to ensure they produce results consistent with the learning objectives at each stage. For the course project you will aggregate a global database and set up the Excel workbook needed to run `anar_t.gms` with your database. Although the data have been tested, we cannot be certain that the experiments you choose will always generate meaningful solutions; this is a problem

that can arise when a CGE model is used with different data and in the process of use identifies issues with the data and/or model.

Hence, this part of the course not only synthesises the coding skills you have developed in the previous exercises, it will help develop your ability to set up a database for a model. The emphasis of the project is on **interpreting results**, particularly in the context of the structure of the economy. The policy simulations, closure assumptions and sensitivity analysis conducted are not prescribed. Instead, you, the researcher, must design the simulation to answer a policy question.

It is tempting to assume that a stylised project such as this is a waste of time: why not proceed directly to an application base on some 'real' world scenario and save time? In contrast we suggest that conducting, on your own, a full stylised project is a valuable method for consolidating what you have learnt, identifying gaps in your understanding and learning to produce a formal report.

2. Backstory and Proposal

‘Backstory’

Develop ‘terms of reference’ for your study. Summarise the policy question you will analyse in a global model, noting that the policy question and the database are interdependent. In this instance we are assuming you are starting from an interest in a particular policy question rather than in a specific country. The ‘terms of reference’ and summary, maximum of two pages, should provide the basis for the development of your database and proposed policy experiments.

DO NOT BE AMBITIOUS. THIS IS A LEARNING EXERCISE.

Proposed aggregation

First, you must determine the database appropriate for the policy question asked. The database provided has a globally consistent Social Accounting Matrices (SAMs) for 28 commodities, 28 activities, 5 factors, and 57 regions, excluding the Globe region.[1] You will determine the aggregation needed. Your aggregation should have no more than 12 commodities/activities; five factors and 8 regions excluding Globe. The available commodities and activities are listed in Appendix A, Tables A1 to A3.

BIGGER IS NOT BETTER. BIG ENOUGH IS BETTER.

Use the Excel sheet `MyAggregation.xlsx` to assign your sector, region, and factor labels and descriptions and provide the mapping from the global database to your customised database. Save the file to `MyAggregation_****.xlsx` where `****` are your initials.

Instructions for Using MyAggregation.xlsx

The rendition of the GTAP database into SAM format follows the documentation in McDonald and Thierfelder (2019) – a link is provided in the cgemod course materials; this is an updated version of GTAP Technical Paper 22 from 2004. The sets used by ANARRES

[1] ANARRES_t will work with larger aggregations that those in the global SAM provided. The SAM provided is a compromise: it allows the user to choose their own aggregation while being small enough to reduce the quantity of user errors.

derive from the conventions used in the technical papers and have been adopted by GTAP (exactly till GTAP 10 and then with GTAP 11 the system needed minor adjustments).

The GTAP database distinguishes between only 3 groups of agents: sectors, regions and factor. The SAM has to have more agents, so each of the GTAP agent labels are prefixed with a few characters that make the agent labels unique, see below

GTAP Agents	Model Agents	Prefixes
Sectors	Commodities	c
	Activities	a
Factors	Factors	f
	Factor use taxes	tf
Regions	Regions	none
	Trade partners	w
	Import duties	tm
	Export taxes	te
	Trade and transport mar	owatp

In the workbook `MyAggregation.xlsx` the agents in the database are detailed in the worksheet '`GTAPAgents`'; these are for information and are locked. The agents you propose for your project are assigned in the workbook 'MyAgents';

1. columns A and B are for the labels and descriptions, respectively, for the sectors in your project;
2. columns C and D are for the labels and descriptions, respectively, for the regions in your project; and
3. columns E and F are for the labels and descriptions, respectively, for the factors in your project.

You should decide on the focus of the policy experiments in your project when choosing the sectors, regions and factors for your project when deciding on the sectors, factors and regions. Avoid illogical aggregations, e.g., do not aggregate agriculture and mining, do not aggregate commodities with no tariffs to commodities with tariffs, e.g., do not aggregate service commodities with goods, otherwise you may compromise the relevance of your database. Be consistent on the aggregation of sectors. For regions there will always need to be some group of regions that covers the 'rest of the world' but otherwise try to aggregate regions that have reasonably similar characteristics and polices. The factor accounts can be

implemented without aggregation, but note that if land and natural resources are aggregated you may need to be careful with the factor market clearing conditions.

