Computing Guide for the CEER Model Using Customized RunGEM

Eduardo Haddad

This version: September 25, 2013

1. Introduction

This document explains how to use the Customized RunGEM program to work with the CEER model. It was originally designed for use at the short course held in Banco de la República, Cartagena, Colombia. It has been recently updated for use at the "Course in Applied CGE Modeling" that took place in Kitakyushu, Japan, in 2013. It draws on the document "Computing Guide for MINIMAL Using Customized RunGEM", by **Mark Horridge**, March 2001.

GEMPACK is a system of software for implementing and solving computable general equilibrium (CGE) models. The CEER model is a spatial CGE model, implemented using GEMPACK and designed for policy analysis in Colombia. RunGEM is a windows program that makes it easy for you to run any CGE model created with GEMPACK. Customized RunGEM is a special version of RunGEM that has been hard-wired to work only with one or a few particular models (such as CEER). In this document, references to *RunGEM* mean *Customized RunGEM*, tailored for use with the CEER model.

This document assumes that you have installed on your computer a recent version of Customized RunGEM (dated March 2001 or later) that contains the CEER model. Instructions for doing this are in Appendix 1.

You should also have studied the CoPS working paper OP-85, *The Theoretical Structure of MONASH-MRF*, by Peter *et al*. (1996), the book *Regional Inequality and Structural Changes: Lessons from the Brazilian Economy*, by Haddad (1999), and the article by Haddad and Hewings (2005), *Market Imperfection in a Spatial Economy: Some Experimental Results*, published in the Quarterly Review of Economics and Finance, Vol. 45. They describe the underlying economic theory of the CEER model.

As you read this document, you will use RunGEM to work through examples designed to familiarize you with the software and, perhaps more importantly, the CEER model. The instructions are quite detailed. Our aim is to give sufficient detail to enable a new RunGEM user to work through the examples relying solely on this document.

A series of numbered questions appear throughout the text. Write your answers in the margin.

2. Starting RunGEM

To see RunGEM in action, double-click on the Customized RunGEM (CEER Model) icon on your desktop. You should see the following screen:

RunGEM uses a tabbed notebook or card index interface. The first 2 pages (**Picture** and **Text**) contain general information. The 3rd page (**Model/Data**) contains information about files used by the CEER model. The remaining 5 pages relate to simulations – we explain those in Part 5 below.

The **Help** menu item gives access to extensive online-help about RunGEM. **Customized RunGEM** is a slightly simplified version of RunGEM, so some of the options described there may not apply. There is a special Help menu item, "Customized RunGEM Help", dealing with these differences.

3. The Model/Data page

Have a look at RunGEM's **Model/Data** page. It gives two pieces of information:

- The *model* is CEER.EXE, an executable program. This has been produced by the GEMPACK program **TABLO** using, as input, the text file CEER.TAB. To change the model specifications, you need to (a) edit CEER.TAB, and (b) run TABLO to make CEER.EXE. That procedure is not covered in this introductory document, and TABLO is not supplied with the **Customized RunGEM** package.

- There are five input data files, MDATA.HAR, which corresponds to the logical file MDATA which is mentioned in CEER.TAB. Similarly, YDATA.HAR corresponds to the logical file, YDATA, NDATA.HAR to NDATA, PDATA.HAR to PDATA, and Terminal.HAR to Terminal.

RunGEM, and the programs that come with it (TABmate, ViewHAR and others) are parts of the standard GEMPACK system, which allows you to create and modify economic models and data. The customized version of the CEER model is designed as an introduction to the CEER model itself, using GEMPACK: therefore the Customized version of RunGEM does not allow you to alter the model equations or database. To change the equations or data, you would need other GEMPACK components (such as the TABLO program) not supplied with Customized RunGEM. See Section 8 for more information.

4. Looking at the data

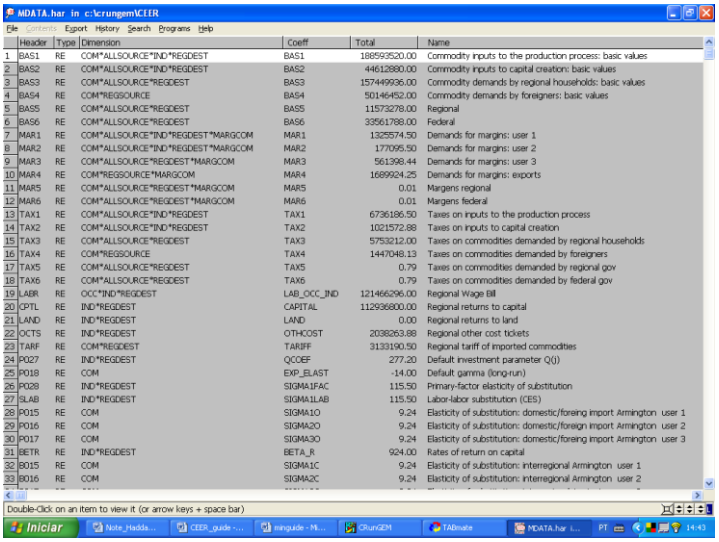
The data files are given the logical names **MDATA**, **YDATA**, **NDATA**, **PDATA** and **Terminal** in the TAB file **CEER.TAB** which lays down the theory of CEER. To see what information is on the MDATA file, for instance, select

View | Input Data files | Original MDATA

in RunGEM's menu. ["Original MDATA" appears to the side of "Input Data files"].

This will start up **ViewHAR,** a windows program for viewing and modifying data held in GEMPACK Header Array files. It will open the MDATA file and show a Contents screen.[1]

[1] The top of the ViewHAR window shows the actual name (MDATA.HAR) and location of the file which has logical name MDATA in the TAB file.



	Header	Type	Dimension	Coeff	Total	Name
1	BAS1	RE	COM*ALLSOURCE*IND*REGDEST	BAS1	188593520.00	Commodity inputs to the production process: basic values
2	BAS2	RE	COM*ALLSOURCE*IND*REGDEST	BAS2	44612880.00	Commodity inputs to capital creation: basic values
3	BAS3	RE	COM*ALLSOURCE*REGDEST	BAS3	157449936.00	Commodity demands by regional households: basic values
4	BAS4	RE	COM*REGSOURCE	BAS4	50146452.00	Commodity demands by foreigners: basic values
5	BAS5	RE	COM*ALLSOURCE*REGDEST	BAS5	11573278.00	Regional
6	BAS6	RE	COM*ALLSOURCE*REGDEST	BAS6	33561788.00	Federal
7	MAR1	RE	COM*ALLSOURCE*IND*REGDEST*MARGCOM	MAR1	1325574.50	Demands for margins: user 1
8	MAR2	RE	COM*ALLSOURCE*IND*REGDEST*MARGCOM	MAR2	177095.50	Demands for margins: user 2
9	MAR3	RE	COM*ALLSOURCE*REGDEST*MARGCOM	MAR3	561398.44	Demands for margins: user 3
10	MAR4	RE	COM*REGSOURCE*MARGCOM	MAR4	1689924.25	Demands for margins: exports
11	MAR5	RE	COM*ALLSOURCE*REGDEST*MARGCOM	MAR5	0.01	Margens regional
12	MAR6	RE	COM*ALLSOURCE*REGDEST*MARGCOM	MAR6	0.01	Margens federal
13	TAX1	RE	COM*ALLSOURCE*IND*REGDEST	TAX1	6736186.50	Taxes on inputs to the production process
14	TAX2	RE	COM*ALLSOURCE*IND*REGDEST	TAX2	1021572.88	Taxes on inputs to capital creation
15	TAX3	RE	COM*ALLSOURCE*REGDEST	TAX3	5753212.00	Taxes on commodities demanded by regional households
16	TAX4	RE	COM*REGSOURCE	TAX4	1447048.13	Taxes on commodities demanded by foreigners
17	TAX5	RE	COM*ALLSOURCE*REGDEST	TAX5	0.79	Taxes on commodities demanded by regional gov
18	TAX6	RE	COM*ALLSOURCE*REGDEST	TAX6	0.79	Taxes on commodities demanded by federal gov
19	LABR	RE	OCC*IND*REGDEST	LAB_OCC_IND	121466296.00	Regional Wage Bill
20	CPTL	RE	IND*REGDEST	CAPITAL	112936800.00	Regional returns to capital
21	LAND	RE	IND*REGDEST	LAND	0.00	Regional returns to land
22	OCTS	RE	IND*REGDEST	OTHCOST	2038263.88	Regional other cost tickets
23	TARF	RE	COM*REGDEST	TARIFF	3133190.50	Regional tariff of imported commodities
24	P027	RE	IND*REGDEST	QCOEF	277.20	Default investment parameter Q(j)
25	P018	RE	COM	EXP_ELAST	-14.00	Default gamma (long-run)
26	P028	RE	IND*REGDEST	SIGMA1FAC	115.50	Primary-factor elasticity of substitution
27	SLAB	RE	IND*REGDEST	SIGMA1LAB	115.50	Labor-labor substitution (CES)
28	P015	RE	COM	SIGMA1O	9.24	Elasticity of substitution: domestic/foreing import Armington user 1
29	P016	RE	COM	SIGMA2O	9.24	Elasticity of substitution: domestic/foreign import Armington user 2
30	P017	RE	COM	SIGMA3O	9.24	Elasticity of substitution: domestic/foreing import Armington user 3
31	BETR	RE	IND*REGDEST	BETA_R	924.00	Rates of return on capital
32	B015	RE	COM	SIGMA1C	9.24	Elasticity of substitution: interregional Armington user 1
33	B016	RE	COM	SIGMA2C	9.24	Elasticity of substitution: interregional Armington user 2

Each of the rows corresponds to a different array of data on the file. Look at the **Name** column to see what these arrays are.[2] Use the buttons at bottom right to set your preferred font size.

