Instructor Copy

Program for Practical GE Modelling Course
Melbourne 16-20 July 2018

Room 4, Conference Centre, Level 12, 300 Flinders Street, Melbourne, Vic 3000

Monday			**Instructor**
9.00am–9.30am	**Course Welcome and Introduction**		Waschik
9.30am–10.30am	**The Broad Structure of a CGE model**	4: oranig.ppt (1-19)	Waschik
10.30am-11.00am	**Morning Tea**		
11am–12.30pm	**Hands-On Computing with ORANI-G: First simulation**	2: FirstSim.doc 2: firstsim.xls	Waschik, Jerie, Mustakinov
12.30pm–1.30pm	**Lunch**		
1.30pm–2.15pm	**Introduction to ORANI-G: Sets, Solution Method, the TAB file**	2: firstsim.ppt 4: oranig.ppt (20-40)	Nassios
2.15pm–3.15pm	**Computing: Interrogating the Data**	6:HandsOnA.doc *HandsOnAans.doc	Waschik, Jerie, Mustakinov
3.15pm–3.45pm	**Afternoon Tea**		
3.45pm–4.15pm	**Theory: Core Coefficients**	4: oranig.ppt (41-60)	Lennox
4.15pm–6.00pm	**Computing: Interrogating the Data**	6: HandsOnA.doc 6: HandsOnB.doc	Waschik, Jerie, Mustakinov
Tuesday			
8.45am–9.45am	**Theory: Production Structure**	4: Oranig.ppt (61-83)	Waschik
9.45am-11.30am	**Computing: Closure and Homogeneity**	7: HandsonB.doc	Tran, Peng
10.30am–10.50am	**Morning Tea (mid-session)**		
11.30–12.30am	**Overview of GEMPACK (including condensation)**	2: GEMPACK.ppt	Jerie
12.30–1.30pm	**Lunch**		
1.30–3.00pm	**Computing: Wage Cut Simulation**	8: Wagecut.doc	Tran, Schiffmann, Ye
3.00–3.45pm	**Wage Cut Simulation: Analysis and Discussion**	8: Wagecut.ppt	Adams
3.45–4.15pm	**Afternoon tea**		
4.15–5.15pm	**Computing: Wage Cut Simulation: Industry Results**	8: Wagecut.doc	Tran, Schiffmann, Ye
5.15-6.00pm	**Wage Cut Discussion (industry results)**	8: Wagecut.xls 8: Wagechart.xls *WageAns.doc	Adams

*To be handed out near end of lab.

Wednesday

8.45am–9.30am	**Theory: Output mix: Export/Local mix, Capital creation**	4: oranig.ppt (84-102)	J. Dixon
9.30am–11.30am	**Computing: AnalyseGE & Tariff Simulation 1**	9: Ant.doc	Wittwer, Peng, King
10.30am–10.50am	**Morning Tea (mid-session)**		
11.30am-12.30pm	**Theory: Household Demands**	4: oranig.ppt (103-129)	Waschik
12.30pm–1.30pm	**Lunch**		
1.30pm–2.30pm	**Theory: Other Final Demands, market clearing**	4: oranig.ppt (130-152)	J. Dixon
2.30pm. – 4.30pm	**Computing: Tariff Simulation 2**	9: Ant.doc 9: Tarfcut.xls *AntAns.doc	Wittwer, Schiffmann, King
3.20pm–3.45pm	**Afternoon Tea (mid session)**		
4.30pm–5.00pm	**Theory: Tariff simulation discussion**	9: tarfsim.ppt	Wittwer, Schiffmann, King
5.00pm-6.00pm	**Computing: Adding Equations to Model**	10: NewEq.doc	Wittwer, Schiffmann, King

Thursday

8.45am –9.45am	**Theory: Purchasers Prices and Macros**	10: neweq.ppt 4: oranig.ppt (153-168)	J. Dixon
9.45am -11.45 am	**Theory: Investment, Labour Market, Closure**	4: oranig.ppt (169-207)	Giesecke
10.30am–10.50am	**Morning Tea (mid-session)**		
11.45am–12.45pm	**Theory: Regional Extension**	10: regional.ppt	Wittwer
12.45pm–1.45pm	**Lunch**		
1.45pm–2.00pm	**Official Photo**		
2.00pm–3.00pm	**Theory: Q&A session**		J. Dixon, Adams, Giesecke
3.00pm–3.30pm	**Group Projects: Allocation and Computing**	11: Grouproj.doc 11: Groups.doc	Senior staff, Roos, Lennox
3.30pm–4.00pm	**Afternoon Tea**		
4.00pm–6.00pm	**Group Projects: Computing and Analysis**	11: Grouproj.doc 11: Groups.doc * group#xls.pdf	Senior staff, Roos, Lennox

Friday

8.45am–10.30am	**Group Projects: Preparing Reports**		Senior staff, Roos, Nassios
10.30am–10.50am	**Morning Tea**		
10.50am–12.30 pm	**Group Projects: Preparing Reports**		Senior staff, Roos, Nassios
12.30pm-1.30 pm	**Lunch**		
1.30pm-3.30pm	**Presentation of Reports on Group Simulations**		Giesecke, Wittwer, Waschik
3.30pm–4pm	**Course Wrap-up**		
	Course will be finished by about 4.00pm		

*To be handed out near end of lab.

Hands-on Computing with ORANI-G: First Simulation

This first session provides a rapid overview of the whole process of computing solutions for the ORANI-G model. You will be introduced to many files containing: model equations (TAB); model data (HAR); simulation details (CMF); and simulation results (SL4). All the different files and steps will be studied more carefully in later sessions -- ***do not worry if you do not understand everything straight away****. We hope that you can work through to Section 3.6 during this session. Sections 3.7 and later are optional, or might be completed some other time.*

Most years, one or more regions of Australia suffer from low rainfall. However, during 2002 an unusually severe and widespread drought affected farmers all over Australia. Agricultural outputs fell sharply. We simulate the effects of such a drought using the ORANI-G model.

Questions are scattered through the instructions. Write down answers to the questions onto the instruction sheet.

1. Getting Started

1.1. Turning on the PC

Turn on your computer and wait for Windows to boot.

1.2. Starting WinGEM

If the WinGEM icon (resembling: ) appears on your desktop, double-click on it to start WinGEM.

Otherwise, click on the ***Start*** button at the bottom left hand side of the screen. Choose ***All Programs*** then in the ***GEMPACK*** section select ***WinGEM***.

WinGEM is a Windows interface to GEMPACK. When it starts it shows a narrow menu across the top of the screen:

1.3. Setting the working directory

You will be working inside the WinGEM shell as much as possible. To see how GEMPACK for Windows is used, you will check the database used for the ORANI-G model and run a simulation.

On the PC,

- All the GEMPACK and Windows GEMPACK programs files are in the folder or directory called **C:\GP**. This directory is called the **GEMPACK directory**. You would not normally alter the programs and other files in the GEMPACK directory.[1]
- The directory called **C:\GPWork** contains various working directories, corresponding to different economic models.

You will be working (editing files, running simulations, looking at results) in the **working directory** of the ORANI-G model, **C:\GPWork\ORANIG.**

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[1] The GEMPACK programs are installed from the GEMPACK CD onto your computer at home. You must add the name of the GEMPACK directory to your DOS path so your computer can find the GEMPACK programs when you need to run them.

When using WinGEM the first step is always to specify the location of the working directory. Choose:

File | Change both default directories

(By this notation we mean first click on ***File*** in the WinGEM menu. This will produce a drop-down menu. In the drop-down menu, click on the menu item

Change both default directories.)

In the file selection box that appears, choose drive **C:** then scroll down and *double*-click on the directory GPWORK. Next *double*-click on the subdirectory **ORANIG.** Check that the blue print above the directory box says C:\GPWORK\ORANIG**.** Click on the ***Ok*** button.

1.4. Viewing text files with TABmate

You'll often work with text files in GEMPACK, so you need a text editor. You could use a word processor but then you would always have to remember to save the file as a text or ASCII file. By default[2], WinGEM uses the TABmate editor which is part of GEMPACK.

To use TABmate to look at the TABLO Input file for the ORANI-G model, select in the WinGEM menu

File | Edit file...

The Open box should list several files associated with the ORANI-G model. You will briefly look at the TABLO Input file since it is the starting point for the ORANI-G model. It contains the equations of the model in a form very like algebra. Select the TABLO Input file to edit:[3]

ORANIG.TAB

(If this file does not appear in the Open box and you have to change directories to find it, you have not set your working directory correctly.)

Various colours appear on the screen for different parts of the TAB file; for example, TABLO Keywords are in BLACK, comments are in royal blue and so on[4]. The first page consists of a several comments (in blue) describing recent changes to the model.

Scroll down a page and you will see statements describing the two files used by this model:

- the input file BASEDATA containing input-out data and elasticities.
- the output (new) file SUMMARY which contains summary and checking data calculated from BASEDATA[5]

Place your cursor on the word BASEDATA and press the ***Gloss*** button (at top middle of the screen). If this gives a message saying "*no info available: run Check to generate*" at the bottom of the screen[6], click on the button marked ***TABLO Check*** (to left of *Gloss*) and then try ***Gloss*** again. This should show you all places in the TABLO Input file where the file BASEDATA is mentioned -- all the places where ini-

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[2] WinGEM lets you choose your text editor, via the **Options | Change editor**... menu command. You could use your own preferred editor, or GEMEdit -- another editor supplied with WinGEM. GEMEdit is a simple black and white editor with a split-screen mode – allowing you to look at two files at once.

[3] There are many versions of the ORANI-G model. The three official versions are: ORANIG98, ORANIG01, and ORANIG (last 2 digits are release years).

[4] If this is not the case you can restore the default properties, (Select menu item Edit | Restore Default Properties) or you can change the screen properties by selecting Edit | Properties to set the font, the font size and various colours on the screen.

[5] BASEDATA and SUMMARY are 'logical' file names. When you run a simulation, you have to specify the name and location of corresponding actual files.

[6] If the message disappears too fast for you to read, click on the line at the bottom of the screen and the message will reappear.

tial data is read from file[7]. Click on the line number at the start of the Gloss line and TABmate will take you to that line[8].

A related feature is: if you hold the Alt key down, while moving the mouse over green words in the TAB file, you should see a short definition of each symbol.

Return to the top of the file (Ctrl and Home goes to the top of the file, Ctrl and End to the bottom of the file) and ***Search |Find |Search forward from top*** for the variable name **a1tot**. The first occurrences (in a comment) are not what we want, so do a Repeat Search ***(F3)*** until you find the line:

```
(all,i,IND)  a1tot(i)      # All input augmenting technical change #;
```

The "(all,i,IND)" means that a1tot is a vector variable with one value for each INDustry. Click on **a1tot** and press the ***Gloss*** button (at top middle of the screen). You can see that a1tot appears in 4 equations: the three demand equations E_x1_s, E_x1prim and E_x1oct and later on the long E_contGDPincE equation. Click on the red line number at left of equation E_x1_s and you should see:

```
Equation E_x1_s  # Demands for commodity composites #
 (all,c,COM)(all,i,IND)  x1_s(c,i) - [a1_s(c,i) + a1tot(i)] = x1tot(i);
```

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,c,COM)(all,i,IND)" mean that Equation E_x1_s is actually a group or block of equations: there is one equation for each "commodity composite[9]" used by each industry. So if there were 37 commodities and 35 industries in the database there would be 1295 (=37*35) separate equations. Each of the variables x1_s, a1_s, a1tot and x1tot is a percentage change: if x1tot("OtherAgric") had value 5, that would mean that output of the OtherAgric industry would be 5% greater than in the initial equilibrium described by the input data in the BASEDATA file. The "a" variables a1_s and a1tot are technological change variables, normally exogenous (values fixed outside the model). Suppose output were fixed (x1tot=0), a shock of 10% to a1tot("OtherAgric") would mean that for each commodity c, the values of x1_s(c,"OtherAgric") must also increase 10% to keep the equation balanced. If you looked at the other equations where a1tot appears, you would find that a shock of 10% to a1tot("OtherAgric") would mean that 10% more of *all* inputs were needed to produce given OtherAgric output [note: positive a1tot 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.)

2. Data for the ORANI-G model

2.1. Viewing the data directly using VIEWHAR

The input-output data used during this course for the ORANI-G model is contained in the data file BASEDATA.HAR. This is a *binary* file used in GEMPACK programs - called a Header Array (HAR) file - so we cannot just look at it in a text editor. Instead we will look at BASEDATA.HAR using a special viewing program, ViewHAR. Select from the main WinGEM menu:

HA Files | View VIEWHAR

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[7] You can click on any variable, coefficient or set and press the Gloss button to display a list of every statement in the file mentioning that symbol. For a variable, say, the first of these statements will usually furnish a definition. The remainder show how the variable is used. Line numbers accompany each statement; you can click on these to jump to that location in the TAB file. If you press Gloss when the cursor is not on a variable, coefficient or set, you get a different list showing the definition of each variable, coefficient or set mentioned in the current statement.

[8] You can return to your original place as follows: At bottom left, the Location Indicator panel shows current line and column numbers. Click there and a window appears, listing lines that you jumped to or from. The most recently visited line appears at the top. You can click on any of these lines to jump there.

[9] An example of a "commodity composite" might be Coal used by the Iron industry. The Coal is potentially a mixture of local and imported coal, so we call it a "dom/imp composite".

The VIEWHAR window will appear. Click on

File | Open Header Array file

and open the file BASEDATA.HAR in directory ORANIG on drive C:

This will open the file BASEDATA.HAR and show its contents on the Contents screen[10].

Each of the rows corresponds to a different array of data on the file. Look at the column under the heading **Name** to see what these arrays are:

	Header	Type	Dimension	Coeff	Total	Name
1	COM	1C	37 length 12			Set COM commodities
2	IND	1C	35 length 12			Set IND industries
3	OCC	1C	8 length 12			Set OCC occupations
4	MAR	1C	4 length 12			Set MAR margin commodities
5	1BAS	RE	COM*SRC*IND	V1BAS	322581.9	Intermediate Basic
6	2BAS	RE	COM*SRC*IND	V2BAS	81887.98	Investment Basic

The first item, COM, is the list of commodities in this database. The array is of type 1C which means an array of strings. Double click on COM to see the commodity names.

To return to the Contents Screen, double-click on any cell [or click on ***Contents*** in the VIEWHAR menu].

Have a look at item 8, 4BAS, showing exports of each commodity. Double-click on the 4BAS row to look at the numbers. Values in this file are measured in million Australian dollars. Would you say Agriculture/Food exports were as large as Mining exports?

Double-click on any cell to return to the Contents Screen, then double-click on item 21 (header 1CAP), which shows the values of capital rentals in each industry. Note down below the following database value -- you will need to know it later:

- V1CAP("MeatDairy") = 1279.52

Double-click on any cell to return to the Contents Screen, then double-click on item 7, 3BAS to see the numbers. The panel at the bottom of ViewHAR tells you that you are seeing household consumption, split according to commodity (COM) and SRC (domestic or imported). What is the single largest category of household expenditure? OwnerDwellng: 48120.0

ViewHAR for shares

ViewHAR can present numbers as shares. To see Row shares, look at the box in the top left hand corner beside the green and yellow bands. Click on the arrow beside this box and choose ***Row*** . You should see shares that add to 1 across each row. The shares show the proportion of domestically-produced or imported goods for household use of each commodity.

Try ***Col*** to calculate column shares, and ***Matrix.*** What share of household spending goes on *DrinksSmokes*? 3.1%

Close VIEWHAR in the normal Windows way ***File | Exit.***

3. Simulating the short-run effect of a drought

In this section you will implement the ORANI-G model and use it to simulate the short-run effects of reduced productivity in Agriculture.

[10] BASEDATA.HAR is the actual file corresponding to the logical file BASEDATA mentioned in ORANIG.TAB.

3.1. Overview of the process

From the WinGEM menu at the top of the screen choose ***Simulation.*** In the drop-down menu the choices are

TABLO Implement
Compile & Link
TABmate Implement
Run TG Program
GEMSIM Solve
SAGEM Johansen Solve
GEMPIE Print
View Solution (ViewSOL)
AnalyseGE

The items from this menu you will be using in this simulation are

TABLO Implement
GEMSIM Solve
View Solution (ViewSOL)

TABLO, GEMSIM and ViewSOL are the names of programs which carry out the three steps of a simulation :

- Step 1 - Implement the model with TABLO
- Step 2 - Solve the equations of the model with GEMSIM
- Step 3 - View the results with ViewSOL

WinGEM will guide you through these steps and indicate what to do next.

3.2. Step 1 - Implementing the ORANI-G model using TABLO.

As we saw previously, the TABLO Input file (which contains the theory of the ORANI-G model) is called **ORANIG.TAB**. Choose

Simulation | TABLO Implement

A window for TABLO will appear. Click the Options menu item at the top of this TABLO window and select "Run from STI file". Then click on the ***Select*** button to select the name of the STI file, ORANIG.STI. The STI (stored input) file contains some instructions which TABLO needs to implement the model. By "implement" we mean convert the TABLO Input file into binary computer files which are used by the simulation program GEMSIM in the next step. These files are referred to as Auxiliary files (or sometimes as the GEMSIM Statement and Table files) and in this case, are called ORANIG.GSS and ORANIG.GST[11].

Click on the ***Run*** button. TABLO runs in a DOS box[12] and when completed returns you to the TABLO window with the names of files it has created: the Information file ORANIG.INF and the Log file GPXX.LOG. Briefly look at both of these files by clicking the ***View*** buttons beside them.

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[11] Section 3.6 below gives an overview of the several files that are used at various stages.

[12] The TABLO DOS box might briefly appear as an icon on the Windows task bar which is normally at the bottom of the screen.

The Information file ORANIG.INF gives information about the TABLO Input file such as whether there are any syntax or semantic errors found by TABLO when it was checking the TABLO Input file. Error messages in the INF file are flagged by the characters '%%'. Search the file for %% to see if there are any errors (hopefully none).

Go to the top of the INF file and search for `INPUT CHECK SUMMARY` to see how many syntax errors and semantic problems there are (if any). Go to the end of the INF file to see what actions GEMSIM can carry out with the GEMSIM Statement and Table files produced in this run of `TABLO`.

Look briefly at the top of the LOG file. It should say the time and date when the log file was created. What GEMPACK Release was used? When you run TABLO in WinGEM, there is no output to the screen as it runs. Instead all, the screen output produced by TABLO goes to the LOG file. If there is some problem in running TABLO, consult both the LOG file and the INF file to find out what went wrong. Since this is a working model, no errors should occur provided you remember to run TABLO using the STI file ORANIG.STI.

When you have looked at these two files, close TABmate and click on the ***Go to GEMSIM*** button at the bottom of the TABLO window to go on to the next step in running a simulation: Step 2 - GEMSIM Solve.

3.3. Step 2 - Solve the equations of the model using GEMSIM.

The *Go To GEMSIM* button takes you to the GEMSIM window.

(Alternatively you can start this window by choosing *Simulation* | *GEMSIM Solve* from WinGEM's main menu.)

First ***Select*** a Command file called FIRSTSIM.CMF.

Look at this Command file in the text editor by clicking the ***Edit*** button. Command (or CMF) files are used to specify the details of a simulation. The main bits of information in this CMF file are:

- the model to use, in the line: auxiliary files = ORANIG;
- the solution method: Euler 3 4 5
- the actual file names, BASEDATA.HAR and SUMMARY.HAR, that correspond to the logical file names, BASEDATA and SUMMARY, which are mentioned in the TAB file. By default, the solution file is named after the CMF file -- so in this case the solution will be stored in file FIRSTSIM.SL4.
- the closure, or list of exogenous variables. The model can determine the value of most *but not all* variables. Some variables must be held fixed (or shocked) by the modeller. These are called *exogenous*. The choice of *which* variables are to be exogenous varies between simulations. In this simulation, industry capital stocks (variable x1cap) are held exogenous. The fixed capital stocks identify the simulation as short-run.
- the shocks are at the end of the file. In this simulation we shock the variable **a1tot** to increase by 10% for each of the agricultural industries, **BroadAcre** and **OtherAgric**. **a1tot** 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[13]. These shocks are used to simulate the main effect of the drought: agricultural productivity is reduced.

Use ***File | Exit*** to return from TABmate to the GEMSIM window.

Click on ***Run*** to run GEMSIM with the Command file FIRSTSIM.CMF. The simulation could take a few minutes to run. Do not touch the keyboard or mouse during this time. While you wait, study the overview of GEMPACK in Section 3.6 below.

[13] You can remind yourself how a1tot is used with the ORANIG.TAB file. From TABmate, use File..Open to re-open the TAB file, and search for (or Gloss on) a1tot.

Eventually, the *Accuracy Summary* window should appear [it is headed "via WinGEM: Whole simulation"]. You should see that nearly all the results are accurate to 5 or 6 significant figures[14]. The accuracy is indicated by two smiling faces (click on the key to see the range of facial expressions). Click OK to close the Accuracy Summary.

If there is an error, view the Log file.

If GEMSIM produces the Solution file, several new buttons will appear. There is no point in trying to look at the Solution file in the text editor because it is a binary file, not a text file. Instead, look at the Solution file using the Windows program ViewSOL, as described next.

3.4. Step 3 - View simulation results using ViewSOL

First click on the button ***Go to 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 2.

Most of the variables are percentage changes, but some (their names start with "del") are ordinary changes, measured in million-dollars. Values for exogenous variables are shown in red. Scroll down the list to find price indices (first letter "p"), nominal values (first letter "w"), and quantity indices (first letter "x"). Write down below what happened to:

- x4tot: aggregate exports -4.46
- x0gdpexp: real expenditure side GDP -0.77
- employ_i: aggregate employment -0.48
- x0cif_c: aggregate imports 0.01
- p4tot: export price index 0.66
- p3tot: consumer price index 0.19
- p1lab_io: average nominal wage 0.19
- p1lnd_i: average return to agricultural land -5.76

Double-click on any number to return to the Contents screen. Then scroll down till you find the variable x1tot (industry outputs). Double-click to view the numbers. Which non-agricultural industry was most affected? MeatDairy -9.4%

Return to Contents and view results for:

- x4: exports
- x3: household use
- x1lab: employment
- regx1prim_i: state real GDP. Which state *gained*? Can you think why? [ACT]

Note down below the following two results -- you will need them later.

- x1cap("MeatDairy") = 0 (exogenous)
- p1cap("MeatDairy") = -27.28

[14] The Accuracy Summary gives separate estimates for Variables and for Data. Data will be more accurate than Variables. This is simply because most variables are %change. If some data has initial value X and increases by y% [accurate to 3 figures], the new value, X*[1+y/100], will be accurate to about 5 figures.

3.5. Other output files

The Summary file

Return to the GEMSIM window, that is, bring it to the front by clicking on it. Look at the data files used in this simulation by clicking on the button marked ***View Input/Output Files*** and view the output file *SUMMARY*. This SUMMARY.HAR file contains various useful tables and data summaries which are calculated only from the initial input data file BASEDATA.HAR[15].

Experienced modellers rely on a good knowledge of the main features of their database. To understand why some industries perform better than others in a simulation, we have to know the special characteristics of each sector. The SUMMARY file contains various data that have proved useful in the past. Some of the most useful are:

Header	Dimension	Coefficient	Name
SALE	COM*SRC*DEST	SALE	Sales aggregates
EMAC	EXPMAC	EXPGDP	Expenditure Aggregates
IMAC	INCMAC	INCGDP	Income Aggregates
TMAC	TAXMAC	TAX	Tax Aggregates
CSTM	IND*COSTCAT	COSTMAT	Cost Matrix
MKUP	COM*FLOWTYPE *SRC*SALECAT2	SALEMAT2	Basic, margin and tax components of purchasers values
MSHR	COM	IMPSHR	Share of imports in local market
SRSE	IND	SUPPLYELAST	Short-run supply elasticity
FACT	IND*FAC	FACTOR	Primary Factor Costs
1TOT	IND	V1TOT	Total industry cost plus tax
RV1P	IND*REG	REGV1PRIM	Factor bills

Use the SUMMARY file to answer the following questions:

- What is the share of exports in GDP? [Header EMAC, Col share] 17.1%
- Intermediate inputs are ??% of the costs of the MeatDairy industry? [CSTM, row share] 70.6%
- For which commodity do imports have the largest market share? [MSHR] OthMachnEqp: 62%
- Which two industries are most[16] labour intensive? [FACT, row share]Education GovAdminDfnc
- Which two industries have highest short-run supply elasticity? [SRSE]GovAdminDfnc Education
- Which region earns most from mining? [Header RV1P] WA: 8177.6

The Updated Data file

Return to the GEMSIM window (click it to bring it to front). Look at the data files used in this simulation by clicking on the button marked ***View Input/Output Files*** and view the updated file *BASEDATA*. This file (actual name FIRSTSIM.UPD) contains post-simulation values for the same data items as are contained in the input BASEDATA file, BASEDATA.HAR.Have a look at header 18, 1CAP.

Write down the new value for the MeatDairy industry in the "updated" column below:

	Initial	Updated	Percent Change
V1CAP("MeatDairy")	1279.5	930.4	-27.28

[15] Thus, even though SUMMARY.HAR is recreated each time you run a simulation, its contents will not change -- unless the input BASEDATA file was changed. As an exception, the final 3 headers [FRNK, TPRS, and TAXV] do depend on the simulation.

[16] The little yellow (transpose) and green (sparse sorted) buttons at top left offer a quick way to answer “which is most” questions.

Write down the original value of V1CAP("MeatDairy") in the "initial" column above (you were asked to note this previously). Then write down the percentage change between Initial and Updated, using the formula[17]:

%change = 100*(Final - Initial)/Initial

The V1CAP vector contains values of capital rentals. Each value is the product of a price, P1CAP, and a quantity, X1CAP. The solution file contains values (you were asked to note these previously) for percent changes in these two variables. Write in these two values below.

	p1cap	x1cap
V1CAP("MeatDairy")	-27.28	0

Use the two variable results above to check that:

updated V1CAP = [original V1CAP]*[1+p1cap/100]*[1+x1cap/100]

How does GEMPACK know which price and quantity variables must be used to update V1CAP? That information comes from a line in the file ORANIG.TAB, which reads:

```
Update  (all,i,IND)   V1CAP(i) = p1cap(i)*x1cap(i);
```

This updated data file has the same headers as the original input file. In fact, it is possible to use the updated data as the starting point (or initial data) for a second simulation. We might do this if we wanted to find the effect of one shock *followed by* another shock. Updated data files are used in a similar way by recursive dynamic models, a type of multiperiod CGE model which solves one year a time. The simulation for year T produces an updated data file which is used as input by the simulation for year T+1.