Once you have completed the labels AND descriptions for your project you need to enter information in the worksheet '`MyAggregation`'. You need to enter information in columns A, E and I and, ideally columns B, F and J. This needs to be done carefully; while some errors may be detected when generating the SAM and data workbook for the model, some errors may only become clear when running the model or even analysing the results. You need to

1. decide which element in GTAPAgents will be assigned to which element in MyAgents for sectors, regions and factors;
2. ensure that every element in GTAPAgents is assigned to at least one element in MyAgents (the cells for the GTAPAgents are locked to reduce errors); and
3. ensure that the mapping of elements in MyAgents to elements in MyAggregation are appropriate.

Notes to help guide you in setting up the `MyAggregation_***.xlsx` file are found on the worksheet 'Notes'. The notes are locked but there is an area for you to add your own notes.

If you complete all the recommend steps for defining your aggregation most of the changes to the workbook that will be used to generate the aggregation used for you project will only require you to copy and paste data.

Proposed experiments and model settings

Write a one-page proposal for the policy experiments you propose to implement to satisfy your 'terms of reference'. This proposal should summarise the planned experiments, base model settings (macroeconomic closures, market clearing conditions, and elasticities), and sensitivity analyses. **Explain why** you have made these choices. This is your point of reference; it defines what you are going to do and why.

Develop your backstory, `MyAggregation_****.xlsx`, and proposed experiments.

If your aggregation is too big and/or the experiments involve large shocks the probability that you will encounter practical/computing problems increases and will interfere with the learning process.

NB: After the course you will be able to experiment independently with the model and data for devising your own aggregations and policy experiments. By working with a smaller aggregation for the project you will reduces the amount of errors you encounter, avoid delays in completing the course and enhance the learning process.

3. Setting up the Directory for the Project's Data & Model

The process is broadly the same as before but the project directory will need two sub directories. The steps for the data part of the project are

1. Create a new directory for this exercise `C:\cgemod\anar_t\anar_t4.`
2. Add a sub directory for data, i.e., `C:\cgemod\anar_t\anar_t4\data`
3. Open GAMS Studio and select `File>New Project` , find the subdirectory `anar_t4\data` and create a new project – we suggest calling the project `anar_t4_data`.
4. In GAMS Studio press `F6` and in the Model Library Explorer then select the tab `Global CGE Course Library` and select and double click `anar_t4_data`, which is SeqNr: 04. This will add the files `anar_t_proj_aggr.gms,` and `anar_t_G4_data.zip` to your working directory.
5. The `anar_t_proj_aggr.gms` model will now be displayed in the editor window and be listed in the Project Explorer as being in the project `anar_t4\data.`
6. Unzip the file `anar_t_G4_data.zip` into the directory `C:\cgemod\anar_t\anar_t4\data`.
7. Now add a sub directory for the model, i.e., `C:\cgemod\anar_t\anar_t4\model`
8. Open GAMS Studio and select `File>New Project` , find the subdirectory `anar_t4\model` and create a new project – we suggest calling the project `anar_t4_model`.
9. In GAMS Studio press `F6` and in the Model Library Explorer then select the tab `Global CGE Course Library` and select and double click `anar_t4`, which is SeqNr: 05. This will add the files `anar_t.gms, anar_t_expt.gms, clean_anar.dat` and `anar_t_G4_model.zip` to your working directory.
10. The `anar_t.gms` model will now be displayed in the editor window and be listed in the Project Explorer as being in the project `anar_t4\model`.
11. Unzip the file `anar_t_G4_model.zip` into the directory `C:\cgemod\anar_t\anar_t4\model.`

4. Creating an Aggregation

In this stage you will generate the aggregation of the course database that you have specified.

The majority of the work for this part of the project is conducted using Excel. The Excel file to control the aggregation has been set up so that you can copy and paste a lot of the required information from `MyAggregation_***.xlsx`. Once you have completed the unique required Excel file, it will be necessary to make two small changes in a GAMS programme file and then run the programme.