You can see that array number 19 is the data at Header "LABR". The data at this header is the value of labor payments, measured in millions of 2004 Colombian pesos. To see the actual data, double-click on the LABR row.

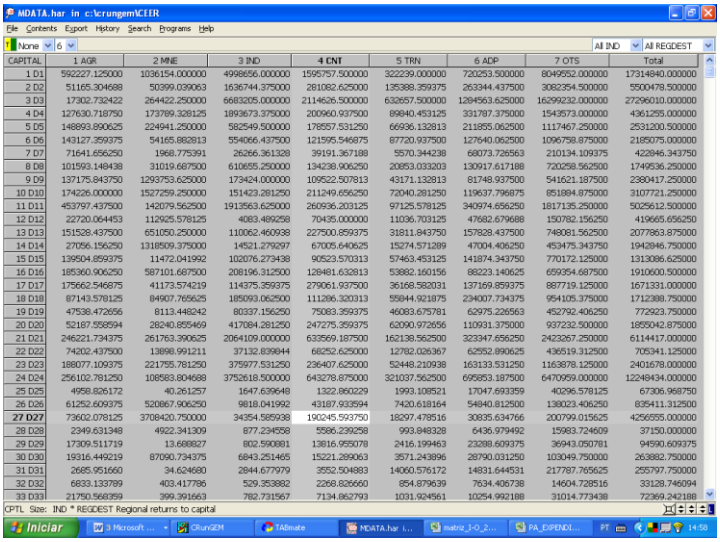
Q1. What is the value of wages in manufacturing (IND) in Bolívar (D4)?

Now click on ***Contents*** in ViewHAR's main menu to return to the list of contents. Similarly, the array number 20 is the data at Header "CPTL". The data at this header is the value of capital payments, measured in millions of 2004 Colombian pesos. To see the actual data, double-click on the CPTL row.

Q2. What is the value of capital payments in the construction sector (CNT) in Nariño (D17)?

Click on the small yellow rectangle near the top left of the ViewHAR window to transpose the matrix (exchange rows and columns). This makes it easier to see.

[2] The arrays may be ordered differently from the list in the text. You can set ViewHAR up to either list the headers alphabetically, or to list them in the order they were written to file. ViewHAR's **File…Options** menu command can be used to customize the display in various ways.



CAPITAL	1 AGR	2 MNE	3 IND	4 CNT	5 TRN	6 ADP	7 OTS	Total
1 D1	592227.125000	1036154.000000	4998656.000000	1595757.500000	322239.000000	720253.500000	8049552.000000	17314840.000000
2 D2	51165.304688	50399.039063	1636744.375000	281082.625000	135388.359375	263344.437500	3082354.500000	5500478.500000
3 D3	17302.732422	264422.250000	6683205.000000	2114626.500000	632657.500000	1284563.625000	16299232.000000	27296010.000000
4 D4	127630.718750	173789.328125	1893673.375000	200960.937500	89840.453125	331787.375000	1543573.000000	4361255.000000
5 D5	148893.890625	224941.250000	582549.500000	178557.531250	66936.132813	211855.062500	1117467.250000	2531200.500000
6 D6	143127.359375	54165.882813	554066.437500	121595.546875	87720.937500	127640.062500	1096758.875000	2185075.000000
7 D7	71641.656250	1968.775391	26266.361328	39191.367188	5570.344238	68073.726563	210134.109375	422846.343750
8 D8	101593.148438	31019.687500	610655.250000	134238.906250	20853.033203	130017.617188	720258.562500	1746536.250000
9 D9	137175.843750	1293753.625000	173424.000000	109522.507813	43171.132813	81748.937500	541621.187500	2380417.250000
10 D10	174226.000000	1527259.250000	151423.281250	211249.656250	72040.281250	119637.796875	851884.875000	3107721.250000
11 D11	453797.437500	142079.562500	1913563.625000	260936.203125	97125.578125	340974.656250	1817135.250000	5025612.500000
12 D12	22720.064453	112925.578125	4083.489258	70435.000000	11036.703125	47682.679688	150782.156250	419665.656250
13 D13	151528.437500	651050.250000	110062.460938	227500.859375	31811.843750	157828.437500	748081.562500	2077863.875000
14 D14	27056.156250	1318509.375000	14521.279297	67005.640625	15274.571289	47004.406250	453475.343750	1942846.750000
15 D15	139504.859375	11472.041992	102076.273438	90523.570313	57463.453125	141874.343750	770172.125000	1313086.625000
16 D16	185360.906250	587101.687500	208196.312500	128481.632813	53882.160156	88223.140625	659354.687500	1910600.500000
17 D17	175662.546875	41173.574219	114375.359375	279061.937500	36168.582031	137169.859375	887719.125000	1671331.000000
18 D18	87143.578125	84907.765625	185093.062500	111286.320313	55844.921875	234007.734375	954105.375000	1712388.750000
19 D19	47538.472656	8113.448242	80337.156250	75083.359375	46083.675781	62975.226563	452792.406250	772923.750000
20 D20	52187.558594	28240.855469	417084.281250	247275.359375	62090.972656	110931.375000	937232.500000	1855042.875000
21 D21	246221.734375	261763.390625	2064109.000000	633569.187500	162138.562500	323347.656250	2423267.250000	6114417.000000
22 D22	74202.437500	13898.991211	37132.839844	68252.625000	12782.026367	62552.890625	436519.312500	705341.125000
23 D23	188077.109375	221755.781250	375977.531250	236407.625000	52448.210938	163133.531250	1163878.125000	2401678.000000
24 D24	256102.781250	108583.804688	3752618.500000	643278.875000	321037.562500	695853.187500	6470959.000000	12248434.000000
25 D25	4958.826172	40.261257	1647.639648	1322.860229	1993.108521	17047.693359	40296.578125	67306.968750
26 D26	61252.609375	520867.906250	9818.041992	43187.933594	7420.618164	54840.812500	138023.406250	835411.312500
27 D27	73602.078125	3708420.750000	34354.585938	190245.593750	18297.478516	30835.634766	200799.015625	4256555.000000
28 D28	2349.631348	4922.341309	877.234558	5586.239258	993.848328	6436.979492	15983.724609	37150.000000
29 D29	17309.511719	13.688827	802.590881	13816.955078	2416.199463	23288.609375	36943.050781	94590.609375
30 D30	19316.449219	87090.734375	6843.251465	15221.289063	3571.243896	28790.031250	103049.750000	263882.750000
31 D31	2685.951660	34.624680	2844.677979	3552.504883	14060.576172	14831.644531	217787.765625	255797.750000
32 D32	6833.133789	403.417786	529.353882	2268.826660	854.879639	7634.406738	14604.728516	33128.746094
33 D33	21750.568359	399.391663	782.731567	7134.862793	1031.924561	10254.992188	31014.773438	72369.242188

ViewHAR is able to show you some shares, as well as the actual data. To see this, click the drop-down list boxes near the top left-hand corner of the ViewHAR window, which at present probably says **None** [we call it the **shares list box**]. Select the **row** share.

Q3. What is Bogotá's (D3) share in capital payments to manufacturing (IND)?

Q4. And in agriculture (AGR)?

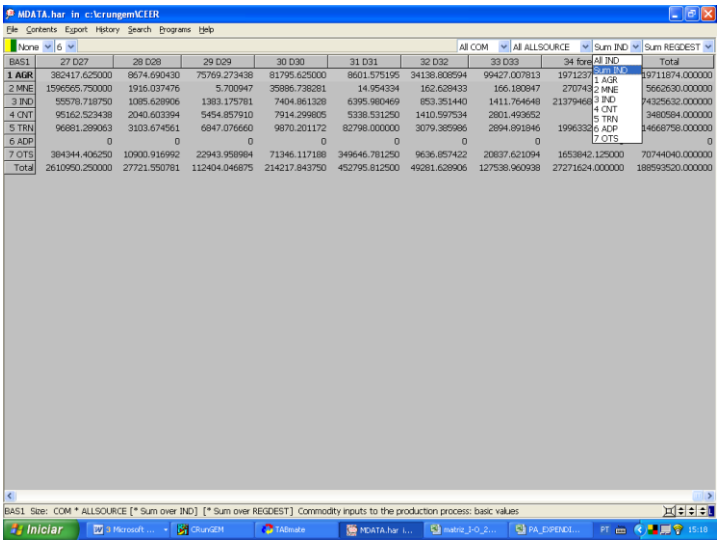
Q5. What is Bogotá's share in the economy-wide payments to capital?

Q6. In which Department the agriculture sector is responsible for the highest share of labor payments?

Q7. Which sector is most capital-intensive in Colombia?

Shares like these are often useful for explaining simulation results.

Now click again on ***Contents*** in ViewHAR's main menu to return to the list of contents. Look at the BAS1 row (array number 1). You can see that this is a 4-dimensional array of size **COMxALLSOURCExINDxREGDEST**. The data at this header is the basic value of commodity inputs to the production process, also measured in millions of 2004 Colombian pesos. To see the actual data, double-click on this BAS1 row. You see a 7x33 matrix of data (plus a totals row and a totals column); the rows have commodity labels and the columns are labelled "D1" up to "D33" plus a 34th column labelled "foreign". These must be the elements of the sets COM (commodities) and ALLSOURCE (source), respectively. What about the 3rd dimension IND and the 4th dimension REGDEST of this data array? The clue is given by the 4 drop-down lists near the top right-hand corner of the screen which say **All COM; All ALLSOURCE; Sum IND; Sum REGDEST** respectively. Because your computer screen is 2-dimensional, what you are seeing are the IND and REGDEST values **summed across sectors and regions**.