[17] If you are too tired to do mental arithmetic, click the Programs menu item at the top of ViewHAR, then click on the Calculator icon which appears.

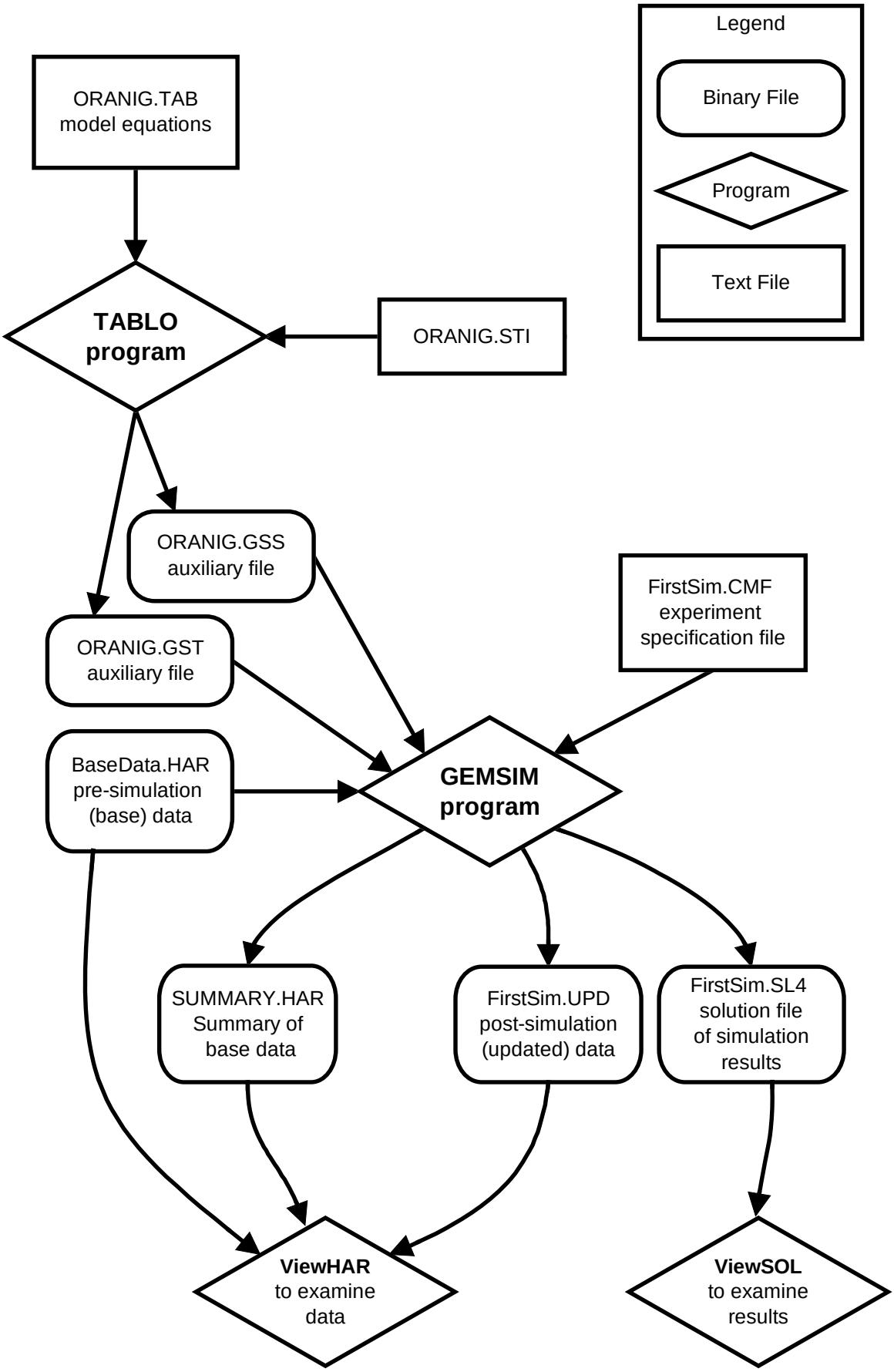


Figure 1: Stages in the GEMPACK process

3.6. Diagram of stages in the GEMPACK process

Figure 1 shows, in simplified form, the main stages in the process that you have just gone through. In the diagram:

- diamond- or lozenge-shaped boxes are GEMPACK programs, such as TABLO, GEMSIM, ViewHAR and ViewSOL.
- rectangles with rounded corners are binary (special format) files which can only be used by particular GEMPACK programs.
- rectangles with sharp corners are ordinary text files, which you could examine or modify with any text editor or word processor. You used the TABmate text editor to look at these files.

The process begins with the text file ORANIG.TAB which contains the equations of the model. The TABLO program translates the TAB file into two auxiliary GSS/GST files, which contain a computer-language representation of the model equations. Another small text input file, ORANIG.STI, specifies various TABLO options[18].

The two GSS/GST files are used by GEMSIM to solve the model [ie, run simulations]. GEMSIM requires two other input files:

- the data file BASEDATA.HAR, containing input-output data and behavioural parameters. This data file contains all necessary information about the initial equilibrium.
- experiment details from a text file FIRSTSIM.CMF, which specifies:
  (a) which variables are to be exogenous (ie, held constant or shocked);
  (b) shocks to some exogenous variables;
  (c) the solution method; and
  (d) the names of input and output files.

The GEMSIM simulation produces three output files:

- the FIRSTSIM.SL4 solution file shows percentage changes in variables from the initial equilibrium. SL4 solution files are in a special binary format: you can examine their contents with the ViewSOL program.
- the FIRSTSIM.UPD updated data file contains post-simulation values for the same data items as are contained in the input data file BASEDATA.HAR.
- the SUMMARY.HAR file contains various useful tables and data summaries which are calculated only from the *initial* input data file BASEDATA.HAR. The contents of the summary file do not depend on the experiment specified in the CMF file.

The files BASEDATA.HAR, FIRSTSIM.UPD, and SUMMARY.HAR are all Header Array files which you can examine using ViewHAR.

All the steps and files shown in Figure 1 are conveniently managed by the WinGEM interface program. However, it is possible to run the same programs without WinGEM by typing into a command prompt (DOS box). The traditional, command-line, method is still the only way to run GEMPACK on some other operating systems, such as UNIX.

The more expensive "source code" version of GEMPACK does not require GEMSIM. Instead TABLO (assisted by a Fortran compiler) produces a model-specific EXE file which runs the simulation. In Figure 1, GEMSIM would be replaced by a file ORANIG.EXE, which could solve the model faster than GEMSIM. For really big models (or huge databases) the source code version is necessary.

---

[18] Are you anxious to know what is in the STI file? It contains *condensation* instructions specifying *omissions, substitutions* and *backsolves*. Clear now? These interesting details are covered later in the week.

3.7. Changing the closure and shocks.

Several simulations can be carried out on the same model by changing the closure and/or the shocks as described in the Command file. Now you will make a new Command file in the text editor and then run another simulation using GEMSIM.

To change the command file FIRSTSIM.CMF, copy it to a new name FIRSTSIM2.CMF as follows:

In the main WinGEM menu, choose ***File | Edit...*** then open the file FIRSTSIM.CMF.

Click on ***File | Save As*** and save the file under the new name FIRSTSIM2.CMF.

Then use the text editor to modify this file, following the steps below.

In the original shortrun closure, the variable **realwage** (CPI-adjusted wage) was held fixed. Now instead we will hold fixed the nominal (un-adjusted) wage variable, **p1lab_io**.

Find the line:

```
realwage ;       ! Average real wage
```

and alter it to read

```
p1lab_io; ! realwage ; ! Average real wage
```

Don't forget the semicolon after p1lab_io. When GEMSIM reads the CMF file, an exclamation mark causes the rest of that line to be treated as a comment.

Exit from the editor after saving your changes.

Click on ***Simulation | Gemsim Solve*** and ***select*** Command file FIRSTSIM2.CMF.

Rerun program GEMSIM with command file FIRSTSIM2.CMF (similarly to Step 2 above).

Then look at the results (FIRSTSIM2.SL4) using ViewSOL. ViewSOL allows you to open several solution files at once. Open the solution from your previous simulation (FIRSTSIM.SL4). Compare the results for macro variables. Are the falls in employment and GDP greater or less with nominal (rather than real) wages fixed ? Explain.

4. GEMPACK without WinGEM

In the examples above we ran the programs TABmate, ViewHAR, GEMSIM and ViewSOL from within WinGEM. However GEMPACK allows you to work in many other ways. You can run TABLO and GEMSIM from within the TABmate editor. Another Windows program, **RunGEM**, is good for running simulations when you are using a standard model which you do not want to change.

In the following set of examples we will use TABmate as editor, and from TABmate run TABLO and GEMSIM, then view results in ViewSOL. Then we run the simulation and view results in RunGEM.

4.1. Running TABLO from TABmate

In the previous examples we started TABmate from within the program WinGEM. Here we start it independently.

If the TABmate icon (resembling: ) appears on your desktop, double-click on it to start TABmate.

Otherwise, click on the ***Start*** button at the bottom left hand side of the screen. Choose ***All Programs*** then in the ***GEMPACK*** section select ***TABmate*** .

Click on the Open folder in the top left hand corner and select

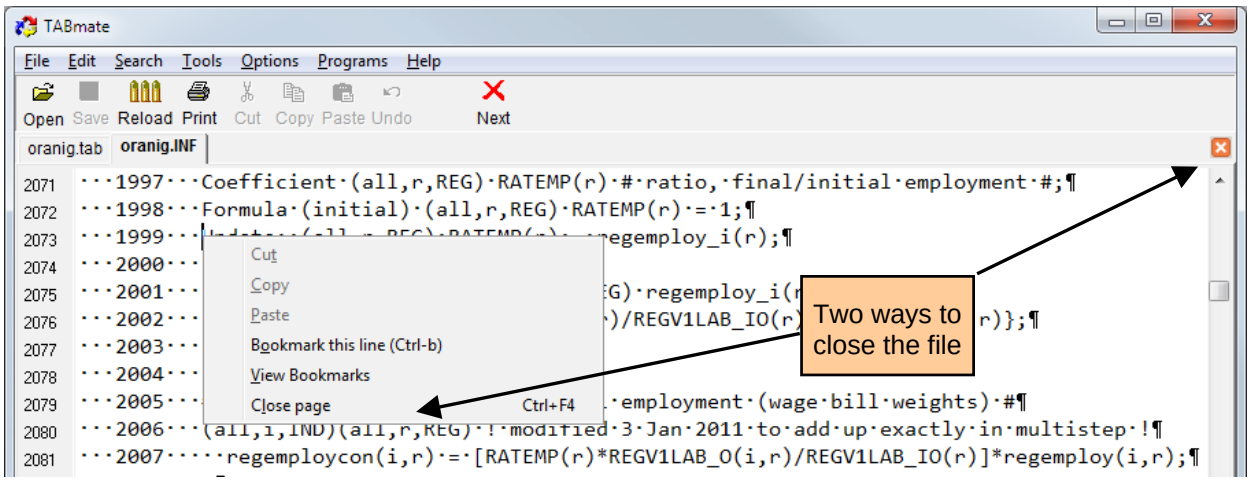
Files of Type : TABLO files (.tab)*

in the box at the bottom of the screen. Open the file C:\GPWork\ORANIG\ORANIG.TAB

To run TABLO to check for errors, select the button ***TABLO Check***. If there is an error, TABLO will point out where it is and you can edit the screen to fix it**.**

Try some of the other buttons to look at the Information (Inf) file and the Log file. When you have finished looking at these files, close them using one of these two methods:

- click the small  icon at top right of the text window
- right-click on the text window, then select ***Close page***.



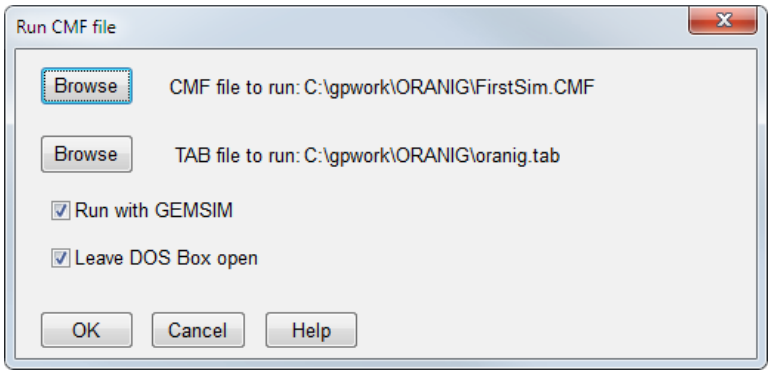
Alternatively, select ***File | Close***.

Return to the page containing ORANIG.TAB and select the ***TABLO STI*** button. A small window should appear asking if you want to run or edit the file ORANIG.STI. Click the ***Run*** button. This has the same effect as running TABLO from a STI in WinGEM. If no errors are found, it goes on to generate the code needed to actually run the model. It generates either FORTRAN code or GEMSIM code according to a setting in the STI file**.** In the course, we are using the Executable-Image version of GEMPACK which only allows you to write output for the program GEMSIM.

The names of the files created are ORANIG.GSS and ORANIG.GST. These files contain implementation of the model in the TABLO Input file ORANIG.TAB.

4.2. Running simulations from TABmate

Click the Run CMF button at the right of the upper TABmate toolbar. Then use the top Browse button to select FIRSTSIM.CMF (the simulation from earlier). Then click OK.

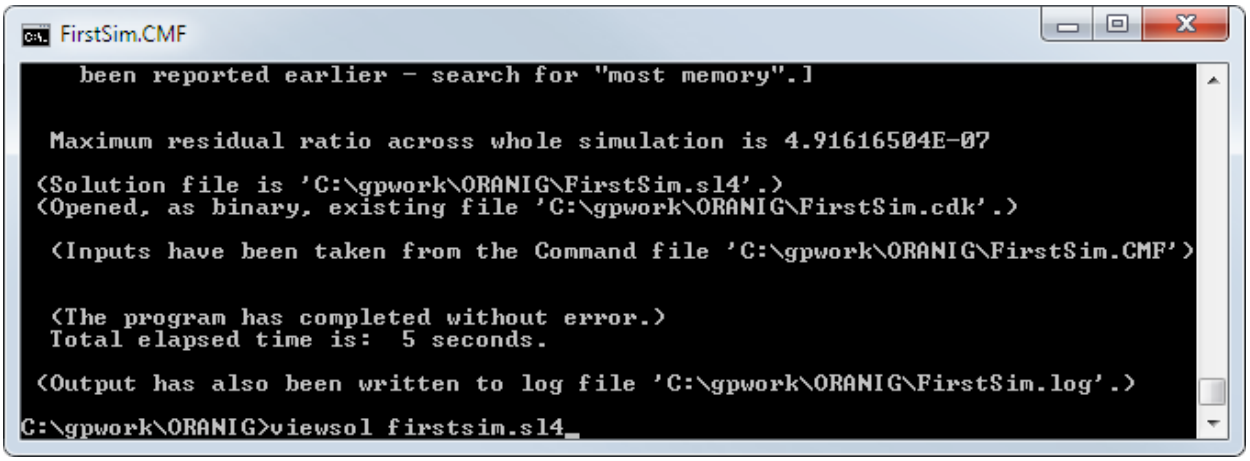


A "DOS Box" should appear with a stream of messages rushing past (see picture below). When it is finished, the last lines of the display should include the lines:

```
Solution file is 'C:\gpwork\ORANIG\FirstSim.sl4'.
The program has completed without error.
```

Click on the "DOS Box" and, as pictured below, type in (followed by Enter key):

```
Viewsol FirstSim.sl4
```



Viewsol should open and display the solution file FirstSim.sl4.

4.3. Running simulations using RunGEM

If the RunGEM icon (resembling: ) appears on your desktop, double-click on it to start RunGEM.

Otherwise, click on the ***Start*** button at the bottom left hand side of the screen. Choose ***All Programs*** then in the ***GEMPACK*** section select ***RunGEM***.

Click on ***RunGEM*** to start it running. [If this is the first time RunGEM has been used, you may be asked to select a model to work with. Click OK and select the model ORANIG.GSS in the directory C:\GPWork\ORANIG. RunGEM may also tell you that the default closure is missing. Just ignore this and click OK.]

The RunGEM screen has the appearance of a Tabbed notebook with separate pages. Click in turn on the pages labelled **Model/Data Closure Shocks** and so on to change from one page to another.

Below you will use RunGEM to repeat the FIRSTSIM simulation from earlier.

On the Model/Data page select the button ***Change Model*** and select the file created in TABmate **C:\GPWork\ORANIG\ORANIG.GSS**

In the box below place your cursor on the line

```
file BASEDATA = ...
```

and **right-click.** Select the menu line *Select or change file name* and select the file **C:\GPWork\ORANIG\BASEDATA.HAR** since this is the data file for the model ORANIG.

On the Closure page, click the Load Closure button and choose file ORANIGSR.CLS (which contains the usual shortrun closure for the ORANIG model):

On the Shocks page, first click the *Clear Shocks* button. Then, click on the arrow beside the box marked *Variable to Shock* and select the variable **a1tot**

In this simulation, you are to give shocks for industries BroadAcre and OtherAgric, which you specify in the *Elements to shock* box. Click on the down arrow on this box. You will be told that the Size and elements of the set IND are not known. [This is because they are read from the BASEDATA file). Click **Yes** to ask RunGEM to check the closure. After a few seconds you will be told that the closure is OK. Now return to the Shocks page and select variable a1tot as the *Variable to shock*. Then click again on the *Elements to shock* box. This time you will see the elements of the set IND.

Select the element "BroadAcre" and give it a shock of 10%. Add this shock to the shock list by selecting the ***Add to Shock List*** button. Next, from the *Elements to shock* box, select the element "Other Agric" and give it a shock of 10%. Add this shock also to the shock list by selecting the ***Add to Shock List*** button.

Look at the page Output Files (probably no changes are needed).

Then go to the Solve page. Change the solution method to Euler 3,4,5 steps. Add a few words to describe the simulation in *Verbal description* box. Then click on the **Solve** button to run the simulation. To see the results go to the Results page. These results should be the same as those calculated earlier using WinGEM and the Command file FIRSTSIM.CMF.

Exit from RunGEM as usual.

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HANDS-ON COMPUTING WITH ORANI-G: PART A
INTERROGATING THE DATA

Starting WinGEM

If the WinGEM icon (resembling: ) appears on your desktop, double-click on it to start WinGEM. Otherwise, click on the ***Start*** button at the bottom left hand side of the screen. Choose ***All Programs*** then in the ***GEMPACK*** section select ***WinGEM***.
WinGEM is a Windows interface to GEMPACK. When it starts it shows a narrow menu across the top of the screen:

WinGEM - GEMPACK for Windows
File Simulation HA files Other tasks Programs Options Window Help

Setting the Directory for Model ORANIG

To keep all examples files for this model together in one area, we have created a separate directory called ORANIG on your C: drive. First choose

File | Change both default directories

In the file selection box, choose drive **C**: and subdirectory **C:\GPWork\ORANIG**

TABLO Input file for ORANIG

Choose ***File | Edit*** and open the TABLO Input file **ORANIG.TAB**. You will need to refer to both the TABLO Input file and the data file for ORANIG to answer the following questions because the sets in the TABLO Input file are read from the data file. For example, the set of commodities is read from the Header array called “COM”.

Looking directly at the Data file for ORANIG

There is one data file associated with ORANIG, a Header Array file called **BASEDATA.HAR**.
(This stands for Australian data for the year 1993/1994.)
Use ViewHAR to look at this file. You can access ViewHAR by choosing the menu item on the WinGEM main menu: ***HA*** Files.

Questions Write your answers beside the questions

1. Which Header contains the set of industries? IND
   How many commodities are there, and how many industries? 37 COM, 35 IND

2. How many margins commodities are there? Which commodities are they?
   Trade, Hotel_Cafe, Transport, FinanceInsur
3. What does the Header “ITEX” contain? What is the name of the set containing individual exports? What are the individual export commodities? WoolMutton GrainsHay BeefCattle OtherAgric ForestFish Mining MeatDairy OthFoodProds DrinksSmokes Textiles ClothingFtw WoodProds PaperPrint
4. What are the names of the COEFFICIENTs used in ORANIG.TAB to represent the Armington elasticities? SIGMA1 SIGMA2 SIGMA3 From what Headers are their values read? 1ARM 2ARM 3ARM

5. What are the values used for the Armington elasticities? What do these parameters represent? Which products have the highest elasticities? TransportEqp 4.2, Textiles 3.5Which have the lowest? nontraded=0

6. What is the value at basic prices of household consumption of imports of commodity "DrinksSmokes"? 620.1 What is the value of household consumption of domestically-produced

commodity "DrinksSmokes"? 5454

7. What is the value of capital rental for industry "ElecGasWater"? 10770.2

8. What is the value at basic prices of the intermediate input of domestically produced commodity "ElecGasWater" to production in industry "Mining" ? 778.5

Note: ViewHAR can only view two dimensions at a time. Use one of the little boxes at top right for aggregating matrices in different dimensions and choose " ElecGasWater". See the ViewHAR help under "Options for real matrices" for more details.

Consequences of the data

You will also need to look at consequences of the data (for example, totals and shares calculated from the data which is read in).

The main TABLO Input file **ORANIG.TAB** can be used for this purpose. As well as solving the model, it writes out various useful data calculated from the original data to a SUMMARY file. You can use GEMSIM to produce this file without actually performing a simulation.

Look at ORANIG.TAB in the editor (***File | Edit...***). Search for "summary".
To produce the SUMMARY file proceed as follows. Choose

Simulation | TABLO Implement

The TABLO window appears: click the ***Options*** item in *this* window, and choose

Run from STI.

Then use the ***Select*** button to choose the file **ORANIG.STI**. [This file contains instructions for 'condensation', which we explain later.]

Click the ***Run*** button to run TABLO.

Then ***Go to GEMSIM***... and ***Select*** the Command file **FORMULAS.CMF**.

Then ***Run*** GEMSIM. This GEMSIM run will read all the data, calculate all coefficients, and write the summary data.

Once the run has finished, press the button ***View Input/Output files*** to see the name of the data file read in and also the name of the SUMMARY file which is created by GEMSIM.
Use ViewHAR to examine the summary file. You can answer the questions below by examining ORANIG.TAB, BASEDATA.HAR, and SUMMARY.HAR.

Later you will add statements to ORANIG.TAB to compute and write more data to SUMMARY.HAR. These will be used to answer more questions.

Questions

Most of the following questions can be answered by examining SUMMARY.HAR. Each data item there has a descriptive "long name". As a guide, you might in each case look first in the TAB file to find

- the correct name of the COEFFICIENT
- how each item was calculated (and whether it is really what you want to find out)
- the Header used in writing this COEFFICIENT to file SUMMARY.
- Then look in SUMMARY.HAR in ViewHAR to find the Header and double-click on it to see the values.
- ViewHAR options: You can get ViewHAR to show the name of the Coefficient by selecting *File | Options* and then clicking on the box *Show coefficient names.* Another good idea is to select *File | Use advanced editing menu* rather than *Use simplified, read-only menu.*

Headers CSTM and FACT are useful for the next two questions:

9. The COEFFICIENT used for the total labour bill in industry "i" is V1LAB_O(i). 12055.8
   (a) What COEFFICIENT is used for the total cost in industry "i" (plus tax)? V1TOT 52099.8
   (b) What COEFFICIENT is used for the total factor input to industry "i"? V1PRIM 24127.8
   (c) What are the calculated values of these three coefficients for industry "Construction"? see above
   (d) What is the share of labour in the total costs of industry "Construction" ? 23.1%

10. (a) What is the total payments to labour summed over all industries? (V1LAB_IO) 194981
    (b) What is the total primary factor payments for all industries? (V1PRIM_I) 378292
    (c) What is the share of labour in total factor cost for all industries? 194981/378292 = 52%

11. What is the value at purchasers prices of exports of domestically-produced commodity "BasicMetals"?
    For example, what COEFFICIENT is this? V4PUR
    what set element do you need to look up? V4PUR("BasicMetals")
    then what header on file SUMMARY "4PUR" = 8149

12. What is the different between the Coefficients SALE, SALES and DOMSALES? What is the value at basic prices of total sales of domestically-produced commodity "ElecGasWater"? 20134

13. Which header in SUMMARY.HAR tells us about Sales structure? Look at the Sales shares. Which industry sells the highest fraction of its output to investment? After that, which is second highest? Explain. Construction: 90.9% TransportEqp: 46.8%

14. Look at the header CSTM in SUMMARY.HAR which tells us about Cost structure.
    What is unusual about the cost structure of "OwnerDwellng"? High capital share
    What does the production of this industry represent? Rents and “imputed” rents

15. The header MSHR in SUMMARY.HAR shows the import penetration for each commodity: ratio of (sales of imported good)/(total domestic sales of domestic+imported good)
    Look at the Formula for IMPSHR in the ORANIG.TAB file.
    Which commodity has the highest import penetration[1]? OthMachnEqp = 61 %

16. Which header shows the share of exports of commodity c in total export earnings. (Use the value at purchasers' prices.) What commodity has the greatest share? Hint: use the "column" share" feature in ViewHAR. 4PUR Mining 28%

17. Use the header SALE to see the ratio of export sales to total sales of domestically-produced commodity c (using basic prices).
    Which commodities export more than 50 percent of the value produced? WoolMutton 58% Mining 55%
    Which commodities are not exported? Trade, Hotel_Cafe, OwnerDwellng

[1] Once you are skilled, two buttons at top left help you answer “which is greater” questions: the green Sparse Sorted and yellow Transpose buttons.