This part of the project exercise is supported by a PowerPoint video.

Note that is very easy to make mistakes when compiling the required Excel file.

The aggregation programme is controlled by an Excel workbook that identifies the sets for the source database (SAM) – `sam_anar_proj_v8.gdx` – and the sets for the output database (SAM) – `sam_anar_C_F_R.gdx` (where `C_F_R` should be replaced by your unique identifier for the project -we use the number of elements in C, F and R). This information allows the programme to load the source database, but a pair of mapping sets are needed before the programme can generate the output database. It is the construction of sets for the output database and the mapping sets that is the task for this part of the project. The process involves combining the information in the workbook `MyAggregation_****.xlsx` with information in `data_samagg_anar_t_8_C_F_R.xlsx`.

Setting up the Excel Workbook

1. Open the workbook `data_samagg_anar_t_8_C_F_R.xlsx`, which will be in the project data directory.
2. Save the workbook `data_samagg_anar_t_8_C_F_R.xlsx`, replacing `C_F_R` with your unique identifier for the project.
3. Read the notes in the worksheet 'NOTES' in the workbook `data_samagg_anar_t_8_C_F_R.xlsx`.
4. Note that some of the cells in the workbook are LOCKED: this is to reduce the number of errors you will make (the code to 'unprotect' worksheets is cgemod).

5. Open the worksheet 'agg_sets' – this sheet will be used to create the set sac and its major subject sets.
    a. In columns T and U add the labels and descriptions for aggregate sectors, in columns W and X and Z and AA do the same for regions and factors respectively. NB: this information can be copied and pasted from the worksheet 'MyAgents' in your workbook MyAggregation_****.xlsx.
    b. Note how the cells in rows 5 and 6 of 'agg_sets' have updated based on the information in columns T, W and Z.
    c. For the columns D to Q use Home>Fill>Fill Down, or Ctrl+D, starting with row 6 to complete the assignment of labels for regions and the major subsets of sac. Note: the length of each column will be determined by the number of entries in the relevant column, T or W or Z.
    d. Create the set sac using Copy and **Paste Special** (to remove the formulae) each of the subsets in columns G to Q in order into column A. It is good practice to complete the descriptions in column B; these can be copied and pasted from columns U or X or AA.
6. Open the worksheet 'mapping' and note that columns B, F and J contain the labels for the three groups of agents in GTAP – sectors, regions, factors – with the associated descriptions in C, G and K. You need to complete columns A, E and I by
    a. deciding which element in GTAPAgents will be assigned to which element in MyAgents for sectors, regions and factors;
    b. ensuring that every element in GTAPAgents is assigned to at least one element in MyAgents; and
    c. ensuring that the mapping of elements in MyAgents to elements in GTAPAgents are appropriate.
    d. This can be done by copy and paste from MyAggregation_*.xlsx.**
7. Open the worksheet 'maps' and note that columns A and B contain the symbols for the sets sac and s respectively and columns F and G contain the symbols for sets r and kk.

8. Note that each member of the sets `s` and `kk` must ONLY be mapped to one member of the sets `sac` and `r` respectively (see Figure 4.2 for an illustration).
9. Once this stage is complete the data for the aggregation programme should be complete.

Figure 4.1 Example of Aggregation Sets (extract from worksheet 'agg_sets')

	A	B	C	D	E	F	G	H	I	J
1	Sets									
2										
3	New SAM accounts			Regions			Commodities	Activities	Factors	Household
4	sac	(description)		r	(description)		c	a	f	h
5	cagri	Agriculture		chn	China and Hong Kong		cagri	aagri	flnd	hous
6	cmins	Minerals		jpko	Japan and Korea		cmins	amins	fuskl	
7	cfood	Food products		rasia	Rest of Asia		cfood	afood	fsklb	
8	clman	Light Manufacturing		india	India		clman	alman	fcapi	
9	chman	Heavy Manufacturing		nafta	NAFTA		chman	ahman	fnres	
10	celct	Electricity		ramer	Rest of Americas		celct	aelct		
11	cgasw	Gas and Water		eu27	EU 27		cgasw	agasw		
12	ccnst	Construction		rworl	Rest of the World		ccnst	acnst		
13	ctrade	Trade		glo	GLOBE		ctrade	atrade		
14	ctrans	Transport					ctrans	atrans		
15	ccomm	Communication					ccomm	acomm		
16	csvcs	Services					csvcs	asvcs		
17	aagri	Agriculture								
18	amins	Minerals								
19	afood	Food products								
20	alman	Light Manufacturing								
21	ahman	Heavy Manufacturing								
22	aelct	Electricity								
23	agasw	Gas and Water								
24	acnst	Construction								
25	atrade	Trade								