BAS1	27 D27	28 D28	29 D29	30 D30	31 D31	32 D32	33 D33	34 fore	Total
1 AGR	382417.625000	8674.690430	75769.273438	81795.625000	8601.575195	34138.808594	99427.007813	1971237	15711674.000000
2 MNE	1596565.750000	1916.037476	5.700947	35886.738281	14.954334	162.628433	166.180847	270743	5662630.000000
3 IND	55578.718750	1085.628906	1383.175781	7404.861328	6395.980469	853.951440	1411.764648	21379468	7432563.2.000000
4 CNT	95162.523438	2040.603394	5454.857910	7914.299805	5338.531250	1410.597534	2801.493652		3480584.000000
5 TRN	96881.289063	3103.674561	6847.076660	9870.201172	82798.000000	3079.385986	2894.891846	1996332	14668758.000000
6 ADP	0	0	0	0	0	0	0		0
7 OTS	384344.406250	10900.916992	22943.958984	71346.117188	349646.781250	9636.857422	20837.621094	1653842.125000	70744040.000000
Total	2610950.250000	27721.550781	112404.046875	214217.843750	452795.812500	49281.628906	127538.960938	27271624.000000	188593520.000000

Q8. What is the total across all sectors of the value of manufacturing goods produced in Bogotá (D3) and sold in César (D9)?

Q9. What is the total across all sectors and across all regions of the value of imported manufactured inputs?

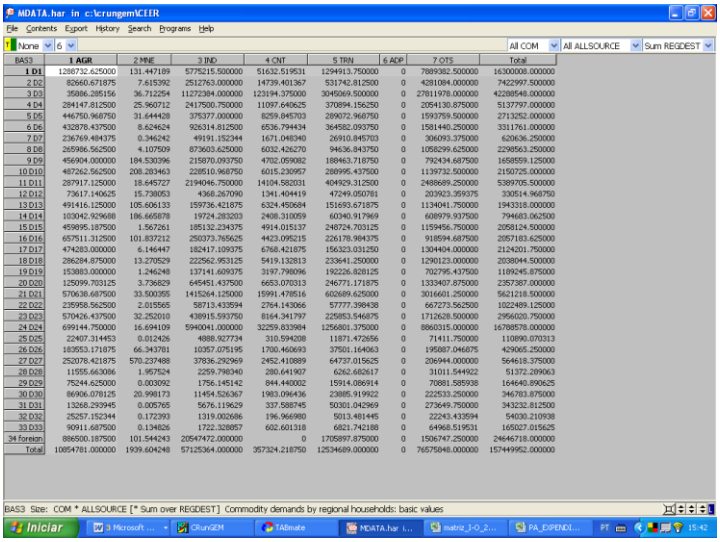
How can you see the value of purchases of one specific input (say IND) by just one sector, for example, other services (OTS), in a given location (e.g. Valle, D24)? To see this, click on the **All COM** drop-down list box near the top right-hand side and select "IND" from the options. Then, click on the **All IND** drop-down list box and select "OTS" from the options. Finally, select "D24" from the drop-down list **All REGDEST**. The data will change and now you are seeing how much is purchased just of manufactured inputs by the other services sector in Valle.

Q10. How much imported manufactured inputs is purchased in Valle by the sector other services?

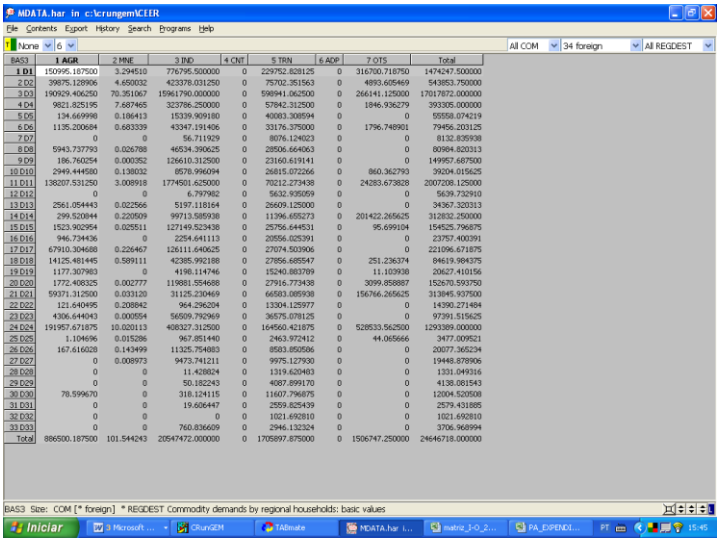
Q11. What are the three main sources of manufactured inputs to other services in Valle?

Q12. And the two main sources of agricultural inputs to Bogotá's manufacturing sector?

Now click again on ***Contents*** in ViewHAR's main menu to return to the list of contents. Look at the rows BAS2, BAS3, BAS4, BAS5 and BAS6. They represent commodity demands by the other users in the CEER model, namely, investors, households, foreigners, regional government, and Central government. Let us take a look at household demand (BAS3). You can see that this is a 3-dimensional array of size **COMxALLSOURCExREGDEST**. There are lots of ways of viewing 2-dimensional slices of a multi-dimensional array.



To see another, click on the **ALLSOURCE** drop-down list box (the 2nd of the three) and select **foreign**, so that only foreign purchases are shown. Now click on the 3rd, **REGDEST**, list box and select **All REGDEST**.



Q13. What is the value of imported agricultural goods consumed by households in Atlántico (D2)?

Q14. What is the total value of imported manufactured goods consumed by Colombian households?

Let's look now at the structure of household consumption embedded in the model. First, click on the **ALLSOURCE** drop-down list box and select **Sum ALLSOURCE**, so that only total purchases are shown. Click on the **REGDEST** drop-down list box and select **ALLREGDEST**. Click on the small yellow rectangle near the top left of the ViewHAR window to transpose the

matrix (exchange rows and columns). From the shares list box, select **row** shares. Now you are seeing consumption shares.

Q15. What do you notice about regional structure of consumption?

Q16. What commodity is responsible for the highest share of household expenses in Colombia?

We saw that all regions have the same structure of consumption. This is a hypothesis used to construct the database of the CEER model. However the model allows for different structures of regional dependence on suppliers. Let's check it!

Q17. What share of household consumption of agricultural goods in Bogotá is supplied by producers within the Capital? And what is the share of agricultural products consumed by households in Antioquia (D1) is supplied regionally?

In the CEER model, domestic output is directed to sales to intermediate use (BAS1), capital creation (BAS2), household consumption (BAS3), exports (BAS4), regional governments (BAS5), and sales to Central government (BAS6). In addition, transportation services (TRN) are also consumed as a margin-commodity, used to facilitate trade between origin-destination pairs. Total sales for margin usage, by different users, are found in the arrays MAR1, MAR2, MAR3 and MAR4. Notice that there is no margin consumption associated with the consumption of public goods.

To answer the following questions, you may use Excel to help you. You can easily copy from ViewHAR and paste to Excel. Note in the main menu that you can decide whether or not to export details from the arrays [***Export* |*Options (labels, totals)***].

Q18. Which sector has the highest export share in the country?

Q19. Which sector sells the greatest proportion of its output to households?

Q20. And which is most investment-oriented in its sales pattern?

Q21. What is the total output of transportation? Do not forget to add margin sales!

Q22. If exports of agriculture increased by 10%, what would be the percent increase in agriculture output (assuming other sales unchanged)?

Q23. What might happen to manufacturing output if its exports went up 10%?

Just to refresh, answer the following:

Q24. Which sector uses the greatest proportion of imports in its material inputs?

Sector	*Import share*
AGR	
MNE	
IND	
CNT	
TRN	
ADP	
OTS	

Q25. And which final demander?

Sector	*Import share*
Investors	
Households	
Exports	
Regional government	
Central government	

Now close the ViewHAR window by selecting ***File | Exit*** from ViewHAR's (not RunGEM's) menu.

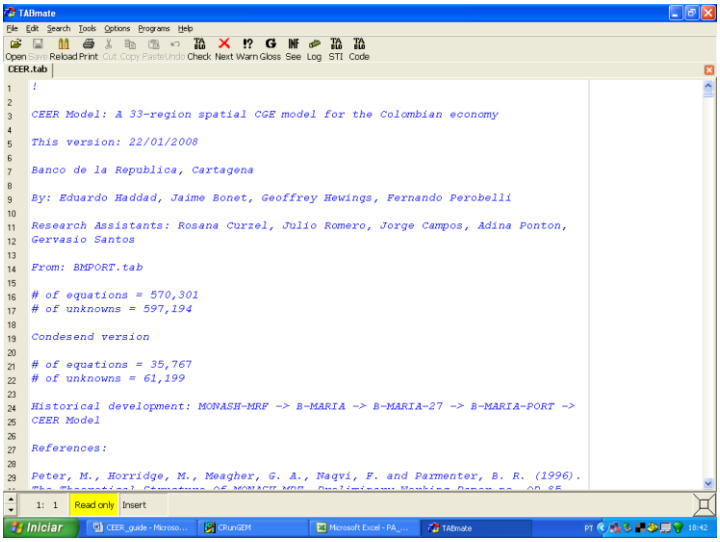
Binary files (such as Header Array files) cannot be looked at in a text editor. To see this, select ***View | Other Text File*** from RunGEM's main menu and select CEER.HAR (the data file). RunGEM tells you that it is unable to open this as a text file (and even suggests that you try to open it with ViewHAR).

5. Looking at the TAB file[3]

To see the model equations use the **View** menu item at the top of the **RunGEM** window and select

View | Main TABLO file

[3] The term **TAB file** is shorthand for **TABLO input file**.



A text editor will appear, with the file CEER.TAB visible. This will probably be the TABmate editor used by GEMPACK. It will be in read-only mode, so that you cannot change the TAB file. The TAB file uses the TABLO language to specify the equations and variables of the CEER model.

TABmate colours items in the TAB file according to their function:

- black for words that are part of the TABLO language;
- green for variables and other items that are specific to this model;
- blue for comments which GEMPACK ignores;
- *italics* for strings that GEMPACK uses as labels or descriptions.

You might also see line numbers in the left hand margin.