GDP questions

18. Are the values of Nominal GDP from the income and expenditure sides equal? Yes

19. Nominal GDP from the expenditure side is often given by the formula

GDP = C + I + G + X - M

where C is Consumption, I is Investment, G is Government, X is Exports, M is Imports.
What COEFFICIENT names are used for C, I, G, X and M in the ORANIG TABLO Input file? Find the values of all these quantities and verify whether the above formula is correct.
(Hint: Textbook definitions of GDP often ignore inventories.)

Fill in the following list of values:

	Coefficient Name (in TAB file)	Value (in Summary file)	Share of GDP ("col" shareof EMAC)
C	= V3TOT	= 260587	= 61%
I	= V2TOT_I	= 92958	= 22%
G	= V5TOT	= 78703	= 18%
X	= V4TOT	=. 73157	= 17%
-M	= -V0CIF_C	= -77502	=-18%
Stocks	= V6TOT	= -98	=-0.02%
GDP	= V0GDPEXP	= 427804	= 100%

20. Nominal GDP from the income side is given by the formula

V0GDPINC = V1PRIM_I + V0TAX_CSI

What do V1PRIM_I and V0TAX_CSI represent? Fill in the following list of values :

Share of GDP (V1PRIM_I / V0GDPINC)= ? 88.4%

		Share of GDP
V1LND	= 2736	= 0.6%
V1LAB_IO	= 194981	= 45.6%
V1CAP_I	= 180575	= 42.2%
V0TAX_CSI	= 49512	= 11.6%
V0GDPINC	= 427804	

Adding more statements to ORANIG.TAB

21. What is the value at purchasers' prices of the intermediate input of domestically-produced commodity BeefCattle to production in the MeatDairy industry ?
    (First what COEFFICIENT is this? What set elements are you looking for - for example the set element for the commodity is "BeefCattle".)

To answer this, you will need to add a **WRITE** statement to the TABLO Input file ORANIG.TAB to report a COEFFICIENT calculated by FORMULA. It will appear in file SUMMARY.HAR.

Right at the end of the TAB file, add the WRITE statement:

```
Write
????? to file SUMMARY header "PUR1" longname "Intermediate purch. value";
```

Replace ????? with the right coefficient name.

Question: why not call the header “1PUR” ?.

Edit the TABLO Input file ORANIG.TAB to add the WRITE statement. Then run TABLO to process the new version of ORANIG.TAB (Don’t forget to choose the STI file first, via **TABLO:Options**…**Run from STI…Select… ORANIG.STI**.) Finally run GEMSIM with the Command file FORMULAS.CMF to calculate the values and write them to the Summary file.

Calculating New Coefficients

As you analyse simulation results, you will need to calculate other values derived from the data file. Often the best way of doing this will be to add extra COEFFICIENTs, FORMULAs and WRITEs to the bottom of ORANIG.TAB.

22. The share of labour (V1LAB_O) in primary factor cost (V1PRIM) has a close connection to the concept of shortrun supply elasticity. Explain[2].

Add statements to the end of ORANIG.TAB which:

(a) define a new coefficient LABSHR dimensioned over IND.
(b) give the formula for LABSHR
(c) write LABSHR to the summary file with header "SHLB".

Which industry has steepest shortrun supply curve? OwnerDwellng And which the flattest? GovAdminDfnc

[2] Appendix J of the ORANI-G document covers this.

Basic, Margin and Tax Components for Main Users

An elaborate example of an addition calculating and writing out values calculated from the data file is in Excerpt 40 of ORANIG.TAB.

The excerpt constructs a four-dimensional matrix showing:
- for each good
- for each source (dom, imp)
- for each main user (Intermediate, Investment, Household, ... etc)
- basic, margin, and tax components

of purchasers' values.
By manipulating this matrix within ViewHAR, a variety of information may be learned.

Use ViewHAR to examine the matrix MKUP in file SUMMARY.HAR. Use the matrix to answer the following questions -- you will need to make extensive use of ViewHAR's facilities for viewing shares and for slicing or summing.

23. Which commodity has the highest rate of tax ? (Use ViewHAR row shares). Petrol_CoalP 34.9%
    What share of total commodity tax revenue does that good account for? (Use col shares). 30.8%

24. For which commodity does margins form the highest share of purchase cost? ClothingFtw 46.5%

25. What is the value at purchasers prices of household consumption of domestically-produced commodity RubberPlastc? 1505

26. Adding all commodities together, what fraction of purchasers' prices do commodity taxes form? 3.3%
    For domestic commodities only? 3% for imported commodities only? 5.1%

27. What % of government demands are imported? What % of government spending is on Education?
    about 0 21.5%
28. What is the value at purchasers' prices of household consumption of imports of commodity DrinksSmokes? 2013

HANDS-ON COMPUTING WITH ORANIG: PART A

INTERROGATING THE DATA

Answers to some questions

Questions

1. How many commodities are there, 37

```
WoolMutton GrainsHay BeefCattle OtherAgric ForestFish Mining MeatDairy
OthFoodProds DrinksSmokes Textiles ClothingFtw WoodProds PaperPrint
Petrol_CoalP Chemicals RubberPlastc NonMetlMinrl BasicMetals FabMetalPrd
TransportEqp OthMachnEqp MiscManuf ElecGasWater Construction Trade Repairs
Hotel_Cafe Transport CommunicSrvc FinanceInsur OwnerDwellng PropBusSrvc
GovAdminDfnc Education HealthCommun CultuRecreat OtherService
```

and how many industries? 35

```
BroadAcre OtherAgric ForestFish Mining MeatDairy OthFoodProds DrinksSmokes
Textiles ClothingFtw WoodProds PaperPrint Petrol_CoalP Chemicals RubberPlastc
NonMetlMinrl BasicMetals FabMetalPrd TransportEqp OthMachnEqp MiscManuf
ElecGasWater Construction Trade Repairs Hotel_Cafe Transport CommunicSrvc
FinanceInsur OwnerDwellng PropBusSrvc GovAdminDfnc Education HealthCommun
CultuRecreat OtherService
```

2. How many margins commodities are there? 4

```
Trade  Hotel_Cafe  Transport  FinanceInsur
```

3. Header “ITEX” contains values for the coefficient IsIndivExp which is 1 for individual export commodities and 0 otherwise. TRADEXP is the name of the set containing individual exports?

Set TRADEXP # *Individual export commodities #* = (all,c,COM: IsIndivExp(c)>0.5);

What are the individual export commodities?

```
WoolMutton GrainsHay OtherAgric ForestFish Mining MeatDairy OthFoodProds
Textiles ClothingFtw Chemicals BasicMetals TransportEqp OthMachnEqp Transport
```

4. What are the names of the COEFFICIENTs used in ORANIG.TAB to represent the Armington elasticities? SIGMA1, SIGMA2, SIGMA3
From what Headers are their values read? 1ARM , 2ARM, 3ARM

5. What are the values used for the Armington elasticities? What do these parameters represent?
Which products have the highest elasticities? TransportEqp 4.17, 4.57, 5.03
Which have the lowest? C23 - C27, C29 - C37 zero

6. What is the value at basic prices of household consumption of imports of commodity "DrinksSmokes"? V3BAS("DrinksSmokes","imp") = 620
What is the value of household consumption of domestically-produced commodity "DrinksSmokes"?
V3BAS("DrinksSmokes","dom")= 5454

7. What is the value of capital rental for industry "ElecGasWater"?
V1CAP("ElecGasWater") = 10770

8. What is the value at basic prices of the intermediate input of domestically produced commodity "ElecGasWater" to production in industry "Mining" ?
V1BAS("ElecGasWater","dom","Mining") = 778

Consequences of the data

9. The COEFFICIENT used for the total labour bill in industry "i" is V1LAB_O(i).
   (a) What COEFFICIENT is used for the total cost in industry "i" (plus tax)? V1TOT(i)
   (b) What COEFFICIENT is used for the total factor input to industry "i"? V1PRIM(i)
   (c) What are the calculated values of these three coefficients for industry "Construction"?
   V1LAB_O("Construction") = 12055
   V1TOT("Construction") = 52099
   V1PRIM("Construction") = 24127
   (d) What is the share of labour in the total costs of industry "Construction" ?
   12055 / 52099= 0.23

10. (a) What is the total payments to labour summed over all industries (V1LAB_IO). 194981
   (b) What is the total primary factor payments for all industries? (V1PRIM_I) 378292
   (c) What is the share of labour in total factor cost for all industries? 194981/378292 = 52%

11. What is the value at purchasers prices of exports of domestically-produced commodity "BasicMetals"?
For example, what COEFFICIENT is this? V4PUR
what set element do you need to look up? V4PUR("BasicMetals")
then what header on file SUMMARY "4PUR"
V4PUR("BasicMetals") = 8149

12. What is the different between the Coefficients SALE, SALES and DOMSALES?
SALE is a matrix of sales of commodities both domestic and imported going the different destinations DEST (Interm, Invest, HouseH, Export, GovGE, Stocks, Margins);

```
Coefficient (all,c,COM)(all,s,SRC)(all,d,DEST) SALE(c,s,d) #sales aggregates #;
```

SALES is the total sales of domestic commodities

```
Coefficient (all,c,COM) SALES(c) # Total sales of domestic commodities #;
Formula     (all,c,COM) SALES(c) = SUM{d,DEST, SALE(c,"dom",d)};
```

DOMSALES is the sales of domestically produced goods to the local market (no exports)

```
Coefficient (all,c,COM) DOMSALES(c) # Total sales to local market #;
Formula     (all,c,COM) DOMSALES(c) = SALES(c) - V4BAS(c);
```

What is the value at basic prices of total sales of domestically-produced commodity "ElecGasWater"?
SALES("ElecGasWater")
In Header SALE select just domestic sales “dom”
("ElecGasWater", “dom”, Sum DEST) in header "SALE" = 20134

13. Which header in SUMMARY.HAR tells us about Sales structure? SALE
Look at Row shares for SALE(All COM, “dom”, All DEST).
Which industry sells the highest fraction of its output to investment? Construction = 90%
After that, which is second highest? Explain. TransportEqp = 46 %

14. Look at the header CSTM in SUMMARY.HAR which tells us about Cost structure.
What is unusual about the cost structure of "OwnerDwellng"? Labour cost zero
What does the production of this industry represent? Ownership and rental of dwellings.

15. The header MSHR in SUMMARY.HAR shows the import penetration for each commodity:
ratio of (sales of imported good)/(total domestic sales of domestic+imported good)

```
Coefficient  (all,c,COM) IMPSHR(c) # Share of imports in local market #;
Formula      (all,c,COM) IMPSHR(c) = V0IMP(c)/[TINY+DOMSALES(c)+V0IMP(c)];
Write IMPSHR to file SUMMARY header "MSHR";
```

Which commodity has the highest import penetration? OthMachnEqp = 61 %

16. Which header shows the share of exports of commodity c in total export earnings. (Use the value at purchasers' prices.) "4PUR"
What commodity has the greatest share? Mining = 0.28 (28%)

17. Use the header SALE to see the ratio of export sales to total sales of domestically-produced commodity c (using basic prices). Header "SALE" (All COM,"dom", All DEST)
Which commodities export more than 50 percent of the value produced?
WoolMutton 58% Mining 55%
Which commodities are not exported? Trade, Hotel_Cafe, OwnerDwellng

GDP questions

18. Are the values of Nominal GDP from the income and expenditure sides equal? Yes
Header EMAC (Total) = V0GDPEXP = 427804
Header IMAC (Total) = V0GDPINC = 427804

19. Nominal GDP from the expenditure side is often given by the formula

GDP = C + I + G + X - M

What COEFFICIENT names are used for C, I, G, X and M in the ORANIG TABLO Input file? (Look in the TAB file)
Find the values of all these quantities and verify whether the above formula is correct.
(Hint: Textbook definitions of GDP often ignore inventories.)

Fill in the following list of values: (Try header "EMAC".)

	Coefficient Name (in TAB file)	Value (in Summary file)	Share of GDP ("col" shareof EMAC)
C	= V3TOT	= 260587	= 61%
I	= V2TOT_I	= 92958	= 22%
G	= V5TOT	= 78703	= 18%
X	= V4TOT	=. 73157	= 17%
-M	= -V0CIF_C	= -77502	=-18%
Stocks=	V6TOT	= -98	=-0.02%
GDP	= V0GDPEXP	= 427804	= 100%

20. Nominal GDP from the income side is given by the formula

V0GDPINC = V1PRIM_I + V0TAX_CSI

What do V1PRIM_I and V0TAX_CSI represent? Fill in the following list of values :

Look at header IMAC in SUMMARY.HAR

```
V1PRIM_I = V1LND_I + V1LAB_IO + V1CAP_I = 378292

Share of GDP (V1PRIM_I / V0GDPINC)= 88.4%
```

		Share of GDP
V1LND	= 2736	= 0.6%
V1LAB_IO	= 194981	= 45.6%
V1CAP_I	= 180575	= 42.2%
V0TAX_CSI	= 49512	= 11.6%
V0GDPINC	= 427804	

Adding more statements to ORANIG.TAB

21. What is the value at purchasers' prices of the intermediate input of domestically-produced commodity BeefCattle to production in the MeatDairy industry ?
(First what COEFFICIENT is this? What set elements are you looking for - for example the set element for the commodity is "BeefCattle".)

To answer this, you will need to add a **WRITE** statement to the TABLO Input file ORANIG.TAB to report a COEFFICIENT calculated by FORMULA. It will appear in file SUMMARY.HAR.

Right at the end of the TAB file, add the WRITE statement:

```
Write
????? to file SUMMARY header "PUR1" longname "Intermediate purch. value";
```

Replace ????? with the right coefficient name.
V1PUR("Beefcattle","dom","MeatDairy" = 4309

Question: why not call the header "1PUR" ?. "1PUR" used already for V1PUR_SI

Calculating New Coefficients

22. The share of labour (V1LAB_O) in primary factor cost (V1PRIM) has a close connection to the concept of shortrun supply elasticity. Explain.
Add statements to the end of ORANIG.TAB which:
(a) define a new coefficient LABSHR dimensioned over IND.
(b) give the formula for LABSHR
(c) write LABSHR to the summary file with header "SHLB".

```
Coefficient (All,i,IND) LABSHR(i) ;
Formula(All,i,IND) LABSHR(i) = V1LAB_O(i) / V1PRIM(i) ;
Write LABSHR to file SUMMARY header "SHLB" longname
    " Share of labour in primary factor cost " ;
```

Basic, Margin and Tax Components for Main Users

23. Which commodity has the highest rate of tax ? (Use ViewHAR row shares feature).
Petrol_CoalP 34.9% of purchaser's price (Sum over "dom' and "imp")
What share of total commodity tax revenue does that good account for? (Use ViewHAR col shares feature). 30.8% of total commodity tax revenue

24. For which commodity does margins form the highest share of purchase cost?
ClothingFtw 46.5%

25. What is the value at purchasers prices of household consumption of domestically-produced commodity RubberPlastc? 1505

26. Adding all commodities together,
what fraction of purchasers' prices do commodity taxes form? 3.3%
For domestic commodities only? 3.0%
for imported commodities only? 5.1%

27. What % of government demands are imported? approx zero
What % of government spending is on Education? 21.5%

28. What is the value at purchasers' prices of household consumption of imports of commodity DrinksSmokes? 2013

HANDS-ON COMPUTING WITH ORANI-G
PART W: A Short-run Simulation:

A Five Percent Reduction in Real Wages

You are now going to perform a short run comparative static experiment simulating the effects of a five percent reduction in real wages for all occupations in all industries.

In WinGEM, select from the *Simulation* option in the main menu.

Simulation | ***GEMSIM Solve...***

The Command file ORANIGSR.CMF contains instructions for GEMSIM. ***Select*** the CMF file, ORANIGSR.CMF (an abbreviation for ORANIG Short Run). Look at ORANIGSR.CMF before you run the simulation. Choose the button ***Edit***.

The short-run closure is described in section 6 of the ORANI-G document and is listed in Table 3.

The solution method is **Johansen**. This gives a simple **one-step** approximation of the model's non-linear equations. The simple one-step is easier for an initial interpretation of the results.

method = Johansen ;

A better solution method is **Gragg** with a 2 4 6 multi-step solution followed by extrapolation. This produces results that are a good solution of the model's non-linear equations. However we have commented out this solution method and steps by placing an exclamation mark **!** at the start of these lines.

! method = **Gragg** ; *! alternative to above*
! steps = **2 4 6 ;**

We suggest you try both solution methods and compare the results. The Command file ORANIGSR.CMF gives the Johansen solution. To use the Gragg solution method, comment out the Johansen line with an exclamation mark and remove the exclamation marks from the Gragg lines and save with a different name ORANIGSR_G.CMF. Run the two simulations, then open both Solution files at once in ViewSOL.

Remember that the Johansen solution gives a set of results which satisfy the linearised equations in the TAB file exactly and the Gragg solution results do not satisfy the linear equations exactly. However the Gragg solution is a better solution to the non-linear equations of the model. The non-linear equations are the equations we really want to solve.

In analysing the results below, use the Johansen simulation ORANIGSR.SL4.

In the Command file ORANIGSR.CMF, the updated data file is called <cmf>.UPD. This means that the updated data file will be called ORANIGSR.UPD. This data file depends on the data and the simulation we are running.

The verbal description indicates that a short run simulation is being performed with a wage-cut shock.

In the Command file ORANIGSR.CMF that contains the Short-run closure, the list of exogenous variables is written out explicitly instead of using "swap" statements. For a short-run closure, the capital stock ***x1cap*** is exogenous and not shocked. This means that the capital stock is fixed for a short-run simulation. Check that the variable ***realwage*** is exogenous. You can only shock exogenous variables.

The shocked variable is ***realwage***. From the equations contained in ORANIG.TAB, what is the meaning of a 5 percent reduction in ***realwage***? Look at the equation E_realwage.

```
Equation E_realwage realwage = p1lab_io - p3tot;
```

How does ***realwage*** relate to the variable ***f1lab_io***? Look at Equations E_p1lab and E_p1lab_io.

```
Equation E_p1lab   # Flexible setting of money wages #
  (all,i,IND)(all,o,OCC)
    p1lab(i,o)= p3tot + f1lab_io + f1lab_o(i) + f1lab_i(o) + f1lab(i,o);

Equation E_p1lab_io
V1LAB_IO*p1lab_io = sum{i,IND, sum{o,OCC, V1LAB(i,o)*p1lab(i,o)}};
```

In Equation E_p1lab, the variables *f1lab_i, f1lab_o* and *f1lab* are exogenous and not shocked so they have a value of zero. So this equation means that all values of the variable p1lab(i,o) for all industries i and occupation o are the same. For all industries and all ocupations,

```
p1lab(i,o) =  p3tot + f1lab_io
```

Hence, from Equation E_p1lab_io, the share-weighted sum p1lab_io also equals this value:

p1lab_io = p3tot + f1lab_io

From equation E_realwage, *f1lab_io* must be the same as *realwage*.

Now exit from the editor and ***Run*** GEMSIM with the CMF file ORANIGSR.CMF.

Check the results in ViewSOL – this is a simple way to start looking at the changes and percentage changes in the solution.

In a later session you will learn to use the AnalyseGE tool – useful when you want to track down individual variables or coefficients or when you want to look at the relative size of terms in an equation.

A GUIDE TO THE INTERPRETATION OF THE REAL-WAGE-CUT SIMULATION

INTRODUCTION

Now that you have run a simulation and produced a solution, you will probably feel overwhelmed by the volume of numbers the model produces. The question you now face is how to make sense of the output.

We have prepared a series of questions that guide you to the answers of some interesting results. The questions are not exhaustive and you may think of many others that are of interest.

The questions we are asking below are designed to rationalise particular results in terms of the model's theoretical framework and underlying database. Often, it is difficult to unravel all of the mechanisms leading to a particular result. However, you need to attempt to rationalise results within the context of the main identifiable mechanisms of the model. This process, apart from giving you insights into a particular economic phenomenon, serves as an informal verification of the simulation's results.

The experiment you are analysing is based on a shock to a macroeconomic variable; the real wage. You may have noticed in the closure of the model that many macro variables are on the exogenous list. For example, on the supply-side of the economy, we fixed the level of capital usage by fixing capital in each industry (x1cap). On the demand side, we fixed domestic absorption (i.e., Gross National Expenditure: real household consumption, x3tot; aggregate real investment, x2tot_i, aggregate real other demands, x5tot; and aggregate real inventories). Therefore, in the closure for the real wage experiment, we have largely imposed the macroeconomic environment.

The constraints that our choice of macro environment places on the economy will be important in determining relative price changes, and therefore the responses of agents to the effects of the cut in real wages. It is handy if we keep the nature of the macro environment in the back of our minds when attempting to interpret the results. Figure 1 presents a schematic representation of the short-run macro environment.

In Figure 1, exogenous variables are depicted in rectangles and endogenous variables are depicted in ovals. The arrows indicate a plausible direction of causation between variables. Thus, on the supply-side of the macroeconomy, we have exogenised the capital stock, technology and the real wage. With the real wage given, the model can determine aggregate employment (why?). With employment, technology and capital determined, the model can determine aggregate output (GDP).

On the demand side, aggregate household consumption, investment, other demands (and inventories) are fixed. With GDP determined from the supply side and domestic absorption (household consumption, investment, government consumption and inventories) given, the trade balance must act as an endogenous ‘swing’ variable to satisfy the GDP identify. That is, if as a result of our shock GDP increases/decreases relative to domestic absorption, the trade balance must move toward surplus/deficit.

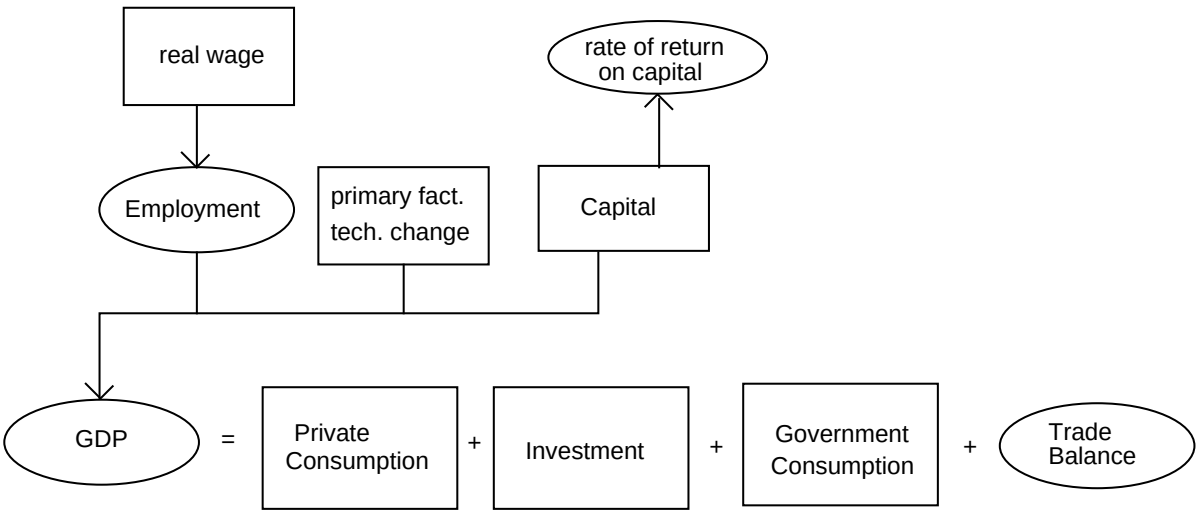

Figure 1. Schematic Representation of the Short-run closure of ORANI

We will interpret the results of the real wage cut beginning with the impact on some main macroeconomic variables. This will enable us to determine the consequences of the shock for the main endogenous macroeconomic variables, and in particular, the trade balance. This will give us insights into broad (economy-wide) relative price movements that result from the shock. A knowledge of the main relative price movements will help us interpret the industry results.

Fill in the following table with the results from this simulation:

Description	Variable	Value
Real household consumption	x3tot	0
Real investment	x2tot_i	0
Real government demands	x5tot	0
Export volume	x4tot	9.09
Import volume CIF	x0cif_c	0.39
Real GDP	x0gdpexp	1.48
Aggregate capital stock	x1cap_i	0
Aggregate employment	employ_i	3.01
Absorption price index*	p0gne	-3.71
GDP price index	p0gdpexp	-3.91
CPI	p3tot	-3.20
Exports price index	p4tot	-0.93
Real devaluation*	p0realdev	3.91
Average nominal wage	p1lab_io	-8.20
Average real wage	realwage	-5.00
Contribution of BOT to real GDP	contBOT	1.48
Terms of trade*	p0toft	-0.93
Aggregate primary factor use	x1prim_i	1.55

MACROECONOMIC RESULTS

Determining the impact on aggregate employment and output

1. First, check the results to see if the shock has been implemented correctly. You should check the value of the shocked variable ***realwage***
   the value of the variable ***f1lab_io***
   the economy-wide nominal wage ***p1lab_io***
   What is the difference between the values of ***p1lab_io*** and the CPI ***p3to***t.
   What are the values of ***p1lab***?

2. What effect do you expect the reduction of the real wage to have on aggregate employment? Verify your intuition by checking the value of aggregate employment ***employ_i***.

3. There are two variables in the model for real value added, commonly known as GDP at factor cost: ***x1prim_i*** and ***x0gdpfac***. Are these two values equal? Look at the equations for these variables.

   From the change in aggregate employment, can you verify the change in real aggregate value added *x0gdpfac*? Hint: find the equation for *x0gdpfac* that calculates the change in aggregate value added using the share weighted average of the percentage changes in real factor inputs (i.e., labour, capital and land).

   x0gdpfac= SL * employ_i + SC * x1cap_i + SN * x1lnd_i

   where SL, SC and SN are the shares of labour, capital and land in aggregate value added. How do you calculate the share of the wage bill in aggregate value added?
   [Hint: in looking at the data yesterday, you found
   V1LND_I(2736), V1LAB_IO(194981), V1CAP_I(180575).]