Figure 4.2 Example of Mapping Sets (extract from worksheet 'maps')

	A	B	C	D	E	F	G	H	I
1	Maps								
2									
3									
4	map_sac_s(sac,s)					map_r_k(r,kk)			
11	cfood	canfd		Meat and animal products		rasia	oasi		Other Asia
12	cfood	cofod		Other food		india	indi		India
13	clman	ctext		Textile and cloths		rasia	paks		Pakistan
14	clman	cwood		Wood products		rasia	sasi		Rest of South Asia
15	clman	cpape		Paper products		nafta	cana		Canada
16	clman	cpetc		Petroleum and coal products		nafta	usam		United States of America
17	chman	cchem		Checical rubber plastics		nafta	mexi		Mexico
18	chman	cminp		Mineral products		ramer	arge		Argentina
19	chman	cmeta		Metals		ramer	braz		Brazil
20	chman	cmetp		Metal products		ramer	esam		East South America
21	chman	cvehi		Vehicale and parts		ramer	rsam		Rest of South America
22	clman	celec		Electronic equipment		ramer	vene		Venezuela
23	clman	coman		Other manufactuing		ramer	came		Central America
24	celct	celct		Electricity		ramer	cari		Caribbean
25	cgasw	cgasm		Gas production and distribution		eu27	aust		Austria
26	cgasw	cwatr		Water		eu27	belg		Belgium
27	ccnst	ccons		Construction		eu27	balt		Baltic states
28	ctrade	ctrad		Trade		eu27	reuu		Rest of the EU
29	ctrans	ctrns		Transport		eu27	czec		Czech republic

Creating the Aggregation

The database for the model `anar_t.gms` is compiled by the programme `anar_t_proj_aggr.gms`, which aggregates the GTAP database and compiles a workbook with much of the data required by the model.

1. In the project data output directory – `cgemmod\anar_t\anar_t4\data\output` – make a copy of the file `data_anar_t_C_F_R_template.xlsx` and give the copy a name suitable for your project. This is a formatted Excel workbook; changes to the workbook will mean that data are not written out to the designated places in the workbook. Make sure this file is in the directory `cgemod\..\..\..\output`, and **that the file is closed**.[2]
2. Open GAMS Studio and Open in a New Project the file `anar_t_proj_aggr.gms`. You need to make two changes to this file.
    a. In line 37 use `SETGLOBAL` to assign the Excel file you created to control the aggregation (see above) to the string '`agg_schem`'. This will instruct the `CALL GDXXRW` command to call in the correct sets for your aggregation scheme.
    b. In line 41 use `SETGLOBAL` to assign the label that will be used for the GDX file that will contain the aggregated SAM, sets and other data and the Excel file that will contain the model's sets data and other data. The label you assign to the string '`data_out`' will be the name you chose for the Excel file in step 1 above. This label is used for the GDX file created by the `Execute_Unload` command and for `GDXXRW` to write data out to the nominated Excel file. **If the Excel file is open the data will not be written out to Excel**.
3. Run the programme `anar_t_proj_aggr.gms`, using `F10`. It will work properly if you have correctly completed the creation of the workbook with the aggregation scheme sheets and provided the correct SETGLOBAL assignments.

[2] GDXXRW will not write data to an open Excel workbook.