Now search for MDATA. Select ***Search | Find...*** from the editor's menu, type in "MDATA", and click **OK** (or press Enter). To search again after you have found the first occurrence, you can either again click OK, or you can close the Search dialog and touch the **F3** key (near the top of your keyboard). Close the Search dialog and press **F3** to see the first 3-4 occurrences of MDATA. You will see that various pieces of data are read from this file. [Note: where several Read statements occur together, the keyword "Read" is only needed for the first Read statement in the group.]

Click in the word MDATA, then click the button above marked **Gloss**. A window will appear, showing each line that contains that word. Line numbers appear in red – you can click on these red numbers to go to that line. Click to go to the line where **LAB_OCC_IND** is read from file.

You will see that the matrix LAB_OCC_IND is read from the header "LABR". The **header** is a short key (up to 4 letters) which identifies the location of LAB_OCC_IND, within the MDATA file (in fact you previously used ViewHAR to examine the values of LAB_OCC_IND in that

file). Now click in the word LAB_OCC_IND, then again click the **Gloss** button to see all occurrences of it. You will see that LAB_OCC_IND is declared as a **COEFFICIENT** and that it holds the value of labor payments. It is used in numerous equations and formulae. Click on the line number for equation E_p0a (zero pure profits in current production) to go there. Click on the word "Equation" and press **Gloss** again. This time you get a list defining all the variables and coefficients in the equation. Press spacebar to close the Gloss window.

You have learned two ways to use the **Gloss** button:

- click on a variable, coefficient or filename: **Gloss** shows every occurrence of that symbol;
- click elsewhere in a statement: **Gloss** shows the first occurrence of each symbol used there.

Both techniques can be very useful to find your way about the TAB file.

Now close TABmate (click the X button at top right of window) and return to RunGEM

6. Running a *numéraire* simulation

In this simulation the usual *numéraire*, **natphi** (the exchange rate), is increased by 10 per cent.

For simulations, the last pages **Closure - Shocks - Output files - Solve - Results** are usually accessed in that order (from left to right).

First click on the **Closure** page of RunGEM. You will see a list of the exogenous variables in the currently selected closure. You can choose between several different closures when running a simulation. The panel below shows which variables are exogenous in the selected closure. RunGEM allows you to load different closures already prepared.[4] To see this, use the **Load Closure** button to load the **SHORTRUN** closure file. Notice that **natphi** is one of the exogenous variables.

Now go to the **Shocks** page. Click on the **Clear Shocks List** button to remove whatever shocks are shown. Now you will specify a shock to variable **natphi**. To do this, click on the **down arrow** to the right of the label **Variable to shock** near the top of the Shocks page. A drop-down list of all the exogenous variables in this standard closure will appear. Click on **natphi**. A new edit box entitled **% Change Shock** will appear. Click in this and type in **10**. Then click on the button **Add to Shock List**. The line

Shock natphi = 10;

should appear in the Shocks memo which occupies the bottom half of the Shocks page. This is the only shock for the *numéraire* simulation.

[4] You can also edit the closure shown on the Closure page, and can save this edited closure.

Have a look at the **Output files** page. It controls the names of output files produced by the simulation. Don't change anything now. Go to the **Solve** page of RunGEM.

1 First click on the topmost **Change** button (the one with **Solution method** before it). Click on **Johansen** to select Johansen's method. You will learn more about the different solution methods available later in this document.

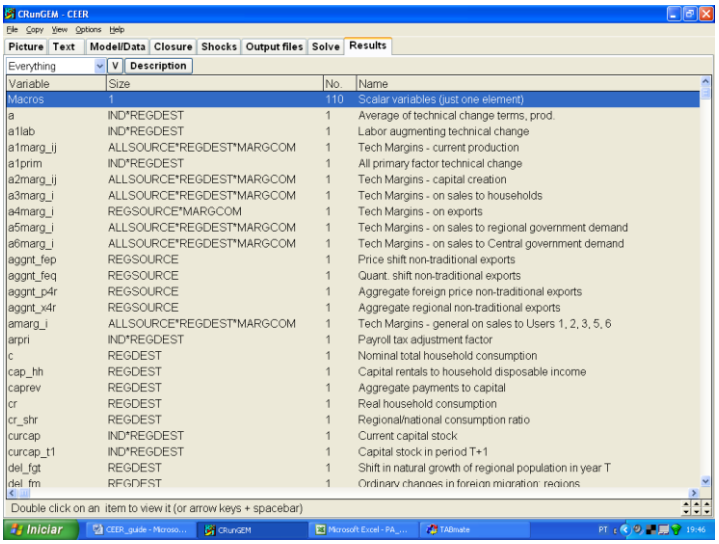
2 If it is not already there, insert the text **Numéraire simulation** in the text box labelled **Verbal description**.

3 Now click on the **Solve** button. A "Please Wait" window will appear while the model is solved. Then RunGEM will show you a box telling you how long the solution took. Just press OK.

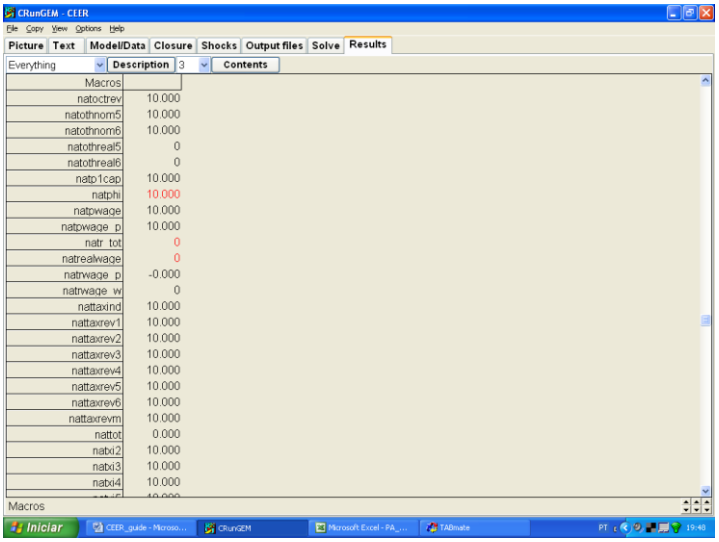
The next natural step is to look at the results.

7. Looking at the results

Click on the Results page of RunGEM. This page allows you to inspect the variable values computed during the **last** successful solution process. You will see the Contents page listing many of the variables of the model. The first row, **Macros**, refers to the rows which have no subscripts (i.e., just one element). The other rows correspond to individual vector and matrix variables. Slowly move the mouse pointer (without clicking) over the various buttons and controls to get a hint about their purpose.



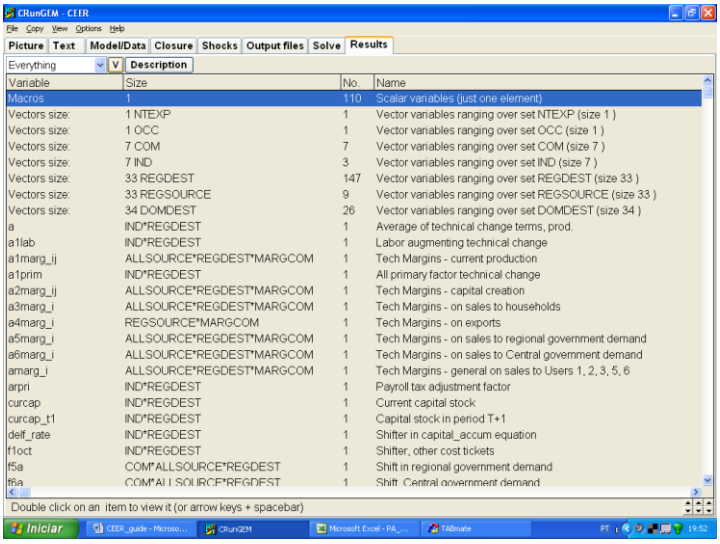
Double-click on the **macros** row to see the results for these variables. Select 3 decimal places.



Exogenous variables are shown in red, including the shocked variable, **natphi**. Notice that all the quantity variables are unchanged (zero), while variables measured in currency units such as prices and values have all increased by 10%. In other words, the single exogenous price (called *numéraire*) serves to determine the absolute level of prices but does not affect relative prices or, therefore, the behaviour of any agents.

Click the **Contents** button to return to the contents list.

To see the effects of another useful way of listing the variables in the **Contents** page, click on the **V** between the two drop-down list boxes near the top of the screen. You should see something like:



To see the results for all variables with a single argument ranging over the set **IND**, double-click on the fifth of the rows above (Vectors size: 7 IND). This time you will see the percent-change results for the 3 such variables (**natlabind**, **naty** and **natz**). When you have finished

looking at these results, double-click on any number to return to the Contents list. Return to the other view of the Contents list by clicking again on the **V** button.

Q26. Which variable shows percentage changes in industry output (activity level)?

7.1. Looking at the updated data

As well as producing percent change simulation results, the simulation above produced an updated version of the MDATA file for the model (and also for YDATA, NDATA, and PDATA). This updated database reflects the state of the economy as it would be after the shock (10 per cent increase in the *numéraire*). You can see this updated data by selecting

View | Updated Data | Updated MDATA

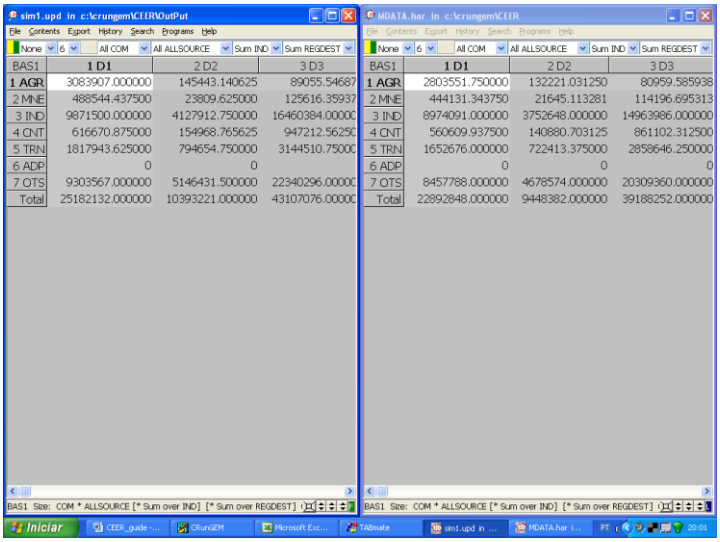
from the RunGEM menu. As usual, RunGEM opens ViewHAR to show you this data set. Double-click on the first Contents row (BAS1). You should see the values of intermediate consumption of inputs from different sources, summed over all sectors and destination regions. Now click **(carefully**) in the **left** side of the button near the bottom right-hand corner of the ViewHAR window, to make this occupy just the **left** half of the screen.