4. You will have noticed that both real GDP at factor cost ***x0gdpfac*** and real GDP at market prices ***x0gdpinc*** have increased, but with real GDP at factor cost rising by more than real GDP at market prices. The difference between the two aggregates is indirect taxes. The dominant effect on aggregate output is the change in employment and this causes GDP to increase (see equations determining contGDPinc and x0gdpinc).

Determining the composition of final demand

Now you have explained the change in GDP from the income side. Next we will attempt to explain the changes in the expenditure-side components of GDP.

5. Given the changes in real GDP and the components of national domestic absorption, what must happen to the change in the foreign trade balance? (Hint: be careful, don't use the variable delb which is the ordinary change in the nominal trade balance to GDP ratio. We wish to know the change in the real trade balance. The formula for the ordinary change in the real trade balance is
   (V4TOT*x4tot - V0CIF_C*x0cif_c)/V0GDPEXP.

   This will give you the ordinary change in the real trade balance in basecase values).
   Hint: Use Summary.har to look at the values of V4TOT, V0CIF_C and V0GDPEXP. Then calculate the expression (V4TOT*x4tot - V0CIF_C*x0cif_c)/V0GDPEXP.

   Look at the variables ***contGDPexp*** and ***contBOT***.

   How is the trade balance being moved? By a change in imports (***x0cif_c***) or a change in exports (***x4tot***) or by some combination?

6. Movements in the international trade balance occur due to activity effects and relative price effects. Changes in domestic demand (with given prices) will tend to change the demand for imports - an

activity effect. Changes in international competitiveness (changes in domestic costs relative to foreign prices/costs) will change foreign export demands and domestic demand for imports. How do you think exports and imports are responding in this simulation? What is the activity effect? Hint: imports are demanded for intermediate use as well as for final use. What is the relative price effect? Hint, check the variable ***p0realdev***.

Now we turn our attention to the results at the industry level.

INDUSTRY RESULTS

7. Look at the industry output (***x1tot***) and employment responses(employ). Note some of the outstanding results (spend about 10 minutes).

You have probably noticed that some industries have performed better than others; the impact of the real wage shock changes the industrial structure of the economy. We will now attempt to explain the impact of the real wage shock on the industrial structure, exploiting insights gained from our interpretation of the macro results.

8. In our analysis of the macro economy, we noticed a move towards trade surplus. We argued that the movement to trade surplus required an improvement in international competitiveness, i.e., a reduction in domestic costs relative to foreign prices. We might speculate that the improvement in competitiveness would favour the traded goods industries, i.e., those industries that sell a large share of their output to foreigners and/or which compete in domestic markets with imports. Can you verify that the traded goods industries do well (x1tot and employ)? Hint: note elements of the set *tradexp* in ORANIG TABLO Input file. Using ViewHAR to look at the header array file SUMMARY.HAR, check sales shares of industries contained in the header "SALE" to further identify export oriented industries, import competing industries and non-traded-sector industries.

   Look also at the results of the Fan decomposition, which you will see by clicking open the variable ***fandecomp*** using ViewSOL. The first column of numbers in the Fan decomposition (LocalMarket) shows us by how much we would expect local-commodity output to change, if output of the local commodity increased in line with the change in domestic demand for the commodity regardless of source (i.e., domestic or imported). The second column of numbers (DomShare) can be interpreted as the amount by which local-commodity output changes due to a relative price change favouring import replacement. The third column of numbers (Export) shows the contribution to the change in the output of the local commodity, brought about by the change in exports. The last column (Total) is the sum of the values in columns 1 to 3. For example, the increase in textile output is 4.9 per cent (last column of the Fan decomposition). Column 1 of the Fan decomposition can be interpreted as saying that given the increase in domestic demand for textiles (local and imported), we may have anticipated the rise in output to be 2.1 per cent. However, column 2 can be interpreted as saying that due to a relative price change favouring locally produced texiles, output of the domestic textile industry increased by an additional 0.7 percentage points (over the growth in local demand). The third column shows that increased export demand accounted for 2.1 percentage points of the total expansion in textile production.

9. Can you explain any anomalies? That is, do you find any seemingly traded-goods industries that perform poorly or non-traded goods industries that perform well? Hint: remember the underlying input-output linkages in the model.

10. Can you explain the performance of the dwelling ownership industry? Hint: what is its composition of primary factor inputs to the production process? Who are its main customers?

11. Can you explain the performance of the construction industry? Hint: what is its sales pattern, i.e., who are its main customers and for what purpose do they buy the construction commodity? (Try to explain why demand is moving the way it is.)

12. Can you explain the performance of the government industry?

13. Can you explain why total indirect tax revenue falls despite a general increase in economic activity? Hint: for which uses are indirect taxes the highest? (Also, don't forget that tariffs are indirect taxes.) Has indirect tax revenue increased *in real terms*?

```
! Command file for ORANIG model, short-run closure

check-on-read elements = warn; ! very often needed
cpu=yes ; ! (Optional) Reports CPU times for various stages
log file = yes;  ! Optional
auxiliary files = ORANIG; ! needed by GEMSIM

! Solution method
!method = GRAGG ;
!steps = 2 4 6 ;
method = johansen; ! alternative to above

! Data and summary file
file basedata = BaseData.har ;
updated file basedata =<cmf>.upd;
file summary  = summary.har;

! Closure

! Exogenous variables constraining real GDP from the supply side
exogenous  x1cap               ! all sectoral capital
           x1lnd               ! all sectoral agricultural land
           a1cap a1lab_o a1lnd
           a1prim a1tot a2tot  ! all technological change
           realwage ;          ! Average real wage

! Exogenous settings of real GDP from the expenditure side
exogenous  x3tot               ! real private consumption expenditure
           x2tot_i             ! real investment expenditure
           x5tot               ! real government expenditure on goods
           delx6 ;             ! real demands for inventories by commodity

! The demand curves of exports are fixed in both quantity and price axes
exogenous  f4p f4q               ! individual exports
           f4p_ntrad f4q_ntrad ; ! collective exports
! Exogenous foreign prices of imports ;
exogenous  pf0cif ;

! All tax rates are exogenous
exogenous  delPTXRATE f0tax_s  f1tax_csi f2tax_csi f3tax_cs f5tax_cs t0imp
           f4tax_trad f4tax_ntrad f1oct ;

! distribution of government demands !
exogenous  f5 ;

! The nominal exchange rate is the numeraire
exogenous phi ;

! Number of households and their consumption preferences are exogenous
exogenous q a3_s ;

exogenous capslack; ! switch off aggregate capital constraint !

! Distribution of investment between industries
xSet EXOGINV  # 'exogenous' investment industries #
 (ElecGasWater, Construction, FinanceInsur, OwnerDwellng,
  PropBusSrvc, GovAdminDfnc, Education, HealthCommun);
xSubset EXOGINV is subset of IND;
xSet ENDOGINV # 'endogenous' investment industries # = IND - EXOGINV;
exogenous finv1(ENDOGINV); ! investment linked to profits
exogenous finv2(EXOGINV);  ! investment follows aggregate investment


! Exogenous variables for regional extension
exogenous    freg1 freg2 freg3 freg4 freg5 freg6;
exogenous    rsum1 rsum2 rsum3 rsum4 rsum5 rsum6;

rest endogenous ;

verbal description =
 ORANIG: Wage cut, DPSV shortrun closure;

shock   realwage = -5 ;     ! real wage shift variable
```

HANDS-ON COMPUTING WITH ORANIG
PART W: A Short-run Simulation:

A Five Percent Reduction in Real Wages

A GUIDE TO THE INTERPRETATION OF THE REAL-WAGE-CUT SIMULATION

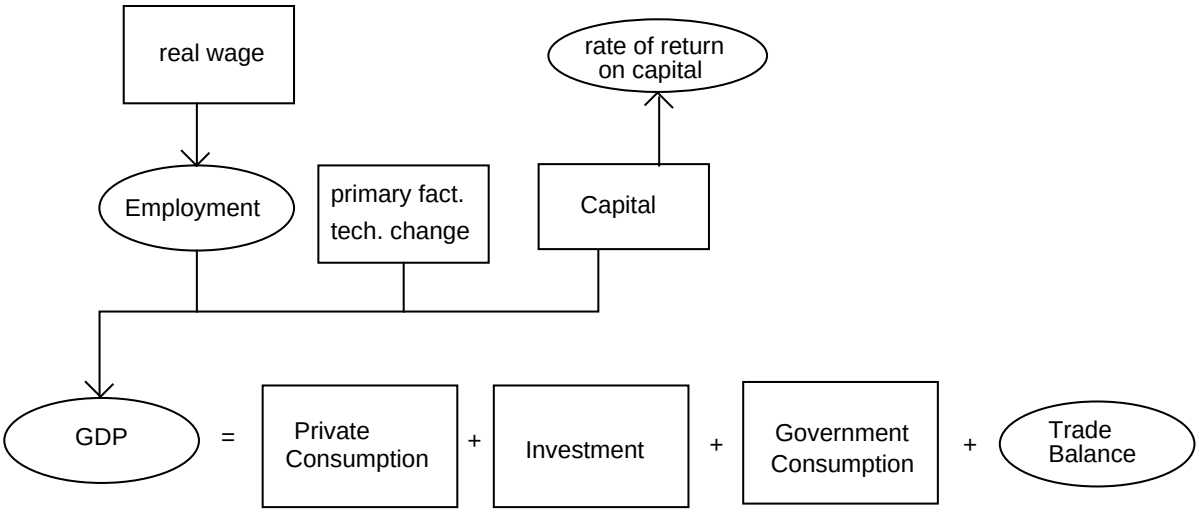

Figure 1. Schematic Representation of the Short-run closure of ORANI

Description	Variable	Value
Real household consumption	x3tot	0
Real investment	x2tot_i	0
Real government demands	x5tot	0
Export volume	x4tot	9.09
Import volume CIF	x0cif_c	0.39
Real GDP	x0gdpexp	1.48
Aggregate capital stock	x1cap_i	0
Aggregate employment	employ_i	3.01
Absorption price index*	p0gne	-3.71
GDP price index	p0gdpexp	-3.91
CPI	p3tot	-3.20
Exports price index	p4tot	-0.93
Real devaluation*	p0realdev	3.91
Average nominal wage	p1lab_io	-8.20
Average real wage	realwage	-5.00
Contribution of BOT to real GDP	contBOT	1.48
Terms of trade*	p0toft	-0.93
Aggregate primary factor use	x1prim_i	1.55

MACROECONOMIC RESULTS

Determining the impact on aggregate employment and output

1. First, check the results to see if the shock has been implemented correctly. You should check the value of the shocked variable ***realwage*** -5.0
   the value of the variable ***f1lab_io*** -5.0
   the economy-wide nominal wage ***p1lab_io*** -8.2
   What is the difference between the values of ***p1lab_io*** and the CPI ***p3tot***. –8.2 – (-3.2) = -5.0
   What are the values of ***p1lab***? –8.2 for all occupations and industries

2. What effect do you expect the reduction of the real wage to have on aggregate employment? Verify your intuition by checking the value of aggregate employment ***employ_i***. 3.01% increase

3. There are two variables in the model for real value added, commonly known as GDP at factor cost: ***x1prim_i*** and ***x0gdpfac***. Are these two values equal? Look at the equations for these variables.
   x1prim_i = 1.55, x0gdpfac = 1.55
   From the change in aggregate employment, can you verify the change in real aggregate value added *x0gdpfac*? Hint: find the equation for *x0gdpfac* that calculates the change in aggregate value added using the share weighted average of the percentage changes in real factor inputs (i.e., labour, capital and land).

   x0gdpfac= SL * employ_i + SC * x1cap_i + SN * x1lnd_i

   where SL, SC and SN are the shares of labour, capital and land in aggregate value added. How do you calculate the share of the wage bill in aggregate value added?
   [Hint: in looking at the data yesterday, you found
   V1LND_I(2736), V1LAB_IO(194981), V1CAP_I(180575).]
   SL = 194981/378292 = 0.515, employ_i = 3.01, x1cap_i = 0, x1lnd_i = 0
   SL*employ_i = 0.515 * 3.01 = 1.55 = x0gdpfac
4. You will have noticed that both real GDP at factor cost ***x0gdpfac*** and real GDP at market prices ***x0gdpinc*** have increased, but with real GDP at factor cost rising by more than real GDP at market prices. The difference between the two aggregates is indirect taxes. The dominant effect on aggregate output is the change in employment and this causes GDP to increase. Look at the equation E_x0gdpinc and the variable contGDPinc to see the effect of the different terms that make up real GDP at market prices.
   x0gdpinc = 1.484

Use contgdpinc to decompose x0gdpinc into contributions from Land, Labour, Capital, Indirect Taxes and Tecnical change.

contGDPinc	
Land	0
Labour	1.373
Capital	0
IndTax	0.111
TechChange	0
Total=x0gdpinc	1.484

Determining the composition of final demand

Now you have explained the change in GDP from the income side. Next we will attempt to explain the changes in the expenditure-side components of GDP.

Given the changes in real GDP and the components of national domestic absorption, what must happen to the change in the foreign trade balance? (Hint: be careful, don't use the variable delb which is the ordinary change in the nominal trade balance to GDP ratio. We wish to know the change in the real trade balance. The formula for the ordinary change in the real trade balance is

Real Trade balance= (V4TOT*x4tot - V0CIF_C*x0cif_c)/100.

This will give you the ordinary change in the real trade balance in basecase values).
Hint: Look at the values of V4TOT, x4tot, V0CIF_C, x0cif_c. Then calculate the expression (V4TOT*x4tot - V0CIF_C*x0cif_c)/100.
V4TOT = 73157, x4tot = 9.09, V0CIF_C = 77502, x0cif_c = 0.39
(V4TOT*x4tot - V0CIF_C*x0cif_c)/100.
= 73157 * 9.09 - 77502 * 0.39 = 6350
Real Balance of trade = 6350
Look at the variables ***contGDPexp*** (the contributions to real GDP from the expenditure side) and ***contBOT*** (the contribution of the Balance of trade to real GDP from the expenditure side).
ContGDPexp

Consumption	0
Investment	0
Government	0
Stocks	0
Exports	1.555
Imports	-0.071
Total	1.484

ContBOT = 1.484

How is the trade balance being moved? By a change in imports (***x0cif_c***) or a change in exports (***x4tot***) or by some combination? Both, but exports larger

5. Movements in the international trade balance occur due to activity effects and relative price effects. Changes in domestic demand (with given prices) will tend to change the demand for imports - an activity effect. Changes in international competitiveness (changes in domestic costs relative to foreign prices/costs) will change foreign export demands and domestic demand for imports. How do you think exports and imports are responding in this simulation? What is the activity effect? Hint: imports are demanded for intermediate use as well as for final use. What is the relative price effect? Hint, check the variable ***p0realdev***. 3.91 = real devaluation

Now we turn our attention to the results at the industry level.

INDUSTRY RESULTS

7. Look at the industry output (***x1tot***) and employment responses(employ). Note some of the outstanding results (spend about 10 minutes).

IND	x1tot	employ	COM:	fandecomp	LocalMarket	DomShare	Export	Total	Expshr	Impshr	Indiv
			WoolMutton		1.31	0	-0.31	1	0.58	0	1
BroadAcre	1.52	8.88	GrainsHay		1.49	-0.01	-0.61	0.87	0.44	0.01	1
OtherAgric	1.72	6.74	BeefCattle		1.96	0	0.72	2.67	0.03	0	0
ForestFish	3.9	6.31	OtherAgric		1.5	0	0.22	1.72	0.1	0.04	1
Mining	1.61	6.35	ForestFish		1.25	0.05	2.6	3.9	0.13	0.03	1
MeatDairy	2.09	3.5	Mining		1.08	0.04	0.52	1.63	0.56	0.2	1
OthFoodProds	3.93	7.34	MeatDairy		0.36	0.01	1.74	2.1	0.34	0.02	1
DrinksSmokes	2.23	5.88	OthFoodProds		0.48	0.12	3.33	3.93	0.21	0.14	1
Textiles	4.88	8.66	DrinksSmokes		0	0.14	2.11	2.25	0.08	0.1	0
ClothingFtw	4.7	6.67	Textiles		2.06	0.72	2.11	4.89	0.22	0.41	1
WoodProds	4.57	6.92	ClothingFtw		0.35	1.35	2.99	4.69	0.13	0.39	1
PaperPrint	2.83	5.2	WoodProds		1.6	0.54	2.42	4.56	0.09	0.18	0
Petrol_CoalP	2.37	19.64	PaperPrint		1.53	0.59	0.71	2.83	0.03	0.18	0
Chemicals	3.87	8.41	Petrol_CoalP		0.72	-0.34	2.04	2.42	0.08	0.15	0
RubberPlastc	4	6.88	Chemicals		1.9	0.28	1.7	3.88	0.14	0.38	1
NonMetlMinrl	1.68	3.37	RubberPlastc		2.21	0.69	1.11	4.01	0.04	0.32	0
BasicMetals	4.29	8.8	NonMetlMinrl		0.79	0.16	0.73	1.68	0.03	0.13	0
FabMetalPrd	3.45	5.31	BasicMetals		2.28	0.07	1.99	4.34	0.39	0.14	1
TransportEqp	4.56	8.37	FabMetalPrd		1.78	0.55	1.12	3.45	0.04	0.15	0
OthMachnEqp	4.73	8.4	TransportEqp		0.89	1.78	1.91	4.57	0.11	0.41	1
MiscManuf	3.31	4.89	OthMachnEqp		0.86	0.31	3.59	4.76	0.19	0.62	1
ElecGasWater	0.94	3.85	MiscManuf		0.28	0.62	2.4	3.3	0.09	0.25	0
Construction	-0.1	-0.19	ElecGasWater		0.9	0	0.04	0.94	0	0	0
Trade	1.09	1.86	Construction		-0.1	0	0.01	-0.09	0	0	0
Repairs	0.94	2.31	Trade		1.09	0	0	1.09	0	0	0
Hotel_Cafe	0.8	1.1	Repairs		0.97	0	0.06	1.03	0	0	0
Transport	2.76	6.24	Hotel_Cafe		0.8	0	0	0.8	0	0	0
CommunicSrvc	2.13	4.9	Transport		0.74	0.11	1.92	2.76	0.16	0.12	1
FinanceInsur	1.5	3.19	CommunicSrvc		0.96	-0.01	1.22	2.18	0.05	0.06	0
OwnerDwellng	0	2.49	FinanceInsur		1.04	-0.01	0.46	1.5	0.02	0.02	0
PropBusSrvc	2.01	3.31	OwnerDwellng		0	0	0	0	0	0	0
GovAdminDfnc	0.28	0.31	PropBusSrvc		1.3	-0.01	0.68	1.97	0.03	0.03	0
Education	1.62	1.75	GovAdminDfnc		0.17	0	0.11	0.28	0	0	0
HealthCommun	0.94	1.13	Education		0.5	-0.02	1.14	1.62	0.04	0.01	0
CultuRecreat	0.93	1.6	HealthCommun		0.91	0	0.03	0.94	0	0	0
OtherService	0.94	1.11	CultuRecreat		0.83	0	0.11	0.93	0	0.01	0
			OtherService		1.07	-0.15	0.02	0.94	0	0.16	0

8. In our analysis of the macro economy, we noticed a move towards trade surplus. We argued that the movement to trade surplus required an improvement in international competitiveness, i.e., a reduction in domestic costs relative to foreign prices. We might speculate that the improvement in competitiveness would favour the traded goods industries, i.e., those industries that sell a large share of their output to foreigners and/or which compete in domestic markets with imports. Can you verify that the traded goods industries do well (x1tot and employ)? Hint: note elements of the set *tradexp* in ORANIG TABLO Input file. Using ViewHAR to look at the header array file SUMMARY.HAR, check sales shares of industries contained in the header "SALE" to further identify export oriented industries, import competing industries and non-traded-sector industries.

FACTOR	1 Lab	2 Cap	3 Lnd	Total
1 BroadAcre	0.171	0.555	0.274	1
2 OtherAgric	0.255	0.54	0.205	1
3 ForestFish	0.618	0.382	0	1
4 Mining	0.254	0.746	0	1
5 MeatDairy	0.599	0.401	0	1
6 OthFoodProds	0.535	0.465	0	1
7 DrinksSmokes	0.38	0.62	0	1
8 Textiles	0.563	0.437	0	1
9 ClothingFtw	0.705	0.295	0	1
10 WoodProds	0.661	0.339	0	1
11 PaperPrint	0.544	0.456	0	1
12 Petrol_CoalP	0.12	0.88	0	1
13 Chemicals	0.46	0.54	0	1
14 RubberPlastc	0.582	0.418	0	1
15 NonMetlMinrl	0.497	0.503	0	1
16 BasicMetals	0.488	0.512	0	1
17 FabMetalPrd	0.65	0.35	0	1
18 TransportEqp	0.544	0.456	0	1
19 OthMachnEqp	0.563	0.437	0	1
20 MiscManuf	0.677	0.323	0	1
21 ElecGasWater	0.244	0.756	0	1
22 Construction	0.5	0.5	0	1
23 Trade	0.586	0.414	0	1
24 Repairs	0.408	0.592	0	1
25 Hotel_Cafe	0.725	0.275	0	1
26 Transport	0.441	0.559	0	1
27 CommunicSrvc	0.435	0.565	0	1
28 FinanceInsur	0.471	0.529	0	1
29 OwnerDwellng	0	1	0	1
30 PropBusSrvc	0.607	0.393	0	1
31 GovAdminDfnc	0.907	0.093	0	1
32 Education	0.927	0.073	0	1
33 HealthCommun	0.831	0.169	0	1
34 CultuRecreat	0.586	0.414	0	1
35 OtherService	0.848	0.152	0	1

9. Can you explain any anomalies? That is, do you find any seemingly traded-goods industries that perform poorly or non-traded goods industries that perform well? Hint: remember the underlying input-output linkages in the model.
   Traded Low labour share BroadAcre, Agric, Mining, Petrol_coalP poor
   Nontraded High labour share Education, HealthCommun well

10. Can you explain the performance of the dwelling ownership industry? Hint: what is its composition of primary factor inputs to the production process? Who are its main customers? No labour, Households, x3tot = 0

11. Can you explain the performance of the construction industry? Hint: what is its sales pattern, i.e., who are its main customers and for what purpose do they buy the construction commodity? (Try to explain why demand is moving the way it is.) OwnerDwellings, Investment, x2tot_i = 0

12. Can you explain the performance of the government industry? x5tot = 0 exogenous

13. Can you explain why total indirect tax revenue falls despite a general increase in economic activity? Hint: for which uses are indirect taxes the highest? (Also, don't forget that tariffs are indirect taxes) DrinksSmokes(Households), Petrol_CoalP(Intermed)

Percentage Change Examples

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Levels form	100*ordinary change	Percentage change
X	Xx	$x = 100\Delta X/X$
$3X$	$3Xx$	x
XY	$XY(x+y)$	$x+y$
X/Y	$(X/Y)(x-y)$	$x-y$
X^{α}	$X^{\alpha}(\alpha x)$	αx
$X+Y$	$Xx+Yy$	$(Xx+Yy)/(X+Y)$ $= S_x x + S_y y$ where $S_x = X/(X+Y)$, $S_y = 1-S_y$
In the examples below we assume *a vector of quantities X_i, total X.* *a vector of prices P_i, average P.* *a vector of values V_i, total V, such that $V_i = P_i X_i$, (thus $v_i = p_i+x_i$).* *that $V = PX$, (thus $v = p+x$).*		
Adding up quantities (rare)		
$X = \Sigma X_i$	$Xx = \Sigma X_i x_i$	$x = \Sigma S_i x_i$ where $S_i = X_i/X$
Adding up quantities with a common price P (frequent)		
$PX = P\Sigma X_i$	$PXx = \Sigma PX_i x_i$ or $Vx = \Sigma V_i x_i$ or $\Sigma V_i(x-x_i) = 0$	$x = \Sigma S_i x_i$ where $S_i = V_i/V$
Adding up values		
$V = \Sigma V_i$	$Vv = \Sigma V_i v_i$ or $V(p+x) = \Sigma V_i(p_i+x_i)$	$v = \Sigma S_i(p_i+x_i)$ where $S_i = V_i/V$
Decomposing value changes into indices of price and quantity change		
$V = \Sigma V_i$	$V(p+x) = \Sigma V_i(p_i+x_i)$	from $v = \Sigma S_i(p_i+x_i)$ price part: $p = \Sigma S_i p_i$ quantity part: $x = \Sigma S_i x_i$ so $v = p + x$
CES (no tech change)		
$X = CES(X_i)$		$x_i = x - \sigma(p_i-p)$ where $p = \Sigma S_i p_i$ implying $x = \Sigma S_i x_i$
CES (with tech change, $a_i<0$ for progress)		
$X = CES(X_i/A_i)$		$x_i-a_i = x - \sigma(p_i+a_i-p)$ where $p = \Sigma S_i(p_i+a_i)$ implying $x = \Sigma S_i(x_i-a_i)$
Ordinary change in a ratio		
$R = X/Y$	$Rr = 100\Delta R = (X/Y)(x-y)$ $100\Delta R = R(x-y)$	$100(\Delta R)/R = r = x - y$
$N = (X-M)/(X+M)$	$200(X+M)(X+M)\Delta N = 4MX(x-m)$	$200\Delta N = (1-N^2)(x-m)$

Using AnalyseGE to examine an ORANI-G tariff cut simulation

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Summary

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).

AnalyseGE is a software tool that assists modellers to move quickly between these different information sources. The AnalyseGE interface gives users "point and click" access to the equations of the model, the data, and the simulation results. In particular a modeller can click on any equation and ask the software to group the terms into different natural parts, and give the numerical values of each term. This greatly reduces the burden associated with analysing simulations, and offers the potential for significantly boosting the productivity of applied general equilibrium modellers.

This document illustrates the use of AnalyseGE by means of an example: a tariff cut simulation using the ORANI-G model. The example is presented as exercises for the reader to follow.

This document is divided into three parts:

Part 1 contains sections 1 and 2,
Part 2 contains section 3,
Part 3 contains sections 4 to 12.