4. If there are any error messages you need to resolve the errors. Carefully read the information provided by the file `anar_t_proj_aggr.log`, either open this file or make the `Process Log` window wider. More complex problems may require using the reference file.
5. The most likely causes are:
    a. spelling errors in the new sets – `sac` and `r`
    b. failing to correct assign elements to the set `sac`
    c. mapping and spelling errors in the worksheet 'maps'
        i. elements of set *s* allocated to more than one element of set *sac*
        ii. elements of set *kk* allocated to more than one element of set *r*
    d. errors in relabeling the input and output files in the programme `anar_t_proj_aggr.gms`.
6. If there are problems with the Excel file this will often cause the programme to abort with the message "Abort problems with GDXXRW". This can be caused by multiple errors, that will be identified (perhaps obliquely), e.g.,
    a. incorrect assignments for SETGLOBAL
    b. errors in the workbook controlling the aggregation
7. Resolve the errors and re run the aggregation programme.
8. Once the programme is complete you will have two files (`data_anar_t_*****.gdx` and `data_anar_t_*****.xlsx`) that will be used to calibrate the model `anar_t.gms` to run your project.

5. Setting up the Project Model's Database

All the files required for the model are already in the sub directory `C:\cgemod\anar_t\anar_t4\model`. The project uses the models `anar_t.gms` and `anar_t_expt.gms`; these are the same files used in the previous modules. We use these files to ensure that all participants start from the same set of files, which simplifies the instructions.

There are 4 distinct phases. First, set up an Excel database for the model that is consistent with your aggregation. Second, run and test the model with the new (aggregated) databases and paired Excel database. Third, run the planned policy experiments. And fourth, conduct a preliminary analysis of the model results, review the planned policy experiments in light of the lessons learned and revise the policy experiments and re run the model before final analysis of the results. This section addresses the first two phases.

Create the Excel Database

In this stage you will compile the unique Excel workbook `data_anar_t_*****.xlsx` that will be used to calibrate the model for your project. The aggregation programme has done a lot of the work for you, but you still need to assign some sets and parameters and to verify that the data are correctly presented.

The file `data_glb_t_8_*_*_*.xlsx` contains a series of worksheets that need to be augmented and/or modified. This can be tricky, especially the first time, and it is easy to make errors; many of these can be avoided by using copy and paste (or Paste/Special/Values) so as to avoid typing errors. The workbook is structured so that GDXXRW know where to find the information required by the model: it is important that you do not change where the information is stored in the workbook, i.e., DO NOT insert rows or columns or move the data entry points. The cells with data are linked to the layout sheet and GAMS expects to find information in the current cell locations.

1. sets sheet:
    a. add descriptions for the elements in the sets sac and r – these are valuable and only requires copy and paste from the your aggregation workbook;

b. select the regions for including in the set *ref;* it cannot include Globe – one option is to include all non-Globe regions;[3]

c. populate the subsets of *c, a,* and *f* which also must be populated – these are used for reporting and can simplify coding experiments*;*

d. the subsets of c and a are used to assign elements to the commodity (cagg) and activity (aagg) aggregates: these sets are used to write out results for aggregated commodities and activities, some of them can be empty sets;[4]

e. assign elements to the sets *wagg* and *ragg* – these elements are aggregates of the trade partners and regions and are used for reporting purposes.

2. maps sheet:

   a. the mapping sets *map_w_tmr, map_tmr_w, map_w_ter, map_ter_w, map_r_w, map_w_r, map_f_tff* and *map_tff_f, map_marg_w, map_wagg_w* and *map_ragg_r*. are populated;

   b. the mapping set *map_c_w_narg* is partly - *t*his is the map between the commodity, *c*, used for margin services, trade partner and margin service. The commodity that is exported to the region "`wglo`" is identified but the element needs to be duplicated for each row in the set `map_c_w_marg`.

3. all elasticity sheets for commodities, *comelastm*, *comelastrm*, *comelaste* and *comelastre* sheets need to reviewed:

   a. the sheets for *comelastm* and *comelastrm* report the elasticities derived from those used by GTAP; you should review the values and decide the values you think are appropriate (the values for glo are 'placeholders', so they need setting);

   b. the sheets for *comelaste* and *comelastre* have no counterpart in the GTAP database, so the values in the sheets are 'placeholders' that you need to replace with your own values.

4. all elasticity sheets for activities, *actelastx* and *actelastva* sheets:

[3] The set ref assigns regions to be used in the global numeraire, which is a weighted average of the exchange rates for regions in the set ref (see in the code the equation ERPIDEF). It is a problem to have a very small region as the global numeraire.