Now, for the original (pre-simulation) version of this data, go back to RunGEM and select

View | Input Data | Original MDATA.

Again double-click to select the **USE** data and this time click carefully on the **right** side of the button to make this ViewHAR occupy the right-hand half of your screen.

Then (via the **Taskbar** or **Alt+Tab**), bring the other ViewHAR window (the one in the left hand half of the screen) to th’’e top.



When you have got both the original and the updated data side-by-side on your screen, take a moment to pat yourself on the back. You are truly a Windows wizard! Now look at a particular cell, say that corresponding to the value of intermediate usage of agriculture product from Antioquia (the top-left cell). Think what has happened to prices and to quantities in this simulation, and hence deduce what must have happened to values. Check that the pre- and post-simulation BAS1 values are consistent with this.[5] You might like to repeat this for some other cells in this or other headers. Close the two ViewHAR windows when you are finished.

Remember that the flows in the updated data are measured in terms of post-simulation prices. By comparing original and updated data, we can make deductions about values, but not about quantities.

8. Simulating the short-run effects of a drought in Antioquia

Most years, one or more regions of Colombia suffer from low rainfall. As a continuing result of climate change, during 2008 an unusually severe drought in Antioquia is expected to affect farmers all over the Department. Agricultural outputs will fall sharply. We simulate the effects of such a drought using the CEER model. Questions are scattered through the instructions. Write down answers to the questions onto the instruction sheet.

The simulation in the next example is one in which the shock is a

10% decrease in technical efficiency

Now look again at the TABLO Input file for the CEER model.

Search | Find for the variable name **a1**. The first occurrence is the variable definition:

```
(all,j,IND)(all,q,REGDEST)
a1(j,q) # All input augmenting technical change #;
```

The "(all,j,IND) (all,q,REGDEST)" means that **a1** is a vector variable with one value for each sector in each region. Click on **a1** and press the ***Gloss*** button (at top middle of the screen). You can see that a1prim appears in 4 equations: the three demand equations E_x1o, E_x1oct and E_x1prim, and later on the long E_a equation. Click on the red line number at left of equation E_x1o and you should see:

[5] You should be able to confirm that the post-simulation value is exactly 10% greater than the original value. Right-click on the original value. A small window should appear: click first the **Copy** button, then the **Close** button. This puts the number in the Windows clipboard. Now use ViewHAR's **Help...Calculator** menu command to launch the Windows calculator, then **Edit...Paste** to enter in the number from ViewHAR. Multiply by 1.1 (***1.1=**) and you should see the same number as in the updated data. You can also do this in Excel.

```
E_x1o # Demand for dom./for. composite inputs, User 1 #
(all,i,COM)(all,j,IND)(all,q,REGDEST)
x1o(i,j,q)=z(j,q)+a1(j,q);
```

Click on the = sign in the equation above and press the **Gloss** button to see a definition of each symbol that is used.

The terms "(all,i,COM)(all,j,IND)(all,q,REGDEST)" mean that Equation E_x1o is actually a group or block of equations: there is one equation for each "commodity composite"[6] used by each industry in each region. So if there were 7 commodities, 7 industries and 33 regions in the database there would be 1617 (=7*7*35) separate equations. Each of the variables **x1o**, **a1**, and **z** is a percentage change: if **z("IND","D3")** had value 5, that would mean that output of the manufacturing sector in Bogotá would be 5% greater than in the initial equilibrium described by the input data files. The "a" variables are technological change variables, normally exogenous (values fixed outside the model). Suppose output were fixed (**z**=0), a shock of 10% to **a1("IND","D3")** would mean that for each commodity c, the values of **x1o(c,"IND","D3")** must also increase 10% to keep the equation balanced. If you looked at the other equations where **a1** appears, you would find that a shock of 10% to **a1("IND","D3")** would mean that 10% less of *all* inputs were needed to produce a given IND output in Bogotá [note: positive **a1** implies technical *regress*].

Press ESC or spacebar to close the Gloss window.

Exit from TABmate in the usual Windows way by ***File | Exit.*** (There are usually alternatives in terms of keystrokes instead of the mouse action. For example you can use keystrokes ***Alt*** followed by ***F*** followed by ***X*** in order to exit.)

8.1. Implementing the shock

Start up RunGEM with the CEER model. Go to the ***Closure*** page. As in the previous example, use the ***Load closure*** button to select the **SHORTRUN** closure. Notice that the variable **a1** (all input augmenting technical change) is exogenous.

In this simulation we shock the variable **a1** to increase by 10% for the agricultural sector (**AGR**) in Antioquia (**D1**). **a1** is a measure of overall technical efficiency – the 10% means either that with inputs held constant output will be 10% less, or that 10% more inputs will be needed to produce the original output. This shock is used to simulate the main effect of the drought: agricultural productivity in Antioquia is reduced.

[6] An example of a "commodity composite" might be mining used by the manufaturing industry. Mining is potentially a mixture of local and imported mining products, so we call it a "dom/imp composite".

Go to the ***Shocks*** page and delete any existing shocks by clicking **Clear Shocks List**. Then specify the shock as follows:

1 Use the combo box[7] at the top to choose which **variable to shock**: click on the arrow at the right. This will show you a list of variables. Click on **a1**. This variable has dimensions **INDxREGDEST**.
2 Select the elements to shock: from the **ALL IND** drop-down list box choose **AGR**. And from the **ALL REGDEST** list box, select **D1** (Antioquia).
2 In the edit box labelled **value of shock**, type 10, meaning a 10% decrease in primary factors technical efficiency in the agriculture sector in Antioquia. Then click the ***Add to shock list*** button.

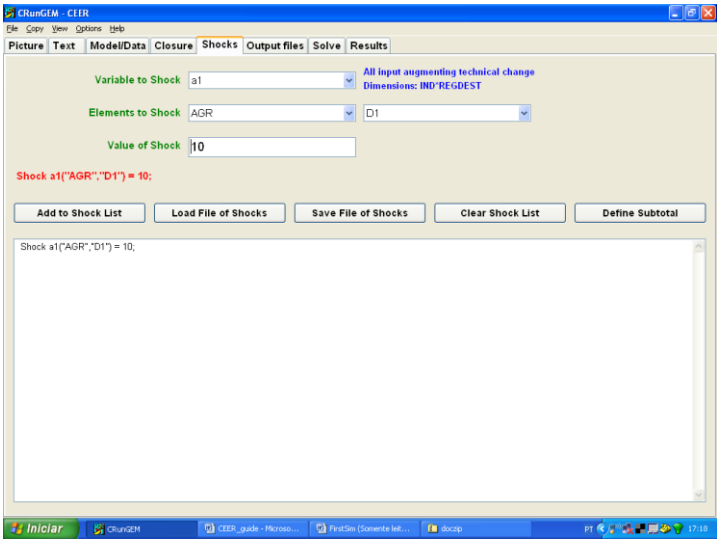
In this simulation, only one variable is shocked. If you wanted more shocks you would repeat steps A and B for each variable that was to be shocked.

The shock list underneath should now contain:[8]

Shock a1("AGR","D1") = 10;

You may edit it directly if necessary

.



When you have finished with the shocks, go to the Output Files page.

8.2. Choosing a special name for output files

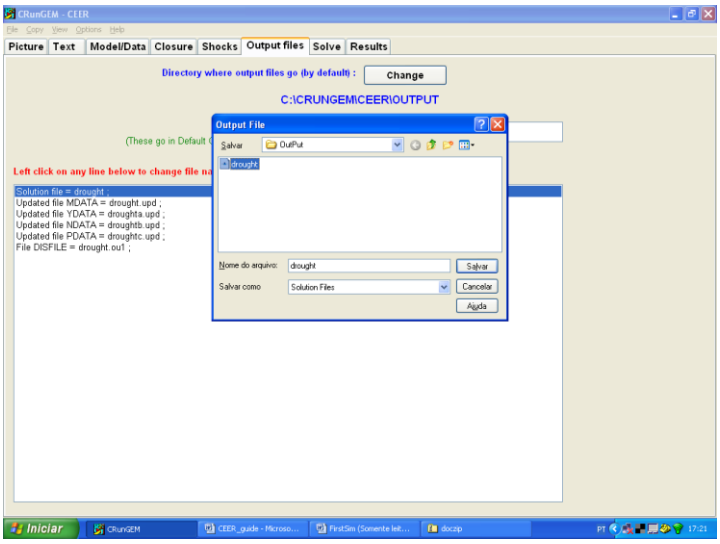
[7] A **drop-down list box** is also called a **combo box**.

[8] If the variable ***a1*** does not appear in the combo box (in case it has been omitted in this version of the model), shock the variable ***a1prim*** instead (*Shock a1("AGR","D1") = 10;*). The difference is that ***a1prim*** is a measure of factor efficiency only.

Later, we want you to compare the solution file from this simulation with another solution file. If you want to preserve solution files for later reference, you have to give a unique name for simulation output files. To do this, go to the Output Files page, and click on the line beginning

solution file =.