This is because the exercises in this document need about three Computer Lab sessions to complete, and the different parts correspond roughly to the three Lab sessions.

CLASS EXERCISES:

Throughout the document there are questions. Write your answer to the right of each question.

Table of Contents

1 Running the tariff cut simulation

The simulation shows the short-run effects of a reduction in the tariff on imported Clothing and Footwear. In the early 1980's, when ORANI was developed, Australian tariffs were higher than today, and tariff cut simulations were a major focus of ORANI work.

The details of the simulation are contained in the file TARFCUT.CMF. Briefly examine this file using TABmate:

What variable is shocked and by what value? *t0imp("ClothingFtw") = -10%*

What type of closure is used? *standard shortrun*

Using TABmate, search through ORANIG.TAB and find the description (between # characters) of the shocked variable.

Now run the TARFCUT simulation using WinGEM.

When using WinGEM the first step is always to specify the location of the working directory. Choose:

File | Change both default directories

and check that the working directory is set to C:\GPWORK\ORANIG.

Let us review the three steps in running a simulation.

- Step 1 - Implement the model with TABLO
- Step 2 - Solve the equations of the model with GEMSIM
- Step 3 - View the results with ViewSOL

To carry out Step 1, choose

Simulation | TABLO Implement

A window for TABLO will appear. Click the Options menu item at the top of this TABLO window and select "Run from STI file". Then click on the ***Select*** button to select the name of the STI file, ORANIG.STI.

Click on the ***Run*** button.

Because we have not changed the TABLO Input file of the model, there is no need to run TABLO. However we have included this step for practice in running TABLO.

To carry out Step 2, choose

Simulation | GEMSIM Solve

Select the Command file for this simulation called TARCUT.CMF. Click on the ***Run*** button and wait until the simulation has finished.

To carry out Step 3, select the ***Go to ViewSOL*** button and look at the results of the simulation in the file TARFCUT.SL4.

1.1 A first look at the results using ViewSOL

First check that the right shock was applied—examine the variable ***t0imp***. Set the number of decimal places to 2. Then have a look at the imports vector ***x0imp***. Only two values are much different from zero.

What happened to imports of ClothingFtw? *x0imp("ClothingFtw") = 9.68%*

What other import changed, and by how much? *x0imp("Textiles") = -1.17%*

Now have a look at the industry outputs, ***x1tot***.

What happened to output of ClothingFtw? *x1tot("ClothingFtw") = -3.51%*

What happened to output of Textiles? *x1tot("Textiles") = -0.23%*

Can you see a pattern in the other industry outputs?

Traded (upper half) expand, non-traded (lower half) static.

Summary: The results for "ClothingFtw" are as you would expect. You have decreased the tariff on Clothing and Footwear, so the imports of Clothing and Footwear increase and the domestic output of Clothing and Footwear decreases. We need to look more closely at "Textiles" to see what is causing the textiles results above.

1.1.1 The Fan Decomposition

The **Fan decomposition** variable ***fandecomp*** shows how the change in demand for a locally-produced commodity, say, textiles, may be divided between:

- local market effect: change in non-export demand for textiles *domestic plus imported*;
- domestic share effect: change in dom/imp ratio for textile demand.
- export effect: change in demand for textile exports

Examine the ***fandecomp*** variable and fill in the table below:

fandecomp	LocalMarket	DomShare	Export	Total
Textiles	*-0.70*	*0.15*	*0.27*	*-0.28*
ClothingFtw	*0.16*	*-5.38*	*1.70*	*-3.515*

Summary: You should see that, for Textiles, increased exports and weakened import competition failed to offset a shrinking local market, leading to a small output decline. For ClothingFtw, increases in both export and local demand were overwhelmed by increased import penetration, leading to a larger output decline.

1.1.2 Macro Variables

Now look at the **macro variables**. Macro variables are scalar variables that have just one component. Some of the macro variables are red (***x3tot, x2tot_I, x5tot, phi***). These red variables are exogenous in the simulation.

All the macro results except for the ***del…*** variables are percentage changes. Variables whose names start with ***del*** are ordinary changes.

Check whether all of the percentage changes in macro variables are less than one percent.

What variable is the numeraire in this simulation? The exchange rate (phi) or the CPI (p3tot)?

In ViewSOL you can copy the macro variables from the table shown on the screen into a spreadsheet. In the ViewSOL menu, select **Export | Copy** to copy the results to the clipboard. Next open the spreadsheet program Excel, and select the Excel menu item **Edit | Paste** to paste the values from the clipboard into Excel. You will see that ViewSOL has helpfully added the variable descriptions to the table.

If you are not sure what the asterisked variables are, search through the TAB file with TABmate to find the equations defining them.

Save the Excel file as TARFCUT.XLS in directory C:\GPWORK\ORANIG (but leave the file open).

Fill in the table of macro variables below.

Description	Variable	Value
Real household consumption	*x3tot*	*0*
Real investment	*x2tot_i*	*0*
Real government demands	*x5tot*	*0*
Export volume	*x4tot*	*0.42*
Import volume CIF	*x0cif_c*	*0.22*
Real GDP	*x0gdpexp*	*0.03*
Aggregate capital stock	*x1cap_i*	*0*
Aggregate employment	*employ_i*	*0.05*
Absorption price index*	*p0gne*	*-0.18*
GDP price index	*p0gdpexp*	*-0.19*
CPI	*p3tot*	*-0.21*
Exports price index	*p4tot*	*-0.05*
Real devaluation*	*p0realdev*	*0.19*
Average nominal wage	*p1lab_io*	*-0.21*
Average real wage	*realwage*	*0*
Contribution of BOT to real GDP	*contBOT*	*0.033*
Terms of trade*	*p0toft*	*-0.05*
Change in aggregate tariff revenue	*delV0tar_c*	*-223.47*

1.1.3 Results relating to Clothing and Footwear

Next, in ViewSOL, change the combo box at top left (the 'filter' box) from "Everything" to "ClothingFtw". This causes ViewSOL to show only results that relate to the ClothingFtw sector. On the ViewSOL Contents page, double-click the first item: *Vector elements matching ClothingFtw*. You will see the ClothingFtw part of each vector variable. Again, use **Export..Copy** to paste these results into another Excel sheet within TARFCUT.XLS. These results will be handy later on. Again save (but do not close) the Excel file.

Summary: As expected, the tariff cut caused the ClothingFtw and Textiles industries to contract, and imports to increase—all bad for GDP. Yet, employment and real GDP expanded —why ? And why did imports of textiles go down? Next you will use AnalyseGE to investigate the simulation in more detail.

2 Investigating results, data, and equations with AnalyseGE

Start AnalyseGE running by returning to the GEMSIM window in WinGEM and clicking on the button ***Go to AnalyseGE.*** Click on the **Select/Change** button and select the Solution file **TARFCUT.SL4** . This may happen automatically if you are starting AnalyseGE from WinGEM.

This Solution file contains the results of the ORANI-G tariff cut simulation.

2.1 Some features of AnalyseGE

AnalyseGE has 3 forms (or windows).

- the TABmate form which contains the model's TABLO Input file[1] (in this case ORANIG.TAB[2]). AnalyseGE extracts the TAB file from the Solution file. Much of the analysis can be done by selecting and clicking on variables and equations in the TABLO Input file, as you will see below.
- the ViewHAR form (which will show the numerical results of various calculations) and
- the AnalyseGE form (which is the form shown each time AnalyseGE starts).

To see these other windows, you use the Menu item ***Front*** or ***AnalyseGE*** (if you are in the TABMate window).

2.2 The tariff shock and duty-paid import prices.

Go to the TABmate form (which is probably already the top one of the three forms associated with AnalyseGE). If not, select ***Front | Bring TABmate to the front***.

AnalyseGE makes it easy to see the values of any variable or coefficient.

To see the value of a variable *t0imp*, find the declaration of variable *t0imp* (for example, search using the Search menu). **Left-click** anywhere in the declaration of *t0imp*. Then **right-click** anywhere on the TABmate form.[3] A menu will appear. Select the option **Evaluate this Variable**. A ViewHAR window will appear to show the values of all components of variable t0imp.

Confirm that the right tariff was reduced.

To get back to the TABmate window, select menu item ***Front | Bring TABmate to the front*** from ViewHAR's main menu.[4]

To see the corresponding feature for Coefficients, go to the top of the TABmate form (click there) and then search for the declaration of coefficient **TARFRATE(c)**. Look at the formula for this coefficient. Left-click on **TARFRATE** in the Coefficient statement, and then **right-click** and select the menu option **Evaluate this Coefficient**. Again the ViewHAR window will appear, with values for TARFRATE.

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[1] The TABLO Input file contains the equations of the model written in algebraic form.

[2] AnalyseGE may call this something like AN1.TAB. This file is put into a temporary directory after AnalyseGE extracts it from the Solution file.

[3] Your mouse has two (or possibly three) buttons. Left clicking uses the left-hand one, while right-clicking uses the right-hand one. In this document, we often just say "click" when we mean left-click. But we will not abbreviate "right-click".

[4] That is, first click on ***Front*** in the main menu, then select option ***Bring TABmate to the front*** from the menu which appears.

Write down the initial ad valorem tariff rate for ClothingFtw: *19.6%*

Note: the power of the tariff [t0imp] is defined as *one plus the ad valorem rate*.

Write down the initial power of the tariff for ClothingFtw: *1.196*

Write down the percentage change in t0imp("ClothingFtw"): *-10%*

Use the Windows calculator to compute the post-simulation power of the tariff for ClothingFtw: *1.0764*

Write down the post-simulation ad valorem rate: *7.64%*

You can also find the values of variables or coefficients from any equation or formula where they appear. To see this, return to the TABmate form, go to the top and then find the equation E_p0B . Left-click on the p0 term on *the* left-hand side (for example, between the "p" and the "0"). Then right-click and select menu option Evaluate (selection or coeff/var at cursor). Again the ViewHAR form will appear and you will see the values of variable p0.

Write down the percentage change in p0("ClothingFtw","imp"): *-10%*

Select menu item ***Front | Bring TABmate to the front*** to return to TABmate.

AnalyseGE lets you know which variables are exogenous and which are endogenous. Exogenous variables are coloured **red**; those not shocked are shown in italics and those shocked are bolded. Endogenous variables are **green** while variables which have been substituted out are coloured **grey** and shown in italics (which indicated that results are not available). If a variable has some components exogenous and some endogenous, the variable is coloured **purple**. Omitted variables are shown as red italics to indicate they have not been shocked. (However in the ViewHAR window, red just means that the value is negative.)

Summary: The ad valorem tariff rate fell from an initial value of 19.6% to 7.64% post simulation. This caused the basic price of imported ClothingFtw to fall by 10%.

2.3 Effect of the tariff cut on imports

Next we investigate the variable *x0imp*, aggregate imports. This variable appears in the next equation, E_delV0TAR. Click on *x0imp* and press the **Gloss** button at the top of TABmate.

A window appears, listing all statements in the TABLO file involving *x0imp*. The first mention defines the variable *x0imp*. The second mention is Equation E_x0imp, The name of the equation, "E_x0imp" suggest that this is the equation that explains variable x0imp. Line numbers are shown in red on the left side of the Gloss window. You can click on these red numbers to jump to that line. Use this method to jump to Equation E_x0imp. You should see:

```
Equation E_x0imp # Import volumes #
(all,c,COM)0.01*[TINY+V0IMP(c)]*x0imp(c)=sum{u,LOCUSER,delSale(c,"imp",u)};
```

The left hand side of this equation shows, for each commodity, the ordinary change in import volumes (measured at current prices). The right hand side shows how the total change in imports is split between various usage categories [Gloss on the set "LOCUSER" to see these categories].

Left-click on the *delSale* term on the right-hand side. Then **right-click** and select menu option **Evaluate (selection or coeff/var at cursor)**. Again the ViewHAR form will appear and you will see the values of variable delSale.

Above, ViewSOL told us that aggregate imports (*x0imp*) changed much only for 2 commodities: Textiles and ClothingFtw. The *delSALE* values show us which demanders are responsible for these changes.

Fill in the following delSale values:

delSale (c,"imp",u)	Intermediate	Household	Rest
Textiles	*-35.5*	*-1.5*	tiny
ClothingFtw	*48.3*	*204.7*	tiny

Summary: You should see that households account for most of the change in ClothingFtw imports. For textiles, most of the decrease is in intermediate use. Why did households increase their imports of ClothingFtw? [You will find out in the section 3.1.]

2.4 Strategy for remainder of analysis

In Part 2 of the ORANI-G tariff cut simulation, we will analyse more results for the ClothingFtw sector (section 3). Please find the document for Part 2 in your folder.

In Part 3 of the ORANI-G tariff cut simulation, we will

- analyse a few results for the Textiles sector (section 4).
- next, examine why some other industries expanded (section 5).
- last, comment briefly on macro results (section 6).

Using AnalyseGE to examine an ORANI-G tariff cut simulation

Part 2

In Part 2 of the ORANI-G tariff cut simulation, we will first, analyse more results for the ClothingFtw sector (section 3).

In Part 3 of the ORANI-G tariff cut simulation, we will

- analyse a few results for the Textiles sector (section 0).
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3 Analysing results for ClothingFtw

3.1 Import-domestic substitution : Household demand for ClothingFtw

In this section you will analyse why household demand for imports of ClothingFtw increased so much.

Go back to the TABmate window via the menu item ***Front | Bring TABmate to the front*** .

Again **Gloss** on delSale.and go to the following equation:

```
E_delSaleC (all,c,COM)(all,s,SRC)
delSale(c,s,"HouseH")=0.01*V3BAS(c,s)*x3(c,s);
```

V3BAS is a dollar amount while x3 is the percentage change in a quantity. Suppose that quantity units are determined by what one dollar will buy. Then V3BAS is also the initial quantity and the product V3BAS*x3 is 100 times the quantity change[5]. The 0.01 in the equation above cancels out this 100 and so the RHS is the quantity change (where one quantity unit is what one pre-simulation dollar will purchase).

For example, evaluate V3BAS, x3 and delSale for c=ClothingFtw and s=imp. A 9.12% increase in quantity x3 corresponds to a sales increase of 204.7 (delSale), from initial sales of 2243.2 (V3BAS).

Then **Gloss** on x3, and go to the following equation:

```
Equation E_x3  # Source-specific commodity demands #
(all,c,COM)(all,s,SRC)
x3(c,s)-a3(c,s) = x3_s(c) - SIGMA3(c)*[ p3(c,s)+a3(c,s) - p3_s(c) ];
```

The form of this CES demand equation is quite common in CGE modelling. The x3_s term on the right-hand side is the so-called "expansion effect". This dictates the increase in demand of each commodity from a given source, based on the overall increase in imp/dom composite for that commodity. If relative prices are unchanged, then this is the end of the story. The second term on the right-hand side of this equation is the "substitution effect". It captures the tendency to source products from the cheapest source. SIGMA3 is the elasticity of substitution between imported and domestic sources, and the negative of this value pre-multiplies the percentage change in the ratio of source-specific price to the average price. When one is conducting analysis of simulation results, it is often quite important to know how much of the change in import demand is due to the expansion effect, and how much is due to the substitution effect. The "intelligent" decomposition tool in AnalyseGE makes this easy to do.

[5] If X is the initial quantity, delX is the change in X, and pX is the percentage change in X, then pX=100*delX/X. Hence X*pX=100*delX.

In order to decompose the RHS of the equation above, click anywhere on this equation in the TABmate form. Then right click and select menu item **Decompose Part of this Equation**. Then, in the "Type of Decomposition" form, select **RHS** (in the top box) to indicate that you are seeking to decompose the right hand side of this equation, select **Intelligent** (in the middle box) to indicate that you want AnalyzeGE to adopt the usual decomposition approach to this demand equation, select **First** (in the third box) to indicate that you want the decomposition toggle to come first in the ViewHAR file. and finally, click **Ok**. In the ViewHAR form which appears, make sure that the combo boxes read "All IntDec1", "ClothingFtw", and "All SRC".

Fill in the table below

	1 dom	2 imp
1 x3_s	*0.55*	*0.55*
2 SIGMA3	*-5.77*	*8.57*
Total	*-5.22*	*9.13*

By definition, the expansion [x3_s] term is the same for both dom and imp ClothingFtw. In each case the substitution [SIGMA3] term is much more important. You can identify the separate parts of this. Use **Evaluate (selection or coeff/var at cursor)** to fill in the table below:

	x3 (c,"dom")	x3 (c,"imp")	x3_s	p3 (c,"dom")	p3 (c,"imp")	p3_s	SIGMA3	S3 (c,"imp")
ClothingFtw	*-5.220*	*9.124*	*0.552*	*-0.746*	*-4.801*	*-2.378*	*3.537*	*0.402*

The composite (average dom/imp) price is defined in the next equation, E_p3_s. Omitting a3 taste change terms, the two equations of this CES nest read:

```
E_x3        x3(c,s)  =  x3_s(c) - SIGMA3(c)*[ p3(c,s)- p3_s(c) ];
E_p3_s      p3_s(c) =  sum{s,SRC, S3(c,s)*p3(c,s)};
```

For c = ClothingFtw, using values from the table above,

```
p3_s(c) =  sum{s,SRC, S3(c,s)*p3(c,s)}
p3_s(c) = 0.598 * (-.746)  + 0.402 *(-4.801) = -2.378
```

the price of ClothingFtw composite p3_s has decreased by –2.38 %,

```
x3(c,"dom") = x3_s(c) - SIGMA3(c) * [p3(c,"dom")-p3_s(c)]
x3(c,"dom") = 0.554 – 3.54*[-0.746 – (-2.378)] = 0.55 - 5.77 = -5.22
```

there is substitution away from the domestic good (-5.22 %), towards the imported good (9.12 %).

```
x3(c,"imp"  = x3_s(c) - SIGMA3(c) * [p3(c,"imp")-p3_s(c)]
x3(c,"imp") = 0.554 – 3.54 *[-4.801 – (-2.378)] = 0.55 + 8.57 = 9.12
```

We could substitute out the p3_s average price variable to get:

```
x3(c,"dom") = x3_s(c) - SIGMA3(c)*S3(c,"imp")[p3(c,"dom")-p3(c,"imp")]
x3(c,"imp") = x3_s(c) - SIGMA3(c)*S3(c,"dom")[p3(c,"imp")-p3(c,"dom")]
```

In each case the substitution term consists of the product of: the Armington elasticity, a share, and the percent change in the ratio of domestic to imported prices. In the first equation, the term SIGMA3(c)*S3(c,"imp") [called the "import pressure"] show that domestic producers are more vulnerable to import competition where both Armington elasticity and import share are larger.

Summary: For ClothingFtw, the household purchasers price has changed by –0.75% (domestic) and by -4.80% (imported). This causes the household demand x3 to change by –5.22% (domestic) and 9.12% (imported) via a substitution away from the domestic good to the imported good.

3.2 Explaining purchasers' prices: Household imports of ClothingFtw

In section 3.1, you might have wondered why the price of imported ClothingFtw to households, p3("ClothingFtw","imp") [= -4.8%] only fell by about half as much as the duty-paid price of imported ClothingFtw, p0("ClothingFtw","imp") [=-10%]. To understand why, Gloss on the variable p3 and go to the equation E_p3:

```
Equation E_p3 # Purchasers prices - households #
 (all,c,COM)(all,s,SRC)
  [V3PUR(c,s)+TINY]*p3(c,s) =
   [V3BAS(c,s)+V3TAX(c,s)]*[p0(c,s)+ t3(c,s)]
    + sum{m,MAR, V3MAR(c,s,m)*[p0dom(m)+a3mar(c,s,m)]};
```

The above equation states that the purchasers' price, p3, is composed of three components: basic values, consumption tax, and trade and transport margins. You can see (by colours) in AnalyseGE that, in this simulation, the variable a3mar (technical change) is exogenous and unshocked (ie, 0). Also the variable t3 (tax rate) is zero for all commodities c and sources s. To see why, Gloss on t3, go to equation E_t3 and note that the two variables on the RHS are both exogenous and unshocked. Thus, although it is formally endogenous, the variable t3 is zero "almost exogenously". Now go back to the equation E-p3 (shown above) in TABmate. You can ignore the a3mar and t3 terms in this simulation.

If we divided both sides in equation E_p3 by V3PUR+TINY we would get the percent change equation:

$$p3 = [1-S_m]p0 + S_m p_m$$

where S_m is the share of margins in purchasers price, and p_m is the average change in the cost of margins. **Intelligently decompose** the RHS of equation E_p3 to see that the second, margin, term contributes relatively little to the above. **Evaluate** p0dom in equation E_p3 above to see that margins prices decrease by only a small amount.

The conclusion of the above must be that, for imported ClothingFtw, the $[1-S_m]$ share must be around 0.5. To check this, Gloss on V3PUR and go to the formula defining it:

```
(all,c,COM)(all,s,SRC)
   V3PUR(c,s) = V3BAS(c,s) + V3TAX(c,s) + sum{m,MAR, V3MAR(c,s,m)};
```

Right click and select **Decompose the RHS of this Formula**. In ViewHAR, set the combo boxes to "All IntDec?", "ClothingFtw", "All SRC" and choose Column Shares.

Fill in the table below.

	1 dom	2 imp
V3BAS	*0.483*	0.471
V3TAX	*0.001*	*0.003*
V3MAR	*0.516*	*0.526*
Total	1.000	1.000

Thus, when you divide both sides of equation E_p3 by V3PUR+TINY, this equation for c=ClothingFtw and s=imp tells us that

p3("ClothingFtw","imp") = 0.474*p0("ClothingFtw","imp") + 0.526*SUM(m,MARG,p0dom(m))

Here p0("ClothingFtw","imp") is –10 and the SUM(m,MARG,p0dom(m)) term is small. Thus the margins share of 0.526 explains why p3("ClothingFtw","imp") is only about –4.8. This is an example where a share from the base data is vital in understanding the size of results.

Summary: Because of local distribution costs, a 10% fall in the duty-paid price of a Chinese teeshirt leads to just a 4.8% fall in the retail price. The detailed treatment of margins is distinctive of the ORANI type of CGE model—and quite important to simulation results. ORANI-G includes a data summary matrix summarizing the proportions of BAS, MAR, and TAX in purchasers' prices.

Search for and evaluate the SALEMAT2 matrix.

Set combos to "All COM", "All FLOWTYPE", "imp", "HouseH". Which commodity has the highest rate of distribution margin, and why? *NonMetlMinrl: 66% [cement, gravel]*

What if you look at domestic commodities? [change “imp” to “dom”.]

3.3 Estimating household demand elasticities

In ORANI-G, intermediate, investment and government demands for composites (imp/dom combined goods) are insensitive to the prices of composites. For example, the Textiles industry will use composite ClothingFtw in proportion to Textiles output, regardless of composite-ClothingFtw price. For these users, the only substitution between commodities is import-domestic substitution. This is because the top nest in the intermediate demand nest is Leontief between composite commodities.[6]

Households, however, **do** substitute between composite commodities. As we saw, above, a fall in the price of composite ClothingFtw leads to a rise in household use (even though total household consumption x3tot is held fixed).

Use the changes in price and quantity to write down an estimate of the elasticity of household demand for ClothingFtw:

	x3_s	p3_s	demand elasticity = %x / %p	B3LUX
ClothingFtw	0.554	-2.378	*-0.233*	*0.25*

ORANI-G uses the linear expenditure system [LES] to model household demands. One way to think of LES is that demand for each composite good is split into two parts:

- a fixed or "subsistence" component representing necessities.
- a variable ("supernumerary") component representing luxuries.

The first part does not change, so its demand elasticity is zero. The second, supernumerary, part is modelled as Cobb-Douglas and so has a demand elasticitity near to -1. The total demand elasticity will be a share-weighted average of these two elasticities:

demand elasticity = (Fixed share) x 0 + (Luxury share) x -1

Above, the shares add to 1 and "Luxury share" is defined as:

[Value of supernumerary use of ClothingFtw]/[Value of all household use of ClothingFtw]

Therefore, the demand elasticity will be close to the [negative of the] value of the "Luxury Share". In the ORANI-G TAB file, this share corresponds to the coefficient B3LUX.

Search for and evaluate B3LUX("ClothingFtw") and fill the final column of the table above.

Is the value close to the previous estimate of demand elasticity? *Yes*

Why are the two estimates not identical ? [hard] *w3lux not fixed, slutsky income effect terms.*

[6] To see this, go to equation E_x1_s which is the equation for the Leontief top nest in the intermediate inputs demand theory. If you Evaluate terms you will see that x1tot(“Textiles”)=–0.232 and that x1_s(“ClothingFtw”,”Textiles”)=–0.232=x1_s(c,”Textiles”) for all other c, even though p1_s(“ClothingFtw”,”Textiles”)=–4.52 falls much more than p1_s(c,”Textiles”) for all other c.

3.4 Total demand for domestic ClothingFtw

We have seen in section 3.2 above that purchasers' prices of imported ClothingFtw to households fell directly as a result of the shock (even after taking account of margins). Of course the same happens for the purchasers' price of imported ClothingFtw used by firms. The amount of this fall can be understood using the equation E_p1 (which also involves margins).

We have seen in section 3.1 above that households substitute towards imported ClothingFtw, away from domestic ClothingFtw. This is because the shock has reduced the price of imported ClothingFtw.

For the same reason, firms (intermediate inputs) substitute towards imported ClothingFtw. There is an Armington nest in each case. For example, the equation for intermediate inputs x1 is E_x1:

```
Equation E_x1  # Source-specific commodity demands #
 (all,c,COM)(all,s,SRC)(all,i,IND)
  x1(c,s,i)-a1(c,s,i) = x1_s(c,i) -SIGMA1(c)*[p1(c,s,i) +a1(c,s,i) -p1_s(c,i)];
```

What about the other uses of imports of ClothingFtw? No ClothingFtw (imported or domestic) is used for capital creation, as the V2BAS values will show you. Also there is no change in government demands for ClothingFtw (domestic or imported) since total government demand x5tot is exogenous and fixed and there is no changes in government demands for the different commodities since the shifters f5 are exogenous and not shocked. Thus we can concentrate on intermediate and household demands.