[4] We have set the model with the `onempty` option so an empty set is allowed.

   a. the sheet for *actelastva* contains values taken from GTAP – they should be reviewed;
   b. the sheet for *actelastx* has no counterpart in the GTAP database, so the values in the sheets are 'placeholders' that you need to replace with your own values.
5. all elasticity sheets for households, *frischelast* and *incelast* sheets:
   a. these contain values for Cobb-Douglas utility functions for all regions;
   b. to set these for a LES determine the values for *frischelast* – the more negative the greater the share of consumption is subsistence (ALL values must be less than or equal to minus 1);
   c. to set these for a LES determine the values for *incelast* need to be set – typically the income elasticity values will be lower for basic goods and increase as goods become less basic (the calibration file ensures that the applied income elasticities are consistent with a complete demand system).
6. **SAVE the Excel workbook.**

Testing the Model

Run the model using `F10` using the new aggregation and paired Excel workbook (using `SETGLOBAL`). You are likely to have errors and on the first run there could be a very large number; do not be disheartened, this is normal and with some care can be rapidly resolved. Many of these apparent errors are cumulative, i.e., one simple error early in the process will generate very large numbers of errors. The most common errors encountered will be a failure to read a file, failures to convert data in Excel into the `data_in.gdx` file and failures of domain checks.

The process of resolving these errors can be speeded up by using one or more of three features of GAMS.

1. Set the cumulative error control to a small number (select GAMS/GAMS Default Configuration and drag `CErr` from the right hand to the left hand frame and set the default to 10 – or as little as 5) – there is no point getting lots of error messages since you need to deal with the first one first.

2. In the file `anar_t_dataload.inc` add the command `$STOP` after the GDX file is read in and just before the file `anar_t_single.inc`. Since most errors will arise when loading data from Excel it is wise to check the data are loading correctly before going further.

    a. Once the data are loaded correctly the `$STOP` instruction can be moved further into the programme – usually after each `INCLUDE` file.

3. In the file `anar_t_dataload.inc` add find the instruction `$CALL "GDXXRW i= ……..` . There are two features here to note.

    a. The instruction `$if errorLevel 1 $abort problems with GDXXRW` will stop the programme if there is a problem with `GDXXRW`. If the programme aborts here read the log file carefully: sometimes the cause of the problem is clear but at other times it will be less obvious

    b. The option `trace=**` controls the amount of information written to the log file about the operation of `GDXXRW`. The default is 0 and the maximum is 4: Hint: we usually find 3 is adequate for debugging.

BE SYSTEMATIC; MAKE ONE CHANGE AT A TIME; DO NOT CHANGE THE LAYOUT SHEET; DO NOT PANIC AND START TO MAKE CHANGES IN THE MODEL FILES.

Once the model appears to be running correctly, carry out the seven standard tests. You should know all these checks by now so we do not repeat the details here; look at previous instructions if you are uncertain.

Hints and Help with Common Problems

This list of common problems and hints as to solutions is not complete; the problems identified are those we have encountered at various times (as new ones are discovered we may revise these 'hints'). The most important skill needed to resolve these problems is learning to read the information provided by GAMS, especially in the log file; it is not always obvious what the information means and it can be the case that the error message is generated by an error earlier in the code. You should also learn to look at the log file; this is especially important when converting Excel data to GDX.

Failure to generate `data_in.gdx` file

1. Incorrect file names: make sure the file names are correct and that they are in the correct directory.
2. Duplicate entries for symbols: look at the log file, wherein duplicates will be identified. (We have added the 'trace' option to the `GDXXRW` call statement in file `anar_t_dataload.inc` file to increase the amount of information produced in the log file.)

```
par=elastva Rng=actelastva!B5 rdim=1 cdim=1
par=elastf Rng=frischelast!B5 rdim=1 cdim=1
par=elasty Rng=incelast!B5 rdim=2 cdim=1
par=controls Rng=controls!A4 rdim=1 cdim=1
dset=mcons Rng=controls!A7 rdim=1
dset=fcons Rng=controls!A31 rdim=1
par=flow_cont Rng=controls!A31 rdim=1
par=mod_cont Rng=controls!A7 rdim=1
**** Duplicate identifier = c
Total time = 1453 Ms
--- .dat_12_5_8_glb_t.inc(81) 2 Mb
***
*** Abort problems with GDXXRW
```