A file dialog will appear; type in a new name. This time, type **drought.SL4** [the suffix SL4 is compulsory]. Then click Save.



When you have set the name for output files, go to the Solve page.

8.3. Choosing the solution method and running the simulation

From the Solve page:

1 First select the solution method to use. To do this, you would need to click on the ***Change*** button to the right of the **Solution method** label. [This button is the top-most button on the page.] Do not change the solution method this time. In the ***Method*** part select **Euler.** [We will discuss the alternative methods later.]

2 Next notice the ***Verbal description*** label and the edit box to its right. It is good practice to enter a few words summarizing the simulation you are about to carry out. So first select the existing entry with your mouse and then replace it by

   10% decrease in productivity in the agricultural sector in Antioquia

3 Now click the Solve button to start the solution process.

RunGEM runs the TABLO-generated program CEER.EXE to solve CEER.

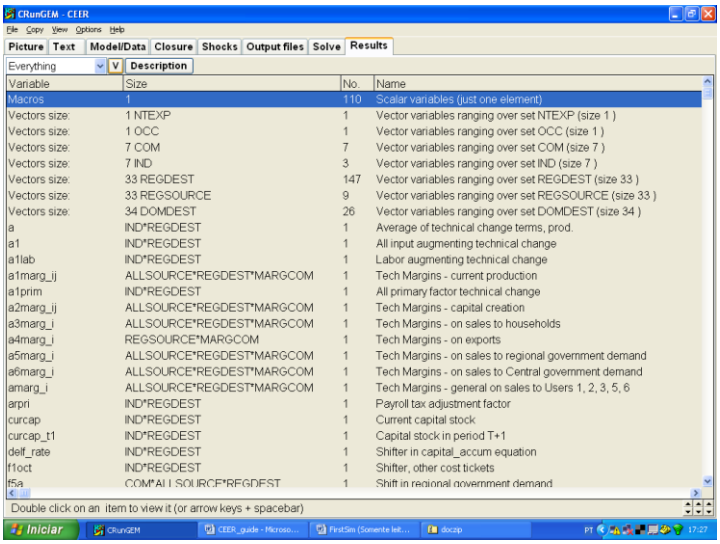
Once it has solved, RunGEM displays an accuracy summary chart showing how many variables are accurate in the levels to 1, 2, 3, 4, 5, or 6 figures. A little face summarizes overall accuracy – hopefully it is smiling. Accuracy of the updated data is summarized in the same way. Click **Help** to learn more, then **OK** to proceed. Another message now tells how long the solution took.

8.4. Looking at the results

When the solution has been obtained, RunGEM will present you with a box telling you how long it took to obtain the solution. Close this and go directly to the ***Results*** page.

This page allows you to inspect the variable values computed during the **last** successful solution process. Initially a **Contents** window is displayed, listing the model variables. You can double-click on the row containing the variable you are interested in to see its results in this simulation. As you saw previously, you can also use the button marked **"V"** to arrange the contents list in two ways:

- variables listed individually;
- variables ranging over the same set grouped together.



You can also look at the results using ViewSOL. First click on the button

View | Solution via ViewSOL

The Contents screen shows the names of the variables. To see the values of a variable, double-click on its name. To return to the Contents screen, double-click on any number (or select Contents in the ViewSOL menu).

Start by double clicking on the first Contents row: **Macros** (Macros are scalar variables or

variables with just one component). You should see a list of macro variables and the value of their changes. You can click on the variable names – a description will appear at the bottom of ViewSOL . Use the decimal places combo box at top right to set the number of decimal places to 3.

Most of the variables are percentage changes, but some are ordinary changes, measured in million-pesos. Values for exogenous variables are shown in red. Scroll down the list to find price indices, nominal values, and quantity indices.

Q26. Write down below what happened to:

natexpvol: export volumes
natgdpreal: real GDP from expenditure side
natemploy: national employment
natimpvol: import volume
natxi4: exports price index
natxi3: consumer price index
natpwage: aggregate nominal wages to workers

Double-click on any number to return to the Contents screen. Then scroll down till you find the variable **natz** (activity level). Double-click to view the numbers.

Q27. Which non-agricultural industry was most affected?

Return to Contents and view regional results for:

x4r: export volume
xi3: regional consumer price index

Q28. Compare the results for **dompq110** (private consumption) and **hhldy000** (disposable income). What do they suggest? Can you find in the CEER.TAB file the relevant equation?

Q29. Look at the results for **yr_r** (real GRP), **l** (aggregate employment) and **z** (activity level by sector). Which Department is the main loser? Which Departments gained in real GDP terms? Can you think why?

8.5. Changing the solution method

In this example, you will tell RunGEM to solve the model using Johansen's method. With Johansen's method, only approximate solutions are obtained to the nonlinear levels equations of the model. GEMPACK also provides multi-step solution procedures referred to as **Euler's** and **Gragg's solution methods.** Coupled with **extrapolation** (a standard numerical method used in various branches of science and engineering), these are able to provide accurate solutions of the

levels equations of the model, as was the case in the example above.

To change the solution method in RunGEM go to ***Solve*** and click on the ***Change*** button to the right of the **Solution method** label. [This button is the top-most button on the page.] In the ***Method*** part select **Johansen**. Then click ***Ok***, and go to the Output Files page.

8.6. Choosing a special name for output files

Later we want you to compare results from this simulation with those from the previous simulation that used the **Euler** solution method. This means that you must specify a unique name for the output files that the next simulation will produce. To do this, go to the Output Files page, and click on the line beginning **solution file =**. A file dialog will appear; type in the name droughtj.SL4. Then click Save.[9]

8.7. Running the Johansen simulation

Now go to the ***Solve*** page and click the ***Solve*** button. A "Please Wait" window will appear while the model is solved. Then RunGEM will show you a box telling you how long the solution took. Just press OK.

8.8. Using ViewSOL to compare two sets of results

The RunGEM Results page lets you see only the most recently-computed solution. Sometimes you want to view 2 solutions at once. You can do that using the ViewSOL program which comes with RunGEM.

We assume that RunGEM is open and you have just successfully completed the steps described in previous sections.

Now select the menu item ***View | Solution via ViewSOL***. The ViewSOL program will open the most recent solution[10] and show a Contents page. In general, ViewSOL works very like the **Results** page of RunGEM. For example, you can double-click on a variable to see its values.

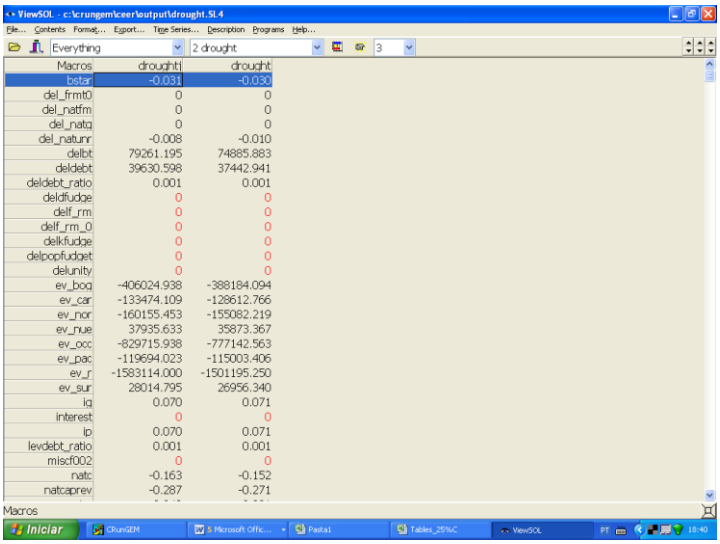
Now, use the ViewSOL menu command ***File | Open*** to open the solution file **drought.SL4**. This ought to contain results from the previous, Euler 1-2-4, simulation.

ViewSOL Contents will again appear. ViewSOL offers a choice of formats for this Contents list. Select ***Format.*** from ViewSOL's main menu and there click on ***Arrange vectors by name*** (in the panel headed Vector options); also click the button ***Order Variables alphabetically***; then click ***Ok*** which will put you back to the Contents list. Now double-click on the **macros** row and you should be able see both solutions together.

---

[9] If you do not give a new name for the SL4 file, RunGEM uses the same name as before, and so overwrites the previous solution file. This might be annoying! You can use Explorer to delete files in the Output directory (maybe to save disk space).

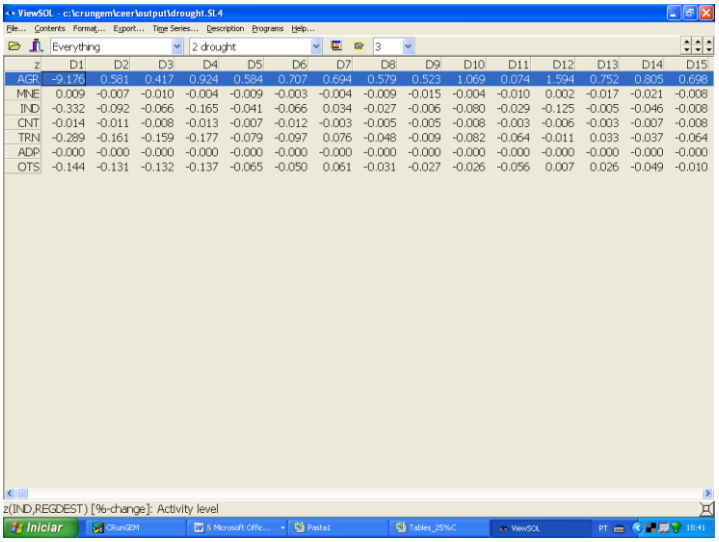
[10] ViewSOL displays a short quotation (either inspiring or corny) while it is loading the solution file.