Suppose for the moment that total demand for composite ClothingFtw remains approximately unchanged. Then, since more imports and less domestic are used for intermediate inputs and households, you can see that total demand for imported ClothingFtw will increase and total demand for domestic ClothingFtw must fall.

To see the sizes of the changes, search for the variable delSale and Evaluate it. Set the combo boxes to ClothingFtw/All SRC/All DEST.

Complete the following table (in which we ignore the columns which are all zero):

delSale ClothingFtw	Interm	HouseH	Export	Total
dom	*–62.7*	*–178.5*	*78.8*	*–162.5*
imp	48.3	204.7	0	253.0
Total	–14.3	*26.2*	78.8	90.6

These are changes in the dollar value. As expected from the discussion above, intermediate and household demand drop significantly[7] for the domestic commodity but increase for the imported commodity.

The only use of ClothingFtw we have not considered above is exports. The table above shows that exports (only the domestic is exported, the imported commodity cannot be re-exported in this model) do increase, but not by sufficient to offset the other declines. [You will look more closely at the size of this export increase in section 3.7 below.] Thus total demand for domestic ClothingFtw decreases. To see that another way, look at the value of x1tot("ClothingFtw") = -3.5%.

[7] To see the corresponding base values for which the delSales are changes, look at the values of the Coefficient SALEMAT2. Set the combo boxes to ClothingFtw/Basic/All SRC/All SALECAT2. For example, the pre-simulation basic value of sales of ClothingFtw is 4621 (from the SALEMAT2 values) and the change is –162.5 (from the delSALES results). Note that this ratio –162.5/4621 equals –0.0351 which is exactly the x1tot("ClothingFtw") result of –3.51 percent.

3.5 Why did domestically-produced ClothingFtw get cheaper ?

So far we have seen that the tariff cut caused imported ClothingFtw to become cheaper (relative to domestically-produced ClothingFtw) so that users switched from domestic to imported. However, the domestic price of ClothingFtw also decreased—this moderated the price difference between domestic and imports, and helped to protect demand for the domestic product.

Find and evaluate the variable p0 (basic prices) and fill in the two values below.

	s=dom	s=imp
p0("ClothingFtw",s)	*-1.416*	*-10*

3.5.1 Relation between commodity prices and industry costs

The price of the domestic ClothingFtw *commodity* is nearly equal to the output price of the ClothingFtw *industry*, p1tot.

What is the value of the output price for the industry, p1tot ? *-1.382%*

The two prices [p1tot, p0("dom")] would be identical if:

(a) all ClothingFtw commodity was made by the ClothingFtw industry; *and*

(b) the ClothingFtw industry made *only* the ClothingFtw commodity.

These conditions are only approximately satisfied. To check them, find and evaluate the MAKE matrix. Use ViewHAR's shares view to answer these 2 questions:

What fraction of ClothingFtw commodity is made by the ClothingFtw industry? *99.6%*

What fraction of ClothingFtw industry output is ClothingFtw commodity? *97.1%*

In compiling Input-output tables, most statistical bureaus build up industry statistics from facts about "establishments", eg individual factories. The factories are grouped according to the commodity that they *mainly* produce. As a result, we often find that "Textiles" factories produce as well a little ClothingFtw, while "ClothingFtw" factories produce as well a little Textiles. Small off-diagonal MAKE entries result from this statistical procedure.[8]

The main equations connecting industry prices to commodity prices are shown below:

```
Formula
 (all,i,IND) MAKE_C(i) = sum{c,COM, MAKE(c,i)};
Equation E_x1tot # Average price received by industries #
 (all,i,IND) p1tot(i) = sum{c,COM, [MAKE(c,i)/MAKE_C(i)]*pq1(c,i)};
Equation
 E_pq1  # Each industry gets the same price for a given commodity #
 (all,c,COM)(all,i,IND) pq1(c,i) = p0com(c);
```

Summary: You can see that if the ClothingFtw industry made *only* the ClothingFtw commodity, the share [MAKE(c,i)/MAKE_C(i)] would = 1, and so the prices p1tot and p0com for ClothingFtw would be identical.

Conclusion: We will have explained why domestically-produced ClothingFtw becomes cheaper if we explain why the output price p1tot("ClothingFtw") decreases. We do this in section 3.6 below.

[8] The ORANI-G data is based on an original commodity/industry input-output table. Often statistical bureaus will adjust the IO data to eliminate off-diagonal MAKE values, so producing an industry/industry or commodity/commodity IO table. In that case the MAKE matrix is perfectly diagonal (ie, redundant), so that the industry/commodity distinction vanishes.

3.6 Why did the output price p1tot("ClothingFtw") decrease?

In the absence of technological change, the output price of each industry, p1tot, can be expressed as a cost-share-weighted average of the price of each industry input. ORANI-G contains an equation, E_p1cst, which computes this average input cost.

Find the equation E_p1cst.

```
Equation E_p1cst  (all,i,IND) p1cst(i) =  [1/V1CST(i)]*[
  sum{c,COM,sum{s,SRC,  V1PUR(c,s,i)*p1(c,s,i)}}
                      +  V1OCT(i)    *p1oct(i)
                      +  V1CAP(i)    *p1cap(i)
                      +  V1LND(i)    *p1lnd(i)
            + sum{o,OCC, V1LAB(i,o)  *p1lab(i,o)}];
```

Evaluate the p1cst variable and check that

p1cst("ClothingFtw") = p1tot("ClothingFtw") = ? *-1.382*

Now left-click within equation E_p1cst, then right-click. Select **Decompose Part of this Equation**. This time click on **Complete** (rather than Intelligent) and, as previously, select RHS and Toggle first. The complete decomposition shows the contributions of each variable. The decomposition shond in ViewHAR shows you how each category of input price contributes to the total change, p1cst.

Fill in the table below:

ClothingFtw	contribution
1 p1	*-0.442*
2 p1oct	*-0.003*
3 p1cap	*-0.893*
4 p1lnd	*0*
5 p1lab	*-0.045*
Total p1cst	*-1.382*

You should see that p1 (material inputs) and p1cap (capital rentals) are much the largest contributors.

3.6.1 Breaking down the reduction in intermediate input prices?

You can use AnalyseGE to see which material inputs contributed to the negative p1 contribution. Return to the TABmate form and select with your mouse the expression *V1PUR(c,s,i)*p1(c,s,i)* .[9] Now **right-click** and select menu option Evaluate (selection or coeff/var at cursor). Again the ViewHAR form will appear and you will see the values of the expression *V1PUR(c,s,i)*p1(c,s,i)*.

Set the combo boxes to All COM/All SRC/ClothingFtw.

The numbers you see now are *dollar contributions* from price changes to total cost [ie, if they were divided by V1CST(i), they would show components of the percent change in p1cst]. Set ViewHAR to show *matrix shares* (the whole matrix adds to one) so you will see the share of each commodity and source in the whole p1 contribution.

[9] That is, left-click just to the left of the "V" in **V1PUR** and drag with your mouse until all of this expression is highlighted. [In fact, you don't have to be quite this precise since AnalyseGE knows where words start and end. So, for example, you could achieve the same by clicking just left of the U in V1PUR(c,s,i) and dragging only to the right of the 1 in p1(c,s,i).]

What share of the p1 contribution comes from price change in domestic ClothingFtw? *15%*

What share of the p1 contribution comes from price change in imported ClothingFtw? *68%*

- You should see that the largest matrix share corresponds to imported ClothingFtw. Thus cheaper clothing imports significantly reduce costs for the domestic clothing industry as well competing with it [these imports are probably semi-finished garments from Asia].
- The next biggest matrix share corresponds to domestic ClothingFtw. That is, cheaper domestic ClothingFtw also contributes significantly to cost reduction—implying that the industry is a customer of itself ! This is quite usual, especially when data has fewer (more aggregated) sectors[10].
- The other large matrix share corresponds to domestic Textiles. As you will see and explain later (see section 4.1), the price of domestic Textiles falls. This reduces the costs in the ClothingFtw industry since that industry uses significant intermediate inputs of domestic Textiles.

What share of ClothingFtw sales go to the ClothingFtw industry? [Hint: V1BAS/SALES[11]] *4.78%*

3.6.2 Why did the capital rental p1cap("ClothingFtw") decrease?

Above we saw that more than half of the reduction in input costs for ClothingFtw came from reduced capital rentals (p1cap).

In this shortrun closure of ORANI-G industry capitals stocks are fixed, and profits are a residual item. The CES between capital and labour in the production function implies a "declining marginal product of labour"—labour is less productive as the L/K ratio rises. Conversely, as output falls with K fixed, L (and thus L/K) must fall by more than output, so labour becomes more productive. You will confirm these assertions below.

To see this search for the equation E_p1cap. You should see equations like:

```
Equation
E_x1lab_o  # Industry demands for effective labour #
 (all,i,IND) x1lab_o(i) = x1prim(i) - SIGMA1PRIM(i)*[p1lab_o(i)-p1prim(i)];
E_p1cap    # Industry demands for capital #
 (all,i,IND) x1cap(i) = x1prim(i)-SIGMA1PRIM(i)*[p1cap(i)-p1prim(i)];
E_p1prim   # Effective price term for factor demand equations #
 (all,i,IND) V1PRIM(i)*p1prim(i) = V1LAB_O(i)*p1lab_o(i)+V1CAP(i)*p1cap(i);
```

Above, technical change variables and demands for land are omitted as irrelevant to this example.

Why is land irrelevant here? [Hint: Decompose RHS of formula for V1PRIM]
V1LND("ClothingFtw") = 0

For which industries would land be relevant? *BroadAcre, OtherAgric*

---

[10] The phenomenon of own-sales can lead to puzzling results. In Australian technical jargon, an industry which buys significant amounts of its own product is said to be "up-itself".

[11] You can evaluate this share by going to the AnalyseGE form (bring that to the Front). Click on the **Clear** button. Then enter
`V1BAS("ClothingFtw","dom","ClothingFtw")/SALES("ClothingFtw") ;`
(don't forget the semi-colon at the end) into the memo. Then click **Evaluate**. You will see the answer. [You can use the memo on the AnalyseGE form to evaluate expressions if you cannot do this conveniently from the TABmate window.]

3.6.2.1 Rewriting the equations for factors

If you divide Equation E_p1prim by V1PRIM, it can be written [dropping subscripts] as

p1prim = SL.p1lab_o + SK.p1cap

where SL is the share of labour in factor costs (V1LAB_O/V1PRIM) and SK is the share of capital in factor costs (V1CAP/V1PRIM).

If you subtract E_p1cap from E_x1lab_o, you get

x1lab_o - x1cap = –SIGMA1PRIM.[p1lab_o – p1cap]

With some manipulation,[12] the first equation becomes

x1prim = SL.x1lab_o + SK.x1cap

The three equations have become

x1prim = SL.x1lab_o + SK.x1cap

p1prim = SL.p1lab_o + SK.p1cap

x1lab_o - x1cap = –SIGMA1PRIM.[p1lab_o – p1cap]

3.6.2.2 The short run equations for factors

With no change in x1cap, we can drop the x1cap terms so these equations become:

(a) x1prim = SL.x1lab_o

(b) p1prim = SL.p1lab_o + SK.p1cap

(c) x1lab_o = –SIGMA1PRIM.[p1lab_o – p1cap]

With output (=x1prim) and wages (p1lab_o) given, we see that:

(i) From (a), if output falls 1%, employment must fall more than 1% [=1/SL]

(ii) From (c), if employment falls, p1cap must fall relative to p1lab_o. p1lab_o is linked to the CPI, so does not change much. Therefore p1cap must fall.

(iii) From (b) if p1cap falls, p1prim (price of value-added) must also fall.

This explains why the capital rental p1cap("ClothingFtw") falls in your simulation.

You know that capital stocks (x1cap) and technology are fixed in that simulation.

You have also seen (and explained—see section 3.4 above) that (domestic) output x1tot of ClothingFtw falls by about 3.5%.

But x1prim is equal to x1tot since there is no technical change (see equation E_x1prim). Thus x1prim("ClothingFtw") falls by about 3.5% and so, from (i) and (ii) above, it follows that p1cap("ClothingFtw") must fall.

---

[12] First substitute the second equation into E_x1lab_o which becomes

x1lab_o = x1prim – SIGMA1PRIM*[p1ab_o – SL*p1lab_o – SK*p1cap]
= x1prim – SIGMA1PRIM*[(1-SL)*p1lab_o – SK*p1cap]
= x1prim – SIGMA1PRIM*SK*[p1lab_o – p1cap] (a1)

since 1–SL=SK. Similarly,

x1cap = x1prim – SIGMA1PRIM*SL*[p1cap – p1lab_o] (a2).

If you add SL times (a1) to SK times (a2) you see that, since SL + SK =1

SL*x1lab_o + SK*x1cap = SL*x1prim + SK*x1prim = x1prim

3.6.2.3 Estimating how much p1cap("ClothingFtw") falls

What's more, the equations above give a pretty good estimate as to how much this price must fall. Suppose for the minute that p1lab_o does not change. [This is not correct, as the figures in the work-sheet below show. However it is true that the p1lab_o is small.[13]]

Then, from (a):

x1lab_o = (1/SL)*x1prim=(1/SL)*(–3.5).

Then, (c) above can be rewritten as

p1cap = x1lab_o/SIGMA1PRIM + p1lab_o.

Ignoring the tiny p1lab_o change, we get:

p1cap = x1lab_o/SIGMA1PRIM = (1/SL)*(–3.5)/SIGMA1PRIM.

The SL value is about 0.7 (this is easily calculated from the base data) and the SIGMA1PRIM value for ClothingFtw is 0.5 (as is easily seen from AnalyseGE). This gives the rough estimate that

p1cap("ClothingFtw") = (1/0.7)*(–3.5)/0.5 = –10.

This is very close to the exact result of –10.171 (see the worksheet below).

Fill in the worksheet below to validate equations (a) to (c) above. Your Excel sheet with industry results may save time. For the Factor shares SL and SK, find and evaluate the coefficient FACTOR, then use ViewHAR's shares view.

SL = labour share	*0.705*
SK = 1 - SL	*0.295*
x1cap	*0*
x1lab_o	*-4.979*
RHS(a) = SL.x1lab_o + SK.x1cap	*-3.510*
LHS(a) = x1prim	*-3.508*
x1tot	*-3.508*
p1lab_o	*-0.214*
p1cap	*-10.171*
RHS(b) = SL.p1lab_o + SK.p1cap	*-3.151*
LHS(b) = p1prim	*-3.155*
SIGMA1PRIM	*0.500*
RHS(c) = -SIGMA1PRIM * [p1lab_o-p1cap]	*-4.9785*
LHS(c) = x1lab_o	*-4.979*

[13] In this closure (where realwage is fixed), wage rates p1lab_o move with the consumer price index p3tot. Given that the only shock here is to a relatively small industry (ClothingFtw accounts for only about 2.5% of GDP), you can see without any detailed analysis that the effect on p3tot must be small compared to the approximately 10% fall in p1cap which is explained in the text.

Since p1lab_o moves with p3tot, the explanation of p1lab_o results relies on the explanation of the macro results for this simulation, which is given later in section 6. Contrast that to the explanation of the p1cap results which, in this shortrun closure, is very much a micro (rather than macro) story, as the text here shows.

Checking calculations such as that above are very often done when developing or extending a model to ensure that the equations are working properly. If the single-step, Johansen, solution method is used, we expect good agreement between LHS and RHS of linearized equations. Agreement is usually pretty good (but not exact) for results from multi-step [non-linear] solution methods.

Summary: Output (x1tot) of ClothingFtw has changed by –3.5%, resulting in a change in labour input (x1lab_o) of –4.97% since capital is fixed (x1cap). The price of capital (p1cap) changes by –10.1% (which is roughly equal to x1lab_o/SIGMA1PRIM). [Note that the price of labour (p1lab_o) only changes by –0.2%, a small amount.]

3.6.3 Slope of the shortrun supply schedule

Consider the shortrun (that is, capital stocks are fixed) and suppose that there is no technical change (which is true in your simulation).

Suppose that output x1tot falls (as it did for ClothingFtw – see section 3.4 above). Now x1prim is equal to x1tot since there is no technical change (see equation E_x1prim). Hence x1prim falls. From point (i) in section 3.6.2, employment x1lab_o must fall by more than x1tot and x1prim. From point (ii) in that section, p1cap must fall by more than p1lab_o. From point (iii), p1prim must also fall. A fall in p1prim causes the output price p1tot to fall. Thus, in the shortrun, when there is no technical change, if the output x1tot falls, so does the price p1tot.

This correlation between output and price implies *an upwardly sloping shortrun supply schedule*. You could obtain this positive relation between output and price by using (c) to eliminate x1lab_o and then (b) to eliminate p1cap from equation (a) above.

In your simulation, output (x1tot) of ClothingFtw has fallen by 3.5%, resulting in a fall in labour input (x1lab_o) of 4.97% since capital is fixed (x1cap). The price of capital (p1cap) falls by 10.1% (which is roughly equal to x1lab_o/SIGMA1PRIM). This causes the price of value-added (p1prim) to fall by 3.1%. The output price p1tot falls by about 1.4%. This confirms the upwardly sloping shortrun supply schedule in your simulation.

The following section is optional and maybe omitted.

3.6.4 Movements OF the supply curve and ALONG the supply curve

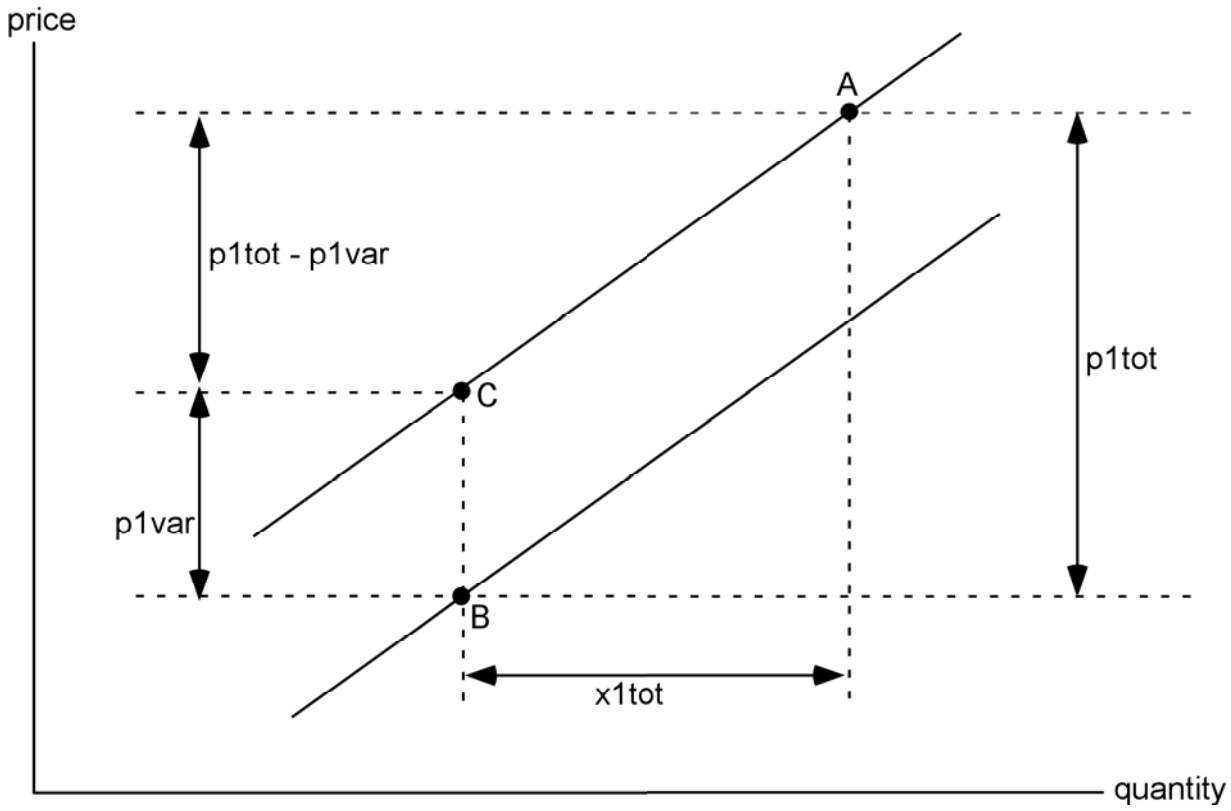
Appendix J of the ORANI-G document (Horridge, *2003)* has a full derivation of the short-run supply elasticity. The formula given there is computed by the SUPPLYELAST coefficient in the ORANI-G TAB file. Find and evaluate this coefficient.

Which industry has most elastic short-run supply? and why ? *GovAdminDfnc 11.9 high labour share*

Which industry has least elastic short-run supply? and why ? *OwnerDwellng 0.0 high capital share*

In using the SUPPLYELAST values we must remember that the shortrun supply curve moves up and down according to the average change in variable [non-capital] costs, p1var. In the diagram below, the initial state is A, and the final state is B. Between A and B there is a price change, p1tot, and a quantity change, x1tot. The movement from A to B consists of a movement *along* the supply curve, A⇒C, and a movement *of* the supply curve C⇒B. In price space, the downward shift of the supply curve is measured by p1var. If we want to estimate the slope of the supply curve along the section CA as a ratio, Δquantity/Δprice, we must subtract the supply shift p1var from the total price change p1tot:

elasticity CA = x1tot/(p1tot-p1var)



Find the equation for variable p1var which calculates average variable costs. Then fill in the table below, for the industry ClothingFtw .

SUPPLYELAST	*4.016*
x1tot	*-3.508*
p1tot	*-1.382*
p1var	*-0.541*
x1tot/[p1tot-p1var]	*4.171225*

The last line above, "x1tot/[p1tot-p1var]" estimates the supply elasticity from simulation results.

How close are the 2 estimates of short-run supply elasticity ? *Pretty close*

Why are the two numbers not identical [hint: up-itself] ? *The SUPPLYELAST formula does not allow for "own-sales" which allow output price to affect input costs.*

3.7 Why did exports of ClothingFtw increase ?

You saw in section 3.4 above that exports of ClothingFtw increase. You will explain this in this section.

Check to find how much exports of ClothingFtw increased. *The variable is x4("ClothingFtw"), the result for which is 13.16. So exports of ClothingFtw increase by 13.16%.*

Find the equation in ORANIG.TAB which "explains" exports x4. [Hint. Gloss on x4 and look for an equation with x4 on the LHS. When you find it, are you surprised at the name?]
There are two equations, namely E_x4A and E_x4B. This naming follows the usual pattern that the equation "explaining" variable xx is called E_xx. The A and B here are because there are two such equations.

In fact there are two equations explaining exports, one for the commodities in the set TRADEXP and one for the commodities in the set NTRADEXP.

Gloss on TRADEXP to find out about that set. You will see

```
Set TRADEXP # Individual export commodities # = (all,c,COM: IsIndivExp(c)>0.5);
```

This is the set of commodities whose exports are determined individually. They are sometimes called the traditional export commodities. They are usually commodities whose exports are substantial.

To see which commodities are in this set TRADEXP, bring the AnalyseGE form to the front (via the **Front** menu). Select menu item ***View | Sets, Subsets, Variables, Coefficients*** . You will see a list of the sets (under the **Sets** tab on the form shown). Run down these sets until you see TRADEXP and click on it. The members of this set are then shown.[14]

Is ClothingFtw in the set TRADEXP? *Yes*

Since ClothingFtw is in the set TRADEXP, demand for its exports is explained by equation E_x4A (rather than equation E_X4B). Close the sets form and go back to the TABmate form (via the **Front** menu). Look at the equation E_x4A. You should see

```
Equation E_x4A  # Individual export demand functions #
(all,c,TRADEXP) x4(c) - f4q(c) = -ABS[EXP_ELAST(c)]*[p4(c) - phi - f4p(c)];
```

Note that the variables f4p and phi are exogenous and not shocked.

How can you tell this? What does that mean about their values?
They are shown in red italics. Their values are zero.

Hence this equation says that

```
x4("ClothingFtw") = -ABS[EXP_ELAST("ClothingFtw")]*p4("ClothingFtw")
```

This connect exports x4 to a price p4 and an elasticity EXP_ELAST.

What is the value of EXP_ELAST("ClothingFtw")? *-10.0*

Hence you can see that

```
x4("ClothingFtw") = -10*p4("ClothingFtw")
```

Thus you will understand why exports of ClothingFtw increased (and by how much) when you understand why the export price p4 fell (and by how much). You look at this in subsection 3.7.1 below. You will complete the explanation of exports in subsection 3.7.2 below.

---

[14] Another way of checking to see the elements of TRADEXP is to look at the values of the Coefficient IsIndivExp which determines the set. These values are read from the BASEDATA file. To see the values, search for IsIndivExp and evaluate. Note that the value for ClothingFtw is 1. This means that ClothingFtw is in TRADEXP since the value is larger than 0.5.

3.7.1 The export price p4 of ClothingFtw

What happens to the export price p4 of ClothingFtw? *It falls by –1.32*

What would you expect to influence the export price of ClothingFtw?

Firstly, the basic price p0("ClothingFtw","dom"). Secondly any export taxes or subsidies. Thirdly, the cost of getting exports from the factory to the port (that is, margins). You will see how all of these are involved in the equations shown below.

Find the equation which "explains" the price p4. As you would expect, this is equation E_p4 which says:

```
Equation E_p4 # Zero pure profits in exporting #
 (all,c,COM)  [V4PUR(c)+TINY]*p4(c) =
   [V4BAS(c)+V4TAX(c)]*[pe(c)+ t4(c)]
    + sum{m,MAR, V4MAR(c,m)*[p0dom(m)+a4mar(c,m)]};
```

This connect p4 to another export price pe, to export taxes t4 and to margins (the last term).

To find about pe, look at equation E_x0dom which says

```
Equation E_x0dom  # Supply of commodities to export market #
 (all,c,COM) TAU(c)*[x0dom(c) - x4(c)] = p0dom(c) - pe(c);
```

Find the values of the Coefficient TAU. In fact they are all zero, so that this equation simply says that pe(c) is equal to p0dom(c) for all commodities c.