3. Bad data range: look in the log file wherein the bad data range is identified (typically caused by either entering data in a worksheet that is not consistent with the range specified in the LAYOUT sheet OR changing the LAYOUT sheet wrongly).

```
par=controls Rng=controls!A4 rdim=1 cdim=1
dset=mcons Rng=controls!A7 rdim=1
dset=fcons Rng=controls!A31 rdim=1
par=flow_cont Rng=controls!A31 rdim=1
par=mod_cont Rng=controls!A7 rdim=1
**** Bad data range for symbol controls : controls!A4 (Sheet name not foun
Total time = 1390 Ms
--- .dat_12_5_8_glb_t.inc(81) 2 Mb
***
*** Abort problems with GDXXRW
***
```

Failure to load expected data from `data_in.gdx` file

These errors are of various types:

1. a parameter and/or elasticity that appears in the Excel workbook does not appear in the GAMS programme:

   a. data are not entered in the Excel workbook where the LAYOUT sheet tells GDX to expect the data;
   b. the wrong labels have been used in the Excel workbook, e.g., using the labels for the set *a* instead of set *c*;
   c. the LAYOUT sheet has been changed.
2. the SAM does not balance despite apparently being balanced in Excel (all those in the project database do balance)
   a. one or more elements are not included in the set *sac*;
3. the data used in the model files differs from that in the `data_in.gdx` file (where the gdx data are consistent with the Excel data)
   a. check that there have been no code changes that mean the wrong data are assigned to the parameter for which errors are reported;
   b. the LAYOUT sheet has been changed.

Failure to pass domain checks

These failures can have multiple possible causes and they can be difficult to find.

1. Element is a subset not included in the parent set, e.g., *csvc* included in *c* but not in *sac*, *ccrop* in *cagr* but not in *c*, etc. When double clicking on the error message, the error will be identified by the cursor flashing immediately before the NEXT (sub)set to be read (see screenshot below which is for the error when *csvc* included in *c* but not in *sac*,). (Note: elements may appear in a parent set, e.g., *sac*, but not in subsets and this should not cause a failure of a domain check.). Additional insight can be found in `anar_t.lst`, searching for `****` (see screen shot below). The main causes are:
   a. an element has been omitted in the parent set;
   c. an element's label has been mistyped – copy and paste helps reduce this type of error;
   d. the LAYOUT sheet has been changed.

Double click the error message:

```
*---- 1b. All data, elasticities and sets from

$GDXIN data_in.GDX

* LOAD sets
$LOADdc sac
$LOADdc c cagr cnat cfd cind cuti cser cagg
$LOADdc a aagr anat afd aind auti aser aagg
$LOADdc f l ls lu k lnd
$LOADdc tmr ter tff h g i owatpmarg w
$LOADdc r ref
$LOADdc ragg wagg

$LOADdc aleon rleon
```

From `anar_t.lst`, search for `****`:

```
 992
 993  * LOAD sets
--- LOAD  sac = 1:sac
--- LOAD  c = 4:c
**** Unique domain errors for symbol c
 Dim  Elements
   1  csvc

--- LOAD  cagr = 5:cagr
--- LOAD  cnat = 6:cnat
```

2. Labels for the elements in parameter tables are not those expected by GAMS
    a. check that there was not an error when changing the row and/or column labels (these can be either typing errors or simply forgetting to update the labels for a table);
    b. the LAYOUT sheet has been changed;
3. Labels for the set elements in the maps are wrong
    a. check that there was not an error when changing the sets in each map (these can be either typing errors or simply forgetting to update the labels for a table);
    b. the LAYOUT sheet has been changed.