Macros	drought1	drought
bstar	-0.031	-0.030
del_frmt0	0	0
del_natfm	0	0
del_natq	0	0
del_natunr	-0.008	-0.010
delbt	79261.195	74885.883
deldebt	39630.598	37442.941
deldebt_ratio	0.001	0.001
deldfudge	0	0
delf_rm	0	0
delf_rm_0	0	0
delkfudge	0	0
delpopfudget	0	0
delunity	0	0
ev_boq	-406024.938	-388184.094
ev_car	-133474.109	-128612.766
ev_nor	-160155.453	-155082.219
ev_nue	37935.633	35873.367
ev_occ	-829715.938	-777142.563
ev_pac	-119694.023	-115003.406
ev_r	-1583114.000	-1501195.250
ev_sur	28014.795	26956.340
ig	0.070	0.071
interest	0	0
ip	0.070	0.071
levdebt_ratio	0.001	0.001
miscf002	0	0
natc	-0.163	-0.152
natcaprev	-0.287	-0.271

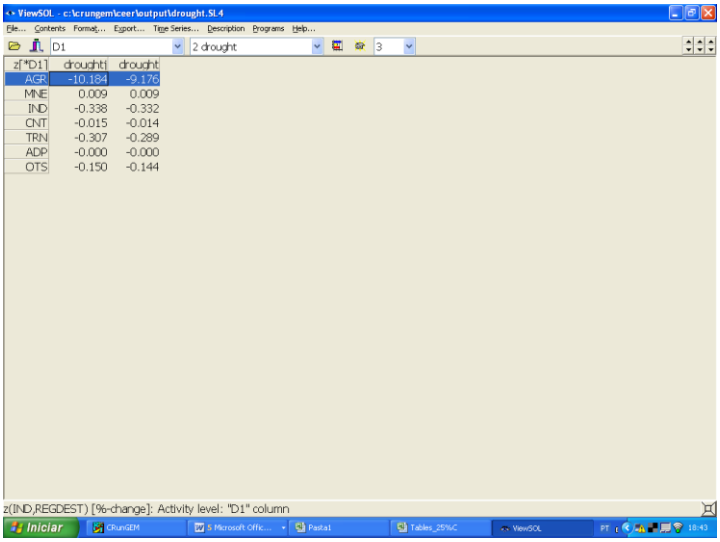
Q30. Do you think that the differences between Johansen and Euler solutions are significant?

Go back to the ViewSOL contents list and double click on the row for **z**, a matrix variable (this will be near the end of the contents list). This time you will only see results for one simulation. But you can use the **solution list box** (see picture) to switch between the two solutions. The Description menu item gives details of the currently selected solution.



z	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
AGR	-9.176	0.581	0.417	0.924	0.584	0.707	0.694	0.579	0.523	1.069	0.074	1.594	0.752	0.805	0.698
MNE	0.009	-0.007	-0.010	-0.004	-0.009	-0.003	-0.004	-0.009	-0.015	-0.004	-0.010	0.002	-0.017	-0.021	-0.008
IND	-0.332	-0.092	-0.066	-0.165	-0.041	-0.066	0.034	-0.027	-0.006	-0.080	-0.029	-0.125	-0.005	-0.046	-0.008
CNT	-0.014	-0.011	-0.008	-0.013	-0.007	-0.012	-0.003	-0.005	-0.005	-0.008	-0.003	-0.006	-0.003	-0.007	-0.008
TRN	-0.289	-0.161	-0.159	-0.177	-0.079	-0.097	0.076	-0.048	-0.009	-0.082	-0.064	-0.011	0.033	-0.037	-0.064
ADP	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
OTS	-0.144	-0.131	-0.132	-0.137	-0.065	-0.050	0.061	-0.031	-0.027	-0.026	-0.056	0.007	0.026	-0.049	-0.010

Now use the Filtering list box to select only the **D1** (Antioquia) component of matrices. This takes you back to the contents screen. Double-click on the **z[*,D1]** row (probably the last row). You should see results for the Euler and Johansen simulations side-by-side:



When you have finished looking at the results, exit from ViewSOL.

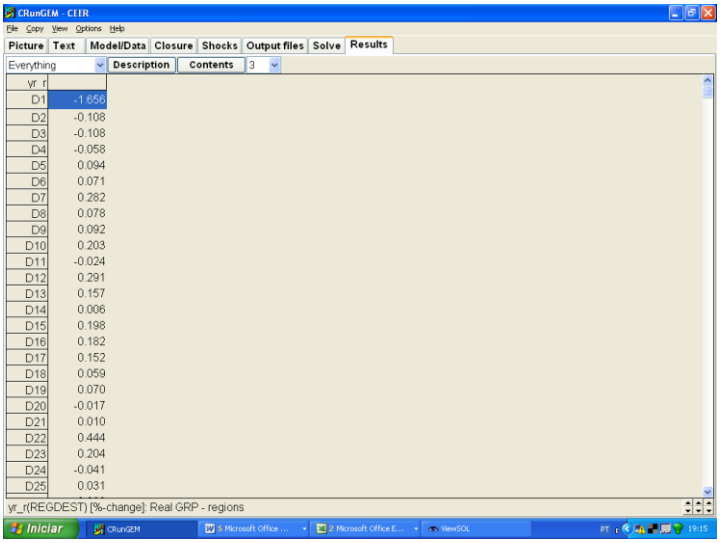
8.9. Copying results into a spreadsheet

RunGEM makes it easy for you to copy simulation results (or data) into other windows programs such as spreadsheets or word processors. You will find this invaluable when you are preparing reports.

As an example, below we set out the simple steps needed to copy the **yr_r** results from the previous simulation into Excel (or another spreadsheet).

Go to the Contents page of the ***Results*** and then select the **yr_r** results

You should see something like:



Now click on ***Copy*** from RunGEM's main menu. A message **Data copied to Clipboard** will appear for a moment.

Now start Excel (or your favourite spreadsheet program) running. In a new sheet, click on the top left-hand cell and then select ***Edit | Paste*** from the main menu. You should see the above table appear in Excel. Note that the number of decimal places selected in RunGEM affects the exact numbers copied.

[If you want to check whether there is a correlation between regional performance in terms of GRP and the share of agriculture in total GRP, as suggested in Q29, open the file **Shares.xls** and create a scatter plot using the appropriate variables].

Close Excel.

In ViewHAR and ViewSOL, the **Export** command lets you copy data to Excel in just the same way.

When you have finished looking at the results, exit from RunGEM and other related programs.

9. An experiment with more complicated shocks: trade liberalization in Colombia

General equilibrium modellers need to explain their results. A general equilibrium model has various main mechanisms that produce the results. The modeller is required to identify and quantify the mechanisms that are important for a particular simulation. To analyse the results in this way, the modeller must bring together details of several different information sources: the equations of the model, the base data, consequences of that data such as totals and shares, and the simulation results (percentage changes or ordinary changes). For this exercise, you can find the story behind the simulation in the companion paper "Spatial Aspects of Trade Liberalization in Colombia: A General Equilibrium Approach", by Haddad, Bonet, Hewings and Perobelli.

This section presents another example with the CEER model: a tariff cut simulation. The example is presented as exercises for the reader to follow.

9.1. Preparing the shock file

The simulation shows the short-run effects of a 25% across-the-board reduction in the tariff rates on imported goods. Tariff rates are set by the Central government in Colombia, so that they vary only across products in the CEER model.

Trade liberalization is an important element of the range of structural changes foreseen by the Colombian government. To explore the effects of such policies, the CEER model is used to simulate the impacts of tariff changes in the Colombian economy. The model is applied to analyze the effects of a uniform 25% decrease in all tariff rates. All exogenous variables are set equal to zero, except the changes in the power of tariffs, i.e., one plus the tariff rates, which were set such that the percentage change decrease in each tariff rate was 25%.

To calculate the size of the shocks, we need to know two important pieces of information in the original database.

Q31. What are the total basic values of imported goods in the Colombian economy? We will need the totals, by product, across different users.

Q32. What is the total tariff revenue, by product?

Q33. What are the implicit tariff rates in Colombia in 2004?

Product	*Basic value of imports (Q31)*	*Tariff revenue (Q32)*	*Tariff rate (Q33)*
AGR			
MNE			
IND			
CNT			
TRN			
ADP			
OTS			

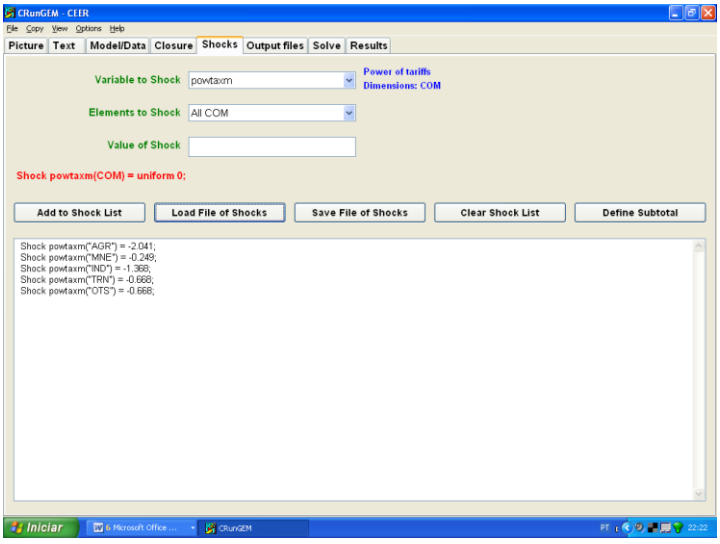
In the CEER model, tariffs are treated as ad valorem on basic values, with the tariff variables **powtaxm** in the linearized model being percentage changes in the powers of tariffs (the power of a tariff is one plus the ad valorem rate).

The details of the shock sizes are contained in the file TARF.SHF.

9.2. Implementing the shocks and running the simulation

Start up RunGEM with the CEER model. Go to the ***Closure*** page. As in the previous example, use the ***Load closure*** button to select the **SHORTRUN** closure. Notice that the variable **powtaxm** is exogenous:

Then go to the ***Shocks*** page and delete any existing shocks by clicking **Clear Shocks List**. Then specify the shocks as follows: click on **Load File of Shocks** and select the previously prepared shock file **tarf.SHF**.