Finally, in this chain of price connections, find the equation which "explains" p0dom. This is the simple equation E_p0dom which says

```
Equation E_p0dom  # Basic price of domestic goods = p0(c,"dom") #
 (all,c,COM) p0dom(c) = p0(c,"dom");
```

Hence you can see that

```
pe("ClothingFtw") = p0dom("ClothingFtw") = p0("ClothingFtw","dom")
```

Thus equation E_p4 can be rewritten as

```
(all,c,COM)  [V4PUR(c)+TINY]*p4(c) =
  [V4BAS(c)+V4TAX(c)]*[p0(c,"dom")+ t4(c)]
   + sum{m,MAR, V4MAR(c,m)*[p0(m,"dom")+a4mar(c,m)]};
```

which makes the expected connection between p4 and domestic prices, export taxes and margins clear.

Decompose the equation E_p4 (Intelligent decomposition). Complete the table below for ClothingFtw.

V4BAS	*-848.1*
V4MAR	*-4.4*
Total	*-852.5*

Thus the first term in the equation above is the main reason for the fall in p4 for ClothingFtw.

You know that the basic price of ClothingFtw has fallen and why (see section 3.5). Nothing has happened to export taxes t4 in this simulation so they are all zero. [You can check that by evaluating t4. A look at equation E_t4A will make it clear why t4 is zero here.]

Suppose for the minute that nothing much happens to the prices p0dom(m) of the margins commodities. [If you evaluate those, you will see that this is not a bad assumption.] Then, dividing the equation above by V4PUR+TINY and setting t4 and p0dom(m) to zero, the equation becomes

```
p4(c) = {[V4BAS(c)+V4TAX(c)]/[V4PUR(c)+TINY]}*p0(c,"com")
```

You can find out about this share by glossing on V4PUR and going to the formula for V4PUR. [It is at about line number 193.] **Decompose the RHS** of this formula. For ClothingFtw you will see that the above share is equal to 0.92. Thus, approximately,

p4("ClothingFtw") = 0.92*p0("ClothingFtw","dom") = 0.92*(-1.42) = -1.31

which, if you evaluate the LHS, is a pretty good approximation to the result.

This explains why p4("ClothingFtw") falls and by how much.

Summary. The export price p4 for ClothingFtw falls because the basic price of domestically-produced ClothingFtw falls. How much p4 falls can be calculated from the fall in p0 and knowledge of the non-margins share in V4PUR.

3.7.2 Why exports of ClothingFtw increase and by how much

In section 3.7, you saw that

```
x4("ClothingFtw") = -10*p4("ClothingFtw")
```

(where the "-10" is the value of the elasticity EXP_ELAST).

In section 3.7.1 above, you explained why p4("ClothingFtw") fell and by how much.

Given that p4 falls by about –1.31%, it is clear that exports x4 must increase by about 10 times that, namely by about 13.1%. [The exact result is 13.16%.]

3.7.3 Tariff simulation Part 3

Please find the document for Part 3 in your folder.

In Part 3 of the ORANI-G tariff cut simulation, we will

- analyse a few results for the Textiles sector (section 4).
- next, examine why some other industries expanded (section 5).
- last, comment briefly on macro results (section 6).

Using AnalyseGE to examine an ORANI-G tariff cut simulation

Part 3

In Part 3 of the ORANI-G tariff cut simulation, we will

- analyse a few results for the Textiles sector (section 4).
- next, examine why some other industries expanded (section 5).
- last, comment briefly on macro results (section 6).

4 Why did Textiles output shrink?

This ends our analysis of ClothingFtw. Next we turn to the other industry which is most affected by the shock, namely Textiles. As you saw in section 1.1 above, the output of Textiles industry x1tot("Textiles") falls by 0.23%. Here you will explain this effect.

The reason for the fall in Textiles output is quite different to that for the fall in ClothingFtw output. In the case of ClothingFtw, output falls because households and firms substitute away from the domestic commodity to the imported commodity (as you saw in section 3.1 above). But there is no such substitution in the case of Textiles.

To check that, look at the x3("Textiles","dom") and x3("Textiles","imp") results.
x3("Textiles","dom") = 0.08, x3("Textiles","imp") = –0.19

The SalesDecomp variable breaks down the percent change in output between main sources of demand.

Find and evaluate SalesDecomp and fill in the table below:

SalesDecomp("textiles")	
Interm	*-0.57*
HouseH	*0.02*
Export	*0.27*
Total[15]	-0.28

You should see that although export and household demand contribute positively to demand, the overall output change is dominated by a large fall in intermediate demand.

Investigate further by looking at the values of the SALEMAT2 Coefficient, which shows the sales of each commodity. Here it is convenient to work with Basic values, so set the combo boxes to Textiles/Basic/All SRC/All SALECAT2.

Which category is the main user and what percent of use goes there?
Intermediate usage (3015) out of total sales 5691. This is about 53%.

Which firm uses most of Textiles and what percentage of intermediate usage does it take?
[Hint. Look at V1BAS and set combos to Textiles/dom/All IND. Take column shares.]
ClothingFtw 38.6%

Thus 0.386*0.53 (about 20%) of total sales of Textiles goes to the ClothingFtw industry. The output of the ClothingFtw industry (x1tot) contracts by 3.5% (see section 3.4). The ClothingFtw industry uses a fixed share of composite Textiles (since top nest is Leontief – see equation E_x1).

[15] You will see that SalesDecomp adds up to commodity output x0dom, which (due to MAKE multiproduction) is not quite the same value as industry output, x1tot.

From this information, how much would you expect the fall of 3.5% in output of ClothingFtw to decrease the demand for Textiles? *About 0.386*0.53*3.5=0.7%.*

In fact total demand for Textiles does not fall by as much since household demand is up by a little (0.08%) and exports are up significantly (1.2%) on a significant base. [Look at the x3 and x4 results. To see the export base, look at SALEMAT2 as above to see that 21.5% of Textiles is exported.]

You will see in section 4.1 below that the price of domestic Textiles falls.

Given this information about the price of domestic Textiles, which earlier section contains the argument which explains why exports of Textiles increase? *Section 3.7*

The FanDecomp variable breaks down the percent change in output between three main causes.

fanDecomp("textiles")		
LocalMarket	-0.70	change in non-export demand for textiles *domestic plus imported*
DomShare	0.15	change in dom/imp ratio for textile demand
Export	0.27	change in demand for textile exports
Total	-0.28	

The DomShare effect is positive because the domestic price of Textiles fell, so enabling import-substitution. The LocalMarket effect shows the effect of demand change *ignoring the just-mentioned price effect*, so that the LocalMarket fall is larger than the corresponding Interm and HouseH components in SalesDecomp. You can see, therefore, that the Textile price fall was quite important in moderating the fall in Textile demand.

4.1 Why did domestically-produced Textiles get cheaper?

What happens to the basic price p0("Textiles","dom") of domestic Textiles? *It falls by 0.24%.*

Why does the price of domestically-produced Textiles fall?

Your first guess may be that the Textiles industry uses significant amounts of the cheaper ClothingFtw imports.

What percentage of total intermediate usage by the Textiles comes from imported ClothngFtw? *Only 0.04%. [Look at the V1BAS matrix for industry Textiles, and look at matrix shares.]*

So the Textiles industry using cheaper imports of ClothingFtw is not the reason.

You saw in section 4 above that demand for domestically-produced Textiles falls. Thus the price must also fall because of the upwardly sloping shortrun supply curve – see section 3.6.3 above.

5 Which industries gained, and why?

This completes our look at the Textiles industry. Now we turn to the results for the other industries. Table 1 below shows some of the main results for each sector, together with important features of each sector that might explain the results. You could gather all the numbers for such a table using AnalyseGE. Most of the numbers relate to commodities but the last two columns relate to industries. For all but the first 3 sectors, commodities and industries are nearly equivalent.

The first column shows x0com, output of commodities. Outside the TCF sectors, these are all positive, though gains in the bottom third of the table are small. The next 3 columns show how the x0com change may be split between 3 causes: overall increase in local demand (LocalMarket), replacement of imported by domestic goods (DomShare), and and increase in exports. Most of the x0com increases are due to the LocalMarket and Export effects; DomShare contributes little.

The next 3 columns report coefficient values. EXPSHR is the share of output which is exported; IMPSHR is the share of imports in the local market; and INDIVEXP has the value 1 if that commodity faces its own export demand curve. Where INDIVEXP=0, commodity exports share a common export demand curve (ie, they all move together).

The first industry column, p1var, shows the change in short-run variable costs (which exclude rents to capital and land). These are all negative, with a tendency to larger falls at the bottom of the table. Last are the industry short-run supply elasticities.

Different sectoral characteristics and input-output linkages between sectors lead to a complicated pattern of sectoral results. Neverthess, there *is* a pattern, as follows.

The industries may be divided into 2 main groups: *traded* and *non-traded*. Traded industries are those which have a larger export share [EXPSHR] or face significant import competion [IMPSHR]. In Table 1, most of the exporters are in the top 2/3 of the Table, whilst import-competition is concentrated in the middle 1/3. These traded sectors tend to expand. The last third of the industries are basically non-traded and sell mainly to final demand; their output changes little.

In this simulation, the main components of absorption (household, government, investment) are fixed, so the main opportunities for expansion are to increase exports, to replace imports, or to sell more to other industries. To achieve either of the first two (increase exports, replace imports) it is necessary to reduce output prices. This is possible because of the generalized fall in input costs (p1var). The effect of the general cost reduction appears in Figure 1 below as downward shift in all industry supply curves.

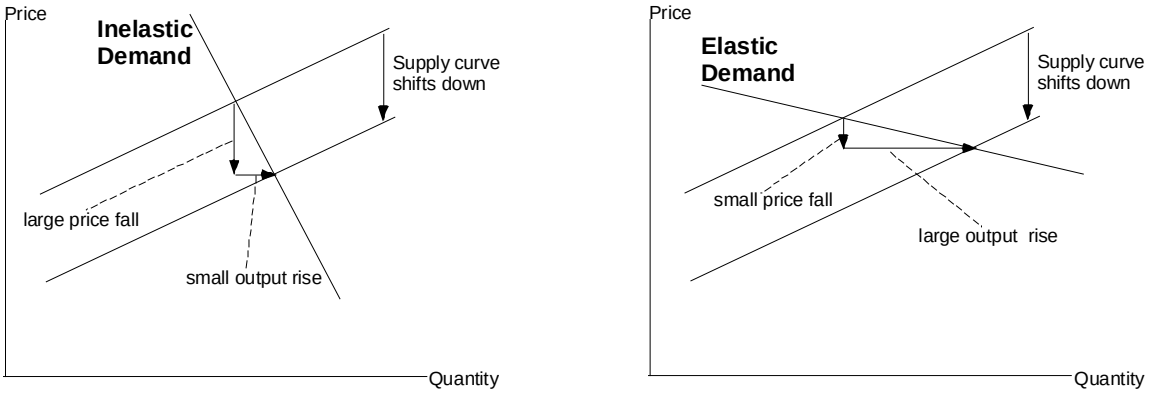


Figure 1. Effects of reduced input costs

Non-traded industries, which face inelastic demand, tend to pass on cost decreases to their customers. Export-oriented industries expand their output instead. Sectors facing significant import competition also expand. The effect of demand elasticity is shown in the two panes of Figure 1, representing two different sectors. The supply schedule of each sectors shifts down, representing the effect of decreased input costs. In the left-hand pane, depicting a non-traded sector, inelastic demand allows the cost increase to be passed on without much output drop. The right-hand pane depicts a trade-exposed

sector. There, elastic demand causes output to rise more, and price to fall less, than in the left-hand pane.

In summary, most output expansion is caused by increased exports, driven by lower costs. Some sectors expand by selling more to exporting sectors: for example, BeefCattle is drawn along by rising exports of MeatDairy; or BasicMetals sells more to other manufacturing industries.

Table 1: Summary of sectoral outputs and characteristics

	Output	Fan decomposition			Coefficients				Variable cost	
Commodity	x0com	Local Market	Dom Share	Export	EXPSHR	IMPSHR	INDIV EXP	Industry	p1var	SUPPLY ELAST
WoolMutton	0.00	-0.05	0.00	0.05	0.58	0.00	1.00			
GrainsHay	0.03	0.04	0.00	-0.01	0.44	0.01	1.00			
BeefCattle	0.07	0.05	0.00	0.02	0.03	0.00	0.00	BroadAcre	-0.06	0.21
OtherAgric	0.04	0.03	0.00	0.01	0.10	0.04	1.00	OtherAgric	-0.08	0.35
ForestFish	0.11	0.02	0.00	0.09	0.13	0.03	1.00	ForestFish	-0.10	2.19
Mining	0.05	0.03	0.00	0.02	0.56	0.20	1.00	Mining	-0.10	0.29
MeatDairy	0.05	-0.03	0.00	0.09	0.34	0.02	1.00	MeatDairy	-0.02	3.81
OthFoodProds	0.11	0.00	0.00	0.10	0.21	0.14	1.00	OthFoodProds	-0.08	2.00
DrinksSmokes	0.06	-0.01	0.00	0.07	0.08	0.10	0.00	DrinksSmokes	-0.08	1.04
Textiles	-0.28	-0.70	0.15	0.27	0.22	0.41	1.00	Textiles	-0.12	2.18
ClothingFtw	-3.52	0.15	-5.37	1.70	0.13	0.39	1.00	ClothingFtw	-0.54	4.02
WoodProds	0.13	0.04	0.01	0.08	0.09	0.18	0.00	WoodProds	-0.10	3.13
PaperPrint	0.06	0.02	0.02	0.02	0.03	0.18	0.00	PaperPrint	-0.11	1.45
Petrol_CoalP	0.06	0.01	-0.01	0.06	0.08	0.15	0.00	Petrol_CoalP	-0.01	0.31
Chemicals	0.09	0.02	0.01	0.06	0.14	0.38	1.00	Chemicals	-0.08	1.46
RubberPlastc	0.09	0.03	0.03	0.04	0.04	0.32	0.00	RubberPlastc	-0.10	2.00
NonMetlMinrl	0.05	0.02	0.01	0.02	0.03	0.13	0.00	NonMetlMinrl	-0.09	1.43
BasicMetals	0.13	0.06	0.00	0.06	0.39	0.14	1.00	BasicMetals	-0.06	1.87
FabMetalPrd	0.10	0.04	0.02	0.04	0.04	0.15	0.00	FabMetalPrd	-0.12	2.79
TransportEqp	0.13	0.02	0.05	0.05	0.11	0.41	1.00	TransportEqp	-0.09	1.95
OthMachnEqp	0.12	0.01	0.01	0.10	0.19	0.62	1.00	OthMachnEqp	-0.09	1.68
MiscManuf	0.09	-0.01	0.03	0.08	0.09	0.25	0.00	MiscManuf	-0.14	2.98
ElecGasWater	0.01	0.01	0.00	0.00	0.00	0.00	0.00	ElecGasWater	-0.11	0.23
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Construction	-0.12	1.08
Trade	0.06	0.06	0.00	0.00	0.00	0.00	0.00	Trade	-0.15	1.42
Repairs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	Repairs	-0.13	0.59
Hotel_Cafe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Hotel_Cafe	-0.14	2.81
Transport	0.07	0.01	0.00	0.06	0.16	0.12	1.00	Transport	-0.10	0.74
CommunicSrvc	0.05	0.01	0.00	0.04	0.05	0.06	0.00	CommunicSrvc	-0.13	0.61
FinanceInsur	0.03	0.01	0.00	0.01	0.02	0.02	0.00	FinanceInsur	-0.17	0.68
OwnerDwellng	0.00	0.00	0.00	0.00	0.00	0.00	0.00	OwnerDwellng	-0.12	0.00
PropBusSrvc	0.05	0.03	0.00	0.02	0.03	0.03	0.00	PropBusSrvc	-0.15	1.43
GovAdminDfnc	0.01	0.00	0.00	0.00	0.00	0.00	0.00	GovAdminDfnc	-0.16	11.94
Education	0.04	0.00	0.00	0.04	0.04	0.01	0.00	Education	-0.20	7.19
HealthCommun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HealthCommun	-0.18	3.73
CultuRecreat	0.01	0.00	0.00	0.00	0.00	0.01	0.00	CultuRecreat	-0.14	1.63
OtherService	0.00	0.01	0.00	0.00	0.00	0.16	0.00	OtherService	-0.16	5.00

Questions:

Why did Hotel_Cafe output not increase? *Sells mainly to consumption*

Why did OwnerDwellng output not increase? *Sells mainly to consumption: inelastic supply*

Why is the LocalMarket component of DrinksSmokes and MeatDairy negative? *Export sales held prices up...households switched to other goods.*

5.1 Why did industry costs decrease?

We saw above that reduced input costs were responsible for expansion in non-TCF sectors. Where did this cost reduction come from? Since ClothingFtw sells mainly to households it is not obvious how cheaper shoes will reduce other sectors' costs.

The chief mechanism by which cheaper TCF (both domestic and imported) leads to cost reductions elsewhere is via the assumption that wages for all sectors are indexed to the CPI. This works as follows:

(a) Cheaper TCF reduces the CPI directly; we call this the *impact effect*.

(b) Wages everywhere go down with the CPI.

(c) Reduced wages reduce costs (and output prices) for all the other sectors.

(d) Generalized reduction in output prices further reduces both the CPI and all sectors input costs: we call this the *second-round effect*.

(e) The further reduction in the CPI reduces all wages.....go back to (c).

The general equilibrium effect will be produced by an endless repetition of steps (c) to (e).

To measure the impact effect of cheaper TCF on the CPI, find the appropriate equation:

```
E_p3tot # Consumer price index #
  p3tot = sum{c,COM, sum{s,SRC, [V3PUR(c,s)/V3TOT]*p3(c,s)}};
```

What is the value of p3tot? *-0.21*

Next select and **Evaluate** the phrase above "[V3PUR(c,s)/V3TOT]*p3(c,s)" to see the contributions of each commodity (dom and imp) to the CPI change.

What is the total contribution to the final change in p3tot from Textiles and ClothingFtw, domestic and imported (add 4 numbers together)? *-0.11*

You should see that the direct or impact effect of cheaper TCF is responsible for just over half the CPI change.

Assertion: The remaining drop in the CPI is due to second-round effects [steps (c) to (e) above].

How can we test the assertion above? One way would be to reason as follows. A 1% direct reduction in the CPI will reduces wages 1%. Let S be the share of wages in GDP. The 1% wage reduction will cause costs generally *and the CPI* to fall by S%. So CPI and wages fall by another S%. This in turn reduces costs by S^2%, and so on. The total eventual reduction in the CPI would be:

$$1 + S + S^2 + S^3 + ... = T\%$$

We can add up the infinite series by noting:

$$ST = S + S^2 + S^3 + S^4 + ... = T - 1$$

So $T = 1/[1-S]$

Find and evaluate the coefficient INCGDP. What is the share of wages in GDP, S? *0.456*

So what is T? *1.84*

You should find that the total effect T is just under double the initial 1% CPI rise. This means that indirect or second-round CPI falls will be slightly less than half the impact effect—which agrees with the assertion above.

A second approach would be to use the model to estimate the second round effects of wage indexation. In a later session you will use the model to simulate the effects of a wage cut. The results will show that a nominal wage cut of 8.2 % is associated with a CPI fall of 3.2 %: the CPI fall is 0.39 times the wage fall. With indexation in place, the CPI drop would cause a further 3.2% fall in wages leading to another 0.39*3.2% drop in the CPI, ... and so on. Since 1/[1-0.39] = 1.64, we can deduce that a tariff cut which directly caused a 1% reduction in the CPI, would indirectly cause (via wage indexation and input-output linkages) an eventual 1.64% reduction in the CPI. Again the total effect is nearly double the impact effect, consistent with the assertion above.

Summary: the benefits of the tariff cut arise mainly[16] from the effect of the tariff cut on the CPI, and on the link between the CPI and wages. If we dropped the wage indexation assumption, or we reduced tariffs on goods sold mainly to some other final demander (say, investment) we would not expect to see expansion in the other sectors.

Our argument, that lower wages are the main cause of non-TCF expansion seems to explain why p1var fell more for the nontraded industries at the bottom of Table 1: for these industries labour accounts for a larger share of costs.

Find and evaluate the coefficient COSTMAT (use *row shares* in ViewHAR). Are the nontraded industries really more labour-intensive? *Yes*

But is labour-intensity the whole story? Find the equation for p1var:

```
Equation E_p1var  # Short-run variable cost price index #
 (all,i,IND)
  p1var(i) = [1/V1VAR(i)]*[V1MAT(i)*p1mat(i) + V1LAB_O(i)*p1lab_o(i)];
```

and evaluate the materials cost index p1mat. You should see that it also falls more for the non-traded industries.

Decompose the RHS of equation E_p1var to find out whether wages (p1lab_o) or materials (p1mat) make the bigger contribution to reduced input costs for non-traded sectors? for traded sectors? *Wages make a bigger contribution than materials for non-traded sectors, for traded sectors wage and material contributions are of similar size.*

[16] A small amount of ClothingFtw is sold directly to other industries, so providing another route for cheaper ClothingFtw to benefit other sectors.

6 Macro results

We will not analyse macro results at length here, since results analysis from the macro point of view is the focus of a later exercise: analysis of a wage-cut simulation. Nevertheless, AnalyseGE can make a useful contribution.

What happened to real GDP? *up 0.0331%*

Which expenditure aggregates contributed to this change? *contGDPexp*

Exports *0.0726%*

Imports *-0.0395%*

Now find equation E_x0gdpinc and decompose the RHS by variable

How much did employment and taxes respectively contribute to real income-side GDP?

employment contributed: *0.0224%*

taxes contributed: *0.0106%*

of taxes, tariffs contributed: *0.0088%*

You should see that 2/3 of the increase comes from the employment gain[17], and most of the remainder from the tariff revenue contribution. The tariff term is a rough[18] measure of the allocative gain from the tariff reduction—the source of welfare gain in formal trade theory. Against this we must posit the welfare loss arising from terms-of-trade deterioration, in this case arising only from the reduced prices paid for Australian exports.

To find the terms-of-trade loss as a percent contribution to GDP, **Bring AnalayseGE to Front**, clear the expression box, type in "`V4TOT*p4tot/V0GDPEXP;`" (don't forget semicolon) and press the **Evaluate** button.

What is the terms-of-trade loss as a percent contribution to GDP? *-0.0079*

How does the terms-of-trade loss compare with the allocative efficiency gain? *About the same !*

6.1.1 Sector-specific shocks have tiny macro effects

Sometimes it is embarasssing to report the tiny GDP % effects that result from shocks to one small sector. To avoid this, you can report results, not in per cent terms, but in base-period-dollars-worth. For example, **Bring AnalayseGE to Front**, clear the expression box, and type in:

```
0.01*sum{i,ind:employ(i)<0, employ(i)*V1LAB_O(i) };
```

Then press the **Evaluate** button.

This gives the value[19] of employment losses. What is it? *-54.07 base-period-million-dollars*

Use a similar method to find value of employment gains. What is it? *149.99 base-period-million-dollars*

[17] According to economists, this is not a real welfare gain, since it requires extra work: always a curse.

[18] The true "Harberger triangle" is actually just half the expression calculated by AnalyseGE. The problem is that AnalyseGE is using the initial tariff level to calculate allocative gain; it should be using a level between the larger initial and the smaller final. See Appendix 1.

[19] It gives the value in base-period-currency units. The initial data is measured in million 93-4 dollars.

7 What if we did not use Johansen's method?

The simulation described above used Johansen's method [specified in TARFCUT.CMF]. This computes a first-order linear approximation to the true model solution. An advantage [from the point of view of AnalyseGE] is that the linear equations in the TAB file are satisfied accurately by the [approximate] variable solution values.

Change the solution method in TARFCUT.CMF to Gragg 2,4,6 steps, save the modified file as TARFCUTG.CMF and rerun the sim. Repeat the analysis above. You will see that, though the linear equations are not satisfied exactly (as they were above), they are still very close to being satisfied, and the analysis can proceed essentially as in the Johansen case.

Section 11 (Appendix 1) explains why you should not expect the linearised equations to be satisfied exactly by an accurate solution (for example, one obtained with Gragg 2,4,6 steps).

8 Other features of AnalyseGE

Although we have illustrated AnalyseGE with the ORANI-G model, the software is completely general-purpose. It can be used to assist with the analysis of any simulation carried out using Release 7.0 (or later) of GEMPACK.

AnalyseGE is fully documented via the Help file which accompanies it. You can find details there about several features we have introduced only briefly in this paper.

The main function of AnalyseGE is to assist with calculations involving data and/or simulation results. The main way of doing such calculations is via the TABmate form, as has been illustrated in the sections above.

Sometimes you may want to carry out calculations which cannot be initiated from the TABmate form, and sometimes the calculations initiated from the TABmate form turn out to be not quite what you want. In such cases it is possible to enter the formulas you want in the memo on the AnalyseGE form. The syntax is very similar to that in TABLO Input files (though AnalyseGE often allows you to omit quantifiers). Full details of this way of initiating calculations can be found in the Help file supplied with AnalyseGE. [Note that when AnalyseGE carries out a calculation initiated from the TABmate form, the corresponding formulas etc are always visible in the memo on the AnalyseGE form after the calculation has been completed. You can look here to check exactly what was calculated, and also to get a good idea as to the sorts of formulas etc that can be entered into that memo.]

The **View** menu on the AnalyseGE form is often useful. This lets you view

- the Command file used for the simulation. This contains the full instructions for the simulation, including the closure and shocks.
- the Sets, Subsets, Variables and Coefficients in the model.
- the Stored-input file used to condense the model when running TABLO (if condensation was carried out).

In fact Release 7.0 (or later) of GEMPACK stores the Command file, the TABLO file (which you see in the TABmate window) and the Stored-input file used to run TABLO on the Solution file. AnalyseGE recovers them from there.