6. Policy Experiments and Interpretation[5]

Remember, you are an economic consultant hired to analyse policy issues that are relevant and current to the region(s) in your chosen global aggregation; these are defined by the 'terms of reference' you have developed

Tasks

1. Define and code appropriate policy experiments. You may modify the experiment file included in the project directory or you may copy an experiment file developed for use with the previous modules – you may choose to adapt experiment files from previous exercises.
2. Specify appropriate macroeconomic closure conditions. You may modify a closure file included in the project directory or you may copy a closure file developed for use with the previous modules – only one closure file is included in the downloaded files, so you may need to get closure files from previous exercises.
3. Specify appropriate factor market clearing conditions. You may modify a closure file included in the project directory or you may copy a closure file developed for use with the previous modules – only one closure file is included in the downloaded files, so you may need to get closure files from previous exercises.
4. Specify the elasticities used.
5. Interpret the economic and policy implications from the results of the experiments.

Develop the experiment file and Sensitivity Analysis

1. Develop the GAMS code needed to run the proposed experiments using loops.
2. Ensure that all the experiments are implementing the intended shocks and producing coherent solutions.

The sensitivity of the results to assumptions embedded within the model needs to be examined.

1. Devise a series of policy experiments that systematically examine the sensitivity of your policy experiment results to these assumptions.

[5] As is common in economics; the questions often do not change, but the answers do!!

2. Explain carefully how you decided upon the policy experiments used to conduct the sensitivity analyses.
3. Comment critically on the results of the sensitivity analyses.

Interpret the Model Results

Now for the fun and hard part – interpreting the results.

7. Project Report

In all cases you should use tables, diagrams etc., to report your results, and then comment on the policy implications of your results.

Remember this project has two purposes

1. to communicate information to your target audience, and
2. 'Learn-by-doing; how to carry out a CGE project.

Appendix A

Table A1 Commodities and activities in the global database

Commodity	Activity	Description
cgrain	agrain	Grains
clvsk	alvsk	Livestock
coagr	aoagr	Other agriculture
ccoal	acoal	Coal
coilg	aoilg	Oil and gas
comin	aomin	Other mining
canfd	aanfd	Meat and animal products
cofod	aofod	Other food
ctext	atext	Textile and clothes
cwood	awood	Wood products
cpape	apape	Paper products
cpetc	apetc	Petroleum and coke products
cchem	achem	Chemical rubber plastics
cminp	aminp	Mineral products
cmeta	ameta	Metals
cmetp	ametp	Metal products
cvehi	avehi	Vehicle and parts
celec	aelec	Electronic equipment
coman	aoman	Other manufactuing
celct	aelct	Electricity
cgasm	agasm	Gas production and distribution
cwatr	awatr	Water
ccons	acons	Construction
ctrad	atrad	Trade
ctrns	atrns	Transport
ccomm	acomm	Communication
cserv	aserv	Financial business and other services
cpubs	apubs	Public services

Table A2 Factors in the global database

Factor	Description
flnd	Land
fuskl	Unskilled labour
fsklb	Skilled labour
fcapi	Capital
fnres	Natural resources

Table A3 Regions in the global database

Region	Description	Region	Description
anz	Australia and New Zealand	hung	Hungary
chhk	China and Hong Kong	irel	Ireland
japa	Japan	ital	Italy
kore	Korea	neth	Netherlands
easi	Rest of East Asia	pola	Poland
seas	South East Asia	spai	Spain
oasi	Other Asia	swed	Sweden
indi	India	unki	United Kingdom
paks	Pakistan	reur	Rest of Europe
sasi	Rest of South Asia	russ	Russian Federation
cana	Canada	eeur	Rest of Eastern Europe
usam	United States of America	rfsu	Rest of Former Soviet Union
mexi	Mexico	gulf	Gulf States
arge	Argentina	iran	Iran
braz	Brazil	saud	Saudi Arabia
esam	East South America	turk	Turkey
rsam	Rest of South America	egyp	Egypt
vene	Venezuela	moro	Morocco
came	Central America	nafr	Rest of North Africa
cari	Caribbean	cfaz	CFA Zone
aust	Austria	wafr	Rest of West Africa
belg	Belgium	nige	Nigeria
balt	Baltic states	ethi	Ethiopia
reuu	Rest of the EU	rsad	Rest of SADC
czec	Czech Republic	safr	South Africa
denm	Denmark	eafr	East Africa
fran	France	rafr	Rest of Africa
germ	Germany	rest	Rest of the World
gree	Greece	glo	Globe