The shock list underneath should now contain:

Shock powtaxm("AGR") = -2.041;
Shock powtaxm("MNE") = -0.249;
Shock powtaxm("IND") = -1.368;
Shock powtaxm("TRN") = -0.668;
Shock powtaxm("OTS") = -0.668;

When you have finished with the shocks, go to the Output Files page. There, click on the line there that begins **solution file =**. In the file dialog; type in the name **tarfsr.SL4**. Then click Save.

Now go to the ***Solve*** page:

- First select the solution method to use. To do this, click on the ***Change*** button to the right of the **Solution method** label. In the ***Method*** part select **Euler** and then make sure that you have **3 solutions** and **1,2,4 steps**. [Select these if they do not become selected after you click on "Euler"]. Check also the radio button **Automatic Accuracy**. Then click ***Ok***.
- Next notice the ***Verbal description*** label and the edit box to its right. It is good practice to enter a few words summarizing the simulation you are about to carry out. So first select the existing entry with your mouse and then replace it by

  25% across-the-board tariff cut

- Now click the ***Solve*** button to start the solution process.

RunGEM runs the TABLO-generated program CEER.EXE to solve CEER.

9.3. Looking at the results

When the solution has been obtained, RunGEM will present you with an accuracy summary and a box telling you how long it took to obtain the solution.

Once it has solved, RunGEM displays an accuracy summary chart showing how many variables are accurate in the levels to 1, 2, 3, 4, 5, or 6 figures. A little face summarizes overall accuracy – hopefully it is smiling. Accuracy of the updated data is summarized in the same way. Click **Help** to learn more, then **OK** to proceed.

Another message now tells how long the solution took. Click **OK** then select ***View | XAC*** file. TABmate will show you the Extrapolation Accuracy File where you can see the effect of the solution method and the extrapolation. To be specific, search for **natxigdp** (GDP price index, expenditure side). This row of the XAC file is

```
-0.190474  -0.190402  -0.190365  -0.190329     CX 5  L6
```

Here the results are respectively the 1-step (-0.190474), the 2-step (-0.190402), the 4-step (-0.190365) and the extrapolated result (-0.190329), with two sub-intervals. The notation CX 5 means that you can be **C**onfident in the e**X**trapolated result (this is the CX) and you can be confident that at least 5 of the figures (that is, at least the -0.1903 part) in the extrapolated result are accurate. The L6 means that at least 6 figures in the corresponding levels result (as distinct from the percent-change result) are accurate.

Close this and go directly to the ***Results*** page.

Look first at the results for **powtaxm** (power of tariffs). Check that the relevant components of the variable were indeed shocked.

Then look at the macro results.

Q34. What variable is the *numéraire* in this simulation? The exchange rate (**natphi**) or the CPI (**natxi3**)?

Q35. What was the effect on the variables listed below?

Real GDP
Real Household Consumption
Activity Level
Employment: Persons
Unemployment Rate (% point change)
Nominal Wage Paid by Producers
GDP Price Index
Consumer Price Index
Export Volume
Import Volume
Balance of Trade (percentage of GDP)

Q36. As expected, the tariff cut caused imports to increase – all bad for GDP. Yet, employment and real GDP expanded – why?

Look over the real GRP results (**yr_r**).

Q37. Which regions are the main losers and gainers? Can you say anything about the short-run effects of trade liberalization on regional inequality?

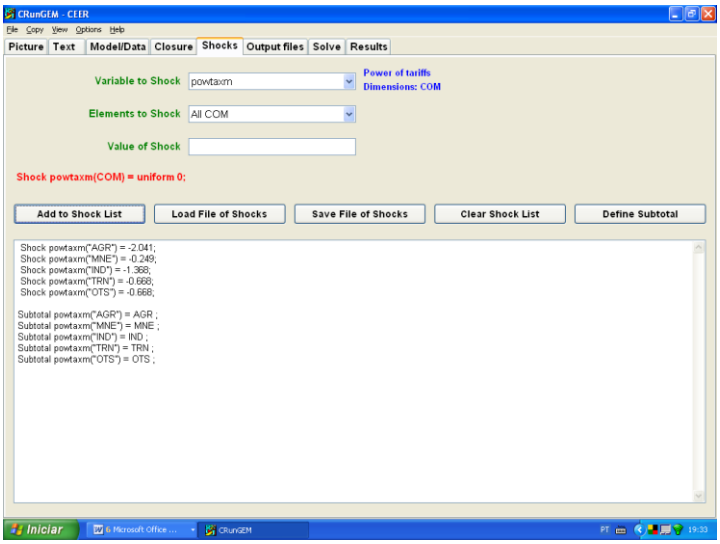
9.4. Using Subtotals to divide up the effects of the shocks

If your simulation involves several different shocks, GEMPACK offers you a very powerful facility known as "subtotals". This allows you to divide the total change in any endogenous variable between the various shocks.

Try it out using the tariffs reduction described above [if necessary, use **Load file of shocks** on the Shocks page to reload the tarf.SHF shock file that you saved, and rerun the simulation]. Go to the ***Shocks*** page and carefully type the following three lines underneath the list of shocks:

Subtotal powtaxm("AGR") = AGR ;
Subtotal powtaxm("MNE") = MNE ;
Subtotal powtaxm("IND") = IND ;
Subtotal powtaxm("TRN") = TRN ;
Subtotal powtaxm("OTS") = OTS ;

Then go to the ***Solve*** page and click the ***Solve*** button**.**



When the solution has been calculated, examine the macro results. You should see 6 columns of numbers. The first column shows the same changes that were calculated before. The next 5 columns show how much of the total change in each variable may be attributed to the exogenous increases in, respectively, tariff reduction on imported agricultural goods, mining goods, manufactured goods, transportation services, and other services. Click on the *Description* button above the results to verify this.

The subtotals columns show that the manufacturing (IND) shock accounts for most of the change. The last 2 columns are rather similar, except that the liberalization of services has slightly stronger impacts than liberalization of transportation services. Finally, the results associated with the mining sector are practically irrelevant.

Q38. Which kind of liberalization produces the biggest impact on national GDP?

Q39. In relative terms, which region benefits most from liberalization of agricultural products? And which region benefits least?

Q40. Why is the liberalization of manufactures worse for the balance of trade?

Go back to the Shocks page and click the Define Subtotal button. This launches a window which can help you compose subtotal statements like the five that you added before. Use the Help button to find out how to use this window, and to find out more about the theory behind subtotals.

10. Customized RunGEM and the complete GEMPACK system

The ***Customized RunGEM with CEER*** package that you have been using is especially arranged and simplified to suit newcomers to CGE modelling using GEMPACK, in general, and the CEER model, specifically. You might wonder how similar using the full GEMPACK system would be.

One difference is that RunGEM looks after *file management*: it controls the names and locations of the dozen or more files used for each GEMPACK simulation. An advanced GEMPACK user has to assume more of this responsibility.

Another difference is that users of the full GEMPACK system often wish to alter the data and specifications of the model. So they have to:

- use ViewHAR to create and modify the HAR files that contain data;
- edit the TAB file, then run the TABLO program to turn the TAB file into a model-solution program.

This document does not describe the many features of ViewHAR and TABmate that are aimed at these tasks. Also, you must buy a GEMPACK licence to run TABLO, to run larger models, or to modify larger data files. Finally, the full GEMPACK system contains many other programs, not described here.

Nevertheless, if you have worked through this document (and mastered the companion document that describes the theory of CEER) you are well on the way to becoming a competent CGE modeller. You should understand the basic theory which underlies CEER – the same theory is used in every other CGE model. You can read and understand a TAB file – so now you have access to the large number of CGE models that use this notation. The tools that you have been introduced to, such as ViewHAR and TABmate, are the same tools used by other CGE model builders. Even the syntax used in RunGEM's Closure and Shocks pages is identical to the corresponding parts of the Command files (CMF files) required in GEMPACK for carrying out simulations.

The GEMPACK web page, at:

http://www.monash.edu.au/policy/gempack.htm

gives access to a great deal of GEMPACK related information, such as details of the GEMPACK product range and licensing arrangements, but also including much free stuff. For example, you could download the **Demonstration version of GEMPACK** which gives access to the full range of GEMPACK capabilities but is limited to very small models.

Appendix 1: Installing Customized RunGEM

The Customized RunGEM for the CEER model is delivered as a single large EXE file, called CRUNGEMX.EXE, and a folder with the CEER model files. You might have downloaded this EXE file from the Internet (www.monash.edu.au/policy/crungem.htm) and saved it in your TEMP folder. CRUNGEMX.EXE is a self-extracting archive which, when you run it, launches a conventional install procedure. Alternatively, you can download CRunGEM from the course area in www.usp.br/nereus.

The install procedure tells you how much free hard disk space you will need. You might have to clean up your hard drive before proceeding. It is best to install into a folder named C:\CRUNGEM. Avoid directory names that contain spaces, commas or Asian characters or are more than 8 letters long.

The package will typically include other models as well. To have the CEER model running properly, you should copy the CEER folder into the folder C:\CRUNGEM. If you want to launch the CEER model directly from double-clicking on the Customized RunGEM icon that will appear on your desktop after installation, you should delete all other **folders** in C:\CRUNGEM, except C:\CRUNGEM\CEER and C:\CRUNGEM\work.

The final step to complete the installation is to copy the \GP folder (also available at the course area in www.usp.br/nereus) directly to the C: drive.

Customized RunGEM assumes that the user has his own copy of the program on his own hard drive. The program cannot be installed on a network drive and used by several people at once.

Appendix 2: Answers to questions in the text

Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
Q29
Q30
Q31
Q32
Q33
Q34
Q35
Q36
Q37
Q38
Q39
Q40