When a TABLO-generated program or GEMSIM from Release 7.0 of GEMPACK carry out a simulation, they create a so-called **SLC file** as well as the usual Solution file. This SLC (Solution Coefficient values file) contains the pre-simulation values of all Coefficients from the TABLO Input file. In particular this contains essentially a copy of the pre-simulation data read (as well as the values of Coefficients whose values are obtained from this pre-simulation data via formulas).

Together the Solution and SLC files provide a very strong audit trail for the simulation. They contain the TABLO Input file for the model, the Command file, the Stored-input file used to run TABLO, and all the pre-simulation data.

This paper has introduced AnalyseGE in the context of a simulation with ORANI-G. You can also find a hands-on introduction to AnalyseGE in the context of a simulation with GTAP (Hertel, 1997) in Pearson *et al* (2002).

9 Installing AnalyseGE on your computer

The AnalyseGE files (including the Solution files for the application described in this paper) can be downloaded from the Web from address

http://www.copsmodels.com/gpange.htm

Follow the instructions there to install AnalyseGE on your computer.

Note that you will not be able to use AnalyseGE to assist in the analysis of your own applications unless you have Release 7.0 (or later) of GEMPACK installed, since AnalyseGE can only be used with Solution files produced by this release (or later releases) of GEMPACK.

10 Conclusion

In this paper we have introduced the capabilities of AnalyseGE.

You can use AnalyseGE to calculate any formula involving simulation results, pre-simulation data and Coefficients of the model. The main way of initiating such calculations is via the TABmate form, however you can also use the memo on the AnalyseGE form (see section 8).

As outlined in section 8, the Solution and SLC files form a strong audit trail for any simulation.

We hope that this software is able to assist modellers analyse their simulation results. For experienced modellers, we hope that it will make them more efficient in their analysis of GE simulations – thereby enabling them to delve more deeply into the mechanisms underlying the results. For non-modellers, we hope that, by making such analysis easy and rewarding, economists will be increasingly drawn back to the fundamental equations of the model, thereby discouraging "confabulation" and encouraging sound analysis.

11 Appendix 1 : Why linearized equations are not satisfied exactly

The linearized equations of the model are not always satisfied exactly when you look at them using AnalyseGE. We explain why in detail in this appendix. This is a more technical section and some readers may prefer to skip it.

In the Johansen (one-step) simulation TARFCUT.SL4, the equations are all satisfied exactly. However here the solution is only an approximate solution of the non-linear equations in the ORANI-G model.

If you carry out a multi-step solution as in TARFCUTG.SL4 as described in section 7 where Gragg's method is used and there is a 2, 4, 6 step solution followed by extrapolation, you will find that the linearized equations are not satisfied exactly. However, the resulting solution satisfies the non-linear equations much better than the simple one-step solution TARFCUT.SL4.

11.1 Linearization of a product

Some equations are obtained by linearizing a levels equation which contains a product. An example is the equation E_x3lux

```
Equation  E_x3lux # Luxury demand for composite commodities #
  (all,c,COM) x3lux(c) + p3_s(c) = w3lux + a3lux(c);
```

In the levels this can be written

X3LUX_L(c) * P3_S_L(c) = W3LUX_L* A3LUX_L(c);

Open TARFCUTG.SL4 in AnalyseGE and search for the Equation E_x3lux. Right click on this equation and select Decompose Part of this Equation. Select Whole Equation and click OK. Look at the results for the ClothingFtw commodity.

x3lux	= 2.337862	
p3_s	= -2.451745	
w3lux	= 0.171201	This is actually (– w3lux)
a3lux	= 0	
Total	= 0.057318	

The Total shows the difference between the LHS of the equation and the RHS. You can see that the linearized equation is not satisfied exactly.

Suppose, for simplicity, that all the levels values are 1, then, in the levels, after the simulation (for ClothingFtw):

X3LUX_L = 1 + 2.337862/100 = 1.02337862 P3_S_L = 1 - 2.451745/100 = 0.97548255

W3LUX_L = 1 - 0.171201/100 = 0.99828799 A3LUX_L = 1.0

X3LUX_L * P3_S_L = 0.99828799

W3LUX_L * A3LUX_L = 0.99828799

So that **post-simulation,** the levels equation is satisfied exactly.

The exact equation is in terms of the percentage changes in the levels values:

(1 + x3lux/100) (1 + p3_s/100)	= (1 + w3lux/100)(1 + a3lux/100)	Exact
x3lux + p3_s + x3lux*p3_s/100	= w3lux + a3lux + w3lux*a3lux/100	Exact
x3lux + p3_s	= w3lux + a3lux	Linearized

You do not want to satisfy the linearized equations in the final solution because what you are trying to satisfy is the (exact) non-linear equations (and you can't have it both ways).

11.2 Shares vary

Other equations in the TABLO Input file contain shares (or other Coefficients). Typically the values of these shares or coefficients change between the pre-simulation data base and the post-simulation one. An example is the equation E_prim which we looked at in section 2.9.2 above.

```
E_p1prim   # Effective price term for factor demand equations #
 (all,i,IND) V1PRIM(i)*p1prim(i) = V1LAB_O(i)*p1lab_o(i)+V1CAP(i)*p1cap(i);
```

which we saw was

x1prim = SL.x1lab_o + SK.x1cap

where SL and SK are shares of labour and capital in factor costs.

Evaluate the LHS and the RHS of the equation E_p1prim for "ClothingFtw" using AnalyseGE

LHS = -4383.334

RHS = -217.511 - 4094.278 = -4311.789

There are two reasons for this difference. Firstly the shares SL and SK vary across the simulation. Secondly, the linearized equation is only an approximate version of the underlying levels equation for the price part of this CES nest.

Note that the linearized equation would not be satisfied exactly if we used post-simulation values for the shares or even an average of pre- and post-simulation values (though the discrepancy would be less in the latter case).

11.3 General comments

You should not expect the linearized equations to be satisfied exactly when looked at in AnalyseGE. Normally you can expect them to be satisfied sufficiently well that the values obtained via AnalyseGE are useful in explaining simulation results.

You may be puzzled as to how GEMPACK is able to obtain arbitrarily accurate solutions of the underlying levels equations of the model even though it seems only to use the linearized equations. The answer is partly that the update statements in the TABLO Input file ensure that each time a small part of the shock is applied, the data values and shares are recalculated. A more detailed intuitive explanation can be found in section 3.12 of the GEMPACK manual, *How Johansen and multi-step solutions are calculated.* A more technical and complete explanation can be found in Pearson (1991).

12 References

Harrison, W.J. and K.R. Pearson (1996), 'Computing Solutions for Large General Equilibrium Models Using GEMPACK', Computational Economics, vol. 9, pp.83-127. [A preliminary version was Impact Preliminary Working Paper No. IP-64, (June 1994), pp.55.]

Hertel, Thomas W. (ed) (1997), *Global Trade Analysis: Modeling and Applications*, Cambridge University Press.

Horridge, J.M.(2003), *ORANI-G: A Generic Single-Country Computable General Equilibrium Model*, downloadable from www.copsmodels.com/oranig.htm.

Pearson K.R. (1991), 'Solving Nonlinear Economic Models Accurately via a Linear Representation', *Impact Preliminary Working Paper* No. IP-55, Melbourne (July), pp.39.

HANDOUT

Some answers for the tariff cut simulation

Contents

1 Running the tariff cut simulation

What variable is shocked and by what value? *t0imp("ClothingFtw") = -10%*

What type of closure is used? *standard shortrun*

1.1 A first look at the results using ViewSOL

What happened to imports of ClothingFtw? *x0imp("ClothingFtw") = 9.68%*

What other import changed, and by how much? *x0imp("Textiles") = -1.17%*

Now have a look at the industry outputs, x1tot.

What happened to output of ClothingFtw? *x1tot("ClothingFtw") = -3.51%*

What happened to output of Textiles? *x1tot("Textiles") = -0.23%*

Can you see a pattern in the other industry outputs?

Traded (upper half) expand, non-traded (lower half) static.

Summary: The results for "ClothingFtw" are as you would expect. You have decreased the tariff on Clothing and Footwear, so the imports of Clothing and Footwear increase and the domestic output of Clothing and Footwear decreases. We need to look more closely at "Textiles" to see what is causing the textiles results above.

The **Fan decomposition** variable *fandecomp* shows how the change in demand for a locally-produced commodity, say, textiles, may be divided between:

- local market effect: change in non-export demand for textiles *domestic plus imported*;
- domestic share effect: change in dom/imp ratio for textile demand.
- export effect: change in demand for textile exports

Examine the fandecomp variable and fill in the table below:

fandecomp	LocalMarket	DomShare	Export	Total
Textiles	*-0.70*	*0.15*	*0.27*	*-0.28*
ClothingFtw	*0.16*	*-5.38*	*1.70*	*-3.515*

Summary: You should see that, for Textiles, increased exports and weakened import competition failed to offset a shrinking local market, leading to a small output decline. For ClothingFtw, increases in both export and local demand were overwhelmed by increased import penetration, leading to a larger output decline.

Description	Variable	Value
Real household consumption	*x3tot*	*0*
Real investment	*x2tot_i*	*0*
Real government demands	*x5tot*	*0*
Export volume	*x4tot*	*0.42*
Import volume CIF	*x0cif_c*	*0.22*
Real GDP	*x0gdpexp*	*0.03*
Aggregate capital stock	*x1cap_i*	*0*
Aggregate employment	*employ_i*	*0.05*
Absorption price index*	*p0gne*	*-0.18*
GDP price index	*p0gdpexp*	*-0.19*
CPI	*p3tot*	*-0.21*
Exports price index	*p4tot*	*-0.05*
Real devaluation*	*p0realdev*	*0.19*
Average nominal wage	*p1lab_io*	*-0.21*
Average real wage	*realwage*	*0*
Contribution of BOT to real GDP	*contBOT*	*0.033*
Terms of trade*	*p0toft*	*-0.05*
Change in aggregate tariff revenue	*delV0tar_c*	*-223.47*

Summary: As expected, the tariff cut caused the ClothingFtw and Textiles industries to contract, and imports to increase—all bad for GDP. Yet, employment and real GDP expanded —why ? And why did imports of textiles go down? Next you will use AnalyseGE to investigate the simulation in more detail.

2 Investigating results, data, and equations with AnalyseGE

2.1 Some features of AnalyseGE

2.2 The tariff shock and duty-paid import prices.

Write down the initial ad valorem tariff rate for ClothingFtw: *19.6%*

Note: the power of the tariff [t0imp] is defined as *one plus the ad valorem rate*.

Write down the initial power of the tariff for ClothingFtw: *1.196*

Write down the percentage change in t0imp("ClothingFtw"): *-10%*

Use the Windows calculator to compute the post-simulation power of the tariff for ClothingFtw: 1.0764

Write down the post-simulation ad valorem rate: 7.64%

Write down the percentage change in p0("ClothingFtw","imp"): *-10%*

Summary: The ad valorem tariff rate fell from an initial value of 19.6% to 7.64% post simulation. This caused the basic price of imported ClothingFtw to fall by 10%.

2.3 Effect of the tariff cut on imports

Fill in the following delSale values:

delSale (c,"imp",u)	Intermediate	Household	Rest
Textiles	*-35.5*	*-1.5*	tiny
ClothingFtw	*48.3*	*204.7*	tiny

Summary: You should see that households account for most of the change in ClothingFtw imports. For textiles, most of the decrease is in intermediate use. Why did households increase their imports of ClothingFtw? [You will find out in the next section.]

2.4 Strategy for remainder of analysis

3 Analysing results for ClothingFtw

3.1 Import-domestic substitution : Household demand for ClothingFtw

Fill in the table below

	1 dom	2 imp
1 x3_s	*0.55*	*0.55*
2 SIGMA3	*-5.77*	*8.57*
Total	*-5.22*	*9.13*

	x3 (c,“dom”)	x3 (c,“imp”)	x3_s	p3 (c,”dom”)	p3 (c,”imp”)	p3_s	SIGMA3	S3 (c,"imp")
ClothingFtw	*-5.220*	*9.124*	*0.552*	*-0.746*	*-4.801*	*-2.378*	*3.537*	*0.402*

Summary: For ClothingFtw, the household purchasers price has changed by –0.75% (domestic) and by -4.80% (imported). This causes the household demand x3 to change by –5.22% (domestic) and 9.12% (imported) via a substitution away from the domestic good to the imported good.

3.2 Explaining purchasers' prices: Household imports of ClothingFtw

```
(all,c,COM)(all,s,SRC)
   V3PUR(c,s) = V3BAS(c,s) + V3TAX(c,s) + sum{m,MAR, V3MAR(c,s,m)};
```

Right click and select **Decompose the RHS of this Formula**. In ViewHAR, set the combo boxes to "All IntDec3", "ClothingFtw", "All SRC" and choose Column Shares.

Fill in the table below.

	1 dom	2 imp
V3BAS	*0.483*	0.471
V3TAX	*0.001*	*0.003*
V3MAR	*0.516*	*0.526*
Total	1.000	1.000

Summary: Because of local distribution costs, a 10% fall in the duty-paid price of a Chinese teeshirt leads to just a 4.8% fall in the retail price. The detailed treatment of margins is distinctive of the

ORANI type of CGE model—and quite important to simulation results. ORANI-G includes a data summary matrix summarizing the proportions of BAS, MAR, and TAX in purchasers' prices.

Search for and evaluate the SALEMAT2 matrix.
Set combos to "All COM", "All FLOWTYPE", "imp", "HouseH". Which commodity has the highest rate of distribution margin, and why? *NonMetlMinrl: 66% [cement, gravel]*
What if you look at domestic commodities? [change "imp" to "dom".]

3.3 Estimating household demand elasticities

Use the changes in price and quantity to write down an estimate of the elasticity of household demand for ClothingFtw:

	x3_s	p3_s	demand elasticity = %x / %p	B3LUX
ClothingFtw	0.554	-2.378	*-0.233*	*0.25*

Search for and evaluate B3LUX("ClothingFtw") and fill the final column of the table above.

Is the value close to the previous estimate of demand elasticity? *Yes*

Why are the two estimates not identical ? [hard] *w3lux not fixed, slutsky income effect terms.*

3.4 Total demand for domestic ClothingFtw

To see the sizes of the changes, search for the variable delSale and Evaluate it. Set the combo boxes to ClothingFtw/All SRC/All DEST.

Complete the following table (in which we ignore the columns which are all zero):

delSale ClothingFtw	Interm	HouseH	Export	Total
dom	*–62.7*	*–178.5*	*78.8*	*–162.5*
imp	48.3	204.7	0	253.0
Total	–14.3	*26.2*	78.8	90.6

3.5 Why did domestically-produced ClothingFtw get cheaper ?

Find and evaluate the variable p0 (basic prices) and fill in the two values below.

	s=dom	s=imp
p0("ClothingFtw",s)	*-1.416*	*-10*

3.5.1 Relation between commodity prices and industry costs

The price of the domestic ClothingFtw *commodity* is nearly equal to the output price of the ClothingFtw *industry*, p1tot.

What is the value of the output price for the industry, p1tot ? *-1.382%*

What fraction of ClothingFtw commodity is made by the ClothingFtw industry? *99.6%*

What fraction of ClothingFtw industry output is ClothingFtw commodity? *97.1%*

Summary: You can see that if the ClothingFtw industry made *only* the ClothingFtw commodity, the share [MAKE(c,i)/MAKE_C(i)] would = 1, and so the prices p1tot and p0com for ClothingFtw would be identical.

Conclusion: We will have explained why domestically-produced ClothingFtw becomes cheaper if we explain why the output price p1tot("ClothingFtw") decreases. We do this in section 3.6 below.

3.6 Why did the output price p1tot("ClothingFtw") decrease?

Evaluate the p1cst variable and check that

p1cst("ClothingFtw") = p1tot("ClothingFtw") = ? *-1.382*

Now left-click within equation E_p1cst, then right-click. Select **Decompose Part of this Equation**.

Fill in the table below:

ClothingFtw	contribution
1 p1	*-0.442*
2 p1oct	*-0.003*
3 p1cap	*-0.893*
4 p1lnd	*0*
5 p1lab	*-0.045*
Total p1cst	*-1.382*

You should see that p1 (material inputs) and p1cap (capital rentals) are much the largest contributors.

3.6.1 Breaking down the reduction in intermediate input prices?

What share of the p1 contribution comes from price change in domestic ClothingFtw? *15%*

What share of the p1 contribution comes from price change in imported ClothingFtw? *68%*

What share of ClothingFtw sales go to the ClothingFtw industry? [Hint: V1BAS/SALES] *4.78%*

3.6.2 Why did the capital rental p1cap("ClothingFtw") decrease?

Why is land irrelevant here? [Hint: Decompose RHS of formula for V1PRIM]
V1LND("ClothingFtw") = 0

For which industries would land be relevant? *BroadAcre, OtherAgric*

What's more, the equations above give a pretty good estimate as to how much this price must fall. Suppose for the minute that p1lab_o does not change. [This is not correct, as the figures in the work-sheet below show. However it is true that the p1lab_o is small] Then, from (a):

x1lab_o = (1/SL)*x1prim=(1/SL)*(–3.5).

Then, (c) above can be rewritten as

p1cap = x1lab_o/SIGMA1PRIM + p1lab_o.

Ignoring the tiny p1lab_o change, we get:

p1cap = x1lab_o/SIGMA1PRIM = (1/SL)*(–3.5)/SIGMA1PRIM.

The SL value is about 0.7 (this is easily calculated from the base data) and the SIGMA1PRIM value for ClothingFtw is 0.5 (as is easily seen from AnalyseGE). This gives the rough estimate that

p1cap("ClothingFtw") = (1/0.7)*–3.5/0.5 = –10.

This is very close to the exact result of –10.171 (see the worksheet below).

Fill in the worksheet below to validate equations (a) to (c) above. Your Excel sheet with industry results may save time. For the Factor shares SL and SK, find and evaluate the coefficient FACTOR, then use ViewHAR's shares view.

SL = labour share	*0.705*
SK = 1 - SL	*0.295*
x1cap	*0*
x1lab_o	*-4.979*
RHS(a) = SL.x1lab_o + SK.x1cap	*-3.510*
LHS(a) = x1prim	*-3.508*
x1tot	*-3.508*
p1lab_o	*-0.214*
p1cap	*-10.171*
RHS(b) = SL.p1lab_o + SK.p1cap	*-3.151*
LHS(b) = p1prim	*-3.155*
SIGMA1PRIM	*0.500*
RHS(c) = -SIGMA1PRIM * [p1lab_o-p1cap]	*-4.9785*
LHS(c) = x1lab_o	*-4.979*

Summary: Output (x1tot) of ClothingFtw has changed by –3.5%, resulting in a change in labour input (x1lab_o) of –4.97% since capital is fixed (x1cap). The price of capital (p1cap) changes by –10.1% (which is roughly equal to x1lab_o/SIGMA1PRIM). [Note that the price of labour (p1lab_o) only changes by –0.2%, a small amount.]

3.6.3 Slope of the shortrun supply schedule

In your simulation, output (x1tot) of ClothingFtw has fallen by 3.5%, resulting in a fall in labour input (x1lab_o) of 4.97% since capital is fixed (x1cap). The price of capital (p1cap) falls by 10.1% (which is roughly equal to x1lab_o/SIGMA1PRIM). This causes the price of value-added (p1prim) to fall by 3.1%. The output price p1tot falls by about 1.4%. This confirms the upwardly sloping shortrun supply schedule in your simulation.

3.6.4 Movements OF the supply curve and ALONG the supply curve

Which industry has most elastic short-run supply? and why ? *GovAdminDfnc 11.9 high labour share*

Which industry has least elastic short-run supply? and why ? *OwnerDwellng 0.0 high capital share*

Find the equation for variable p1var which calculates average variable costs. Then fill in the table below, for the industry ClothingFtw .

SUPPLYELAST	*4.016*
x1tot	*-3.508*
p1tot	*-1.382*
p1var	*-0.541*
x1tot/[p1tot-p1var]	*4.171225*

The last line above, "x1tot/[p1tot-p1var]" estimates the supply elasticity from simulation results.

How close are the 2 estimates of short-run supply elasticity ? *Pretty close*

Why are the two numbers not identical [hint: up-itself] ? *The SUPPLYELAST formula does not allow for "own-sales" which allow output price to affect input costs.*

3.7 Why did exports of ClothingFtw increase ?

You saw in section 3.4 above that exports of ClothingFtw increase. You will explain this in this section.

Check to find how much exports of ClothingFtw increased. *The variable is x4("ClothingFtw"), the result for which is 13.16. So exports of ClothingFtw increase by 13.16%.*

Find the equation in ORANIG.TAB which "explains" exports x4. [Hint. Gloss on x4 and look for an equation with x4 on the LHS. When you find it, are you surprised at the name?]
There are two equations, namely E_x4A and E_x4B. This naming follows the usual pattern that the equation "explaining" variable xx is called E_xx. The A and B here are because there are two such equations.

Is ClothingFtw in the set TRADEXP? *Yes*

Note that the variables f4p and phi are exogenous and not shocked.

How can you tell this? What does that mean about their values?
They are shown in red italics. Their values are zero.

What is the value of EXP_ELAST("ClothingFtw")? *-10.0*

3.7.1 The export price p4 of ClothingFtw

What happens to the export price p4 of ClothingFtw? *It falls by –1.32*

Decompose the equation E_p4 (Intelligent decomposition). Complete the table below for ClothingFtw.

V4BAS	*-848.1*
V4MAR	*-4.4*
Total	*-852.5*

Summary. The export price p4 for ClothingFtw falls because the basic price of domestically-produced ClothingFtw falls. How much p4 falls can be calculated from the fall in p0 and knowledge of the non-margins share in V4PUR.

3.7.2 Why exports of ClothingFtw increase and by how much

Given that p4 falls by about –1.31%, it is clear that exports x4 must increase by about 10 times that, namely by about 13.1%. [The exact result is 13.16%.]

4 Why did Textiles output shrink?

To check that, look at the x3("Textiles","dom") and x3("Textiles","imp") results.
x3("Textiles","dom") = 0.08, x3("Textiles","imp") = –0.19

The SalesDecomp variable breaks down the percent change in output between main sources of demand.

Find and evaluate SalesDecomp and fill in the table below:

SalesDecomp("textiles")

Interm	*-0.57*
HouseH	*0.02*
Export	*0.27*
Total	-0.28

You should see that although export and household demand contribute positively to demand, the overall output change is dominated by a large fall in intermediate demand.

Investigate further by looking at the values of the SALEMAT2 Coefficient, which shows the sales of each commodity. Here it is convenient to work with Basic values, so set the combo boxes to Textiles/Basic/All SRC/All SALECAT2.

Which category is the main user and what percent of use goes there?
Intermediate usage (3015) out of total sales 5691. This is about 53%.

Which firm uses most of Textiles and what percentage of intermediate usage does it take?
[Hint. Look at V1BAS and set combos to Textiles/dom/All IND. Take column shares.]
ClothingFtw 38.6%

Thus 0.386*0.53 (about 20%) of total sales of Textiles goes to the ClothingFtw industry. The output of the ClothingFtw industry (x1tot) contracts by 3.5% (see section 3.4). The ClothingFtw industry uses a fixed share of composite Textiles (since top nest is Leontief – see equation E_x1).

From this information, how much would you expect the fall of 3.5% in output of ClothingFtw to decrease the demand for Textiles? *About 0.386*0.53*3.5=0.7%.*

In fact total demand for Textiles does not fall by as much since household demand is up by a little (0.08%) and exports are up significantly (1.2%) on a significant base. [Look at the x3 and x4 results. To see the export base, look at SALEMAT2 as above to see that 21.5% of Textiles is exported.]

You will see in section 4.1 below that the price of domestic Textiles falls.

Given this information about the price of domestic Textiles, which earlier section contains the argument which explains why exports of Textiles increase? *Section 3.7*

The FanDecomp variable breaks down the percent change in output between three main causes.

fanDecomp("textiles")

LocalMarket	-0.70	change in non-export demand for textiles *domestic plus imported*
DomShare	0.15	change in dom/imp ratio for textile demand
Export	0.27	change in demand for textile exports
Total	-0.28	

4.1 Why did domestically-produced Textiles get cheaper?

What happens to the basic price p0("Textiles","dom") of domestic Textiles? *It falls by 0.24%.*

Why does the price of domestically-produced Textfiles fall?

What percentage of total intermediate usage by the Textiles comes from imported ClothngFtw? *Only 0.04%. [Look at the V1BAS matrix for industry Textiles, and look at matrix shares.]*

So the Textiles industry using cheaper imports of ClothingFtw is not the reason.

5 Which industries gained, and why?

Table 1: Summary of sectoral outputs and characteristics

	Output	Fan decomposition			Coefficients				Variable cost	
Commodity	x0com	Local Market	Dom Share	Export	EXPSHR	IMPSHR	INDIV EXP	Industry	p1var	SUPPLY ELAST
WoolMutton	0.00	-0.05	0.00	0.05	0.58	0.00	1.00			
GrainsHay	0.03	0.04	0.00	-0.01	0.44	0.01	1.00			
BeefCattle	0.07	0.05	0.00	0.02	0.03	0.00	0.00	BroadAcre	-0.06	0.21
OtherAgric	0.04	0.03	0.00	0.01	0.10	0.04	1.00	OtherAgric	-0.08	0.35
ForestFish	0.11	0.02	0.00	0.09	0.13	0.03	1.00	ForestFish	-0.10	2.19
Mining	0.05	0.03	0.00	0.02	0.56	0.20	1.00	Mining	-0.10	0.29
MeatDairy	0.05	-0.03	0.00	0.09	0.34	0.02	1.00	MeatDairy	-0.02	3.81
OthFoodProds	0.11	0.00	0.00	0.10	0.21	0.14	1.00	OthFoodProds	-0.08	2.00
DrinksSmokes	0.06	-0.01	0.00	0.07	0.08	0.10	0.00	DrinksSmokes	-0.08	1.04
Textiles	-0.28	-0.70	0.15	0.27	0.22	0.41	1.00	Textiles	-0.12	2.18
ClothingFtw	-3.52	0.15	-5.37	1.70	0.13	0.39	1.00	ClothingFtw	-0.54	4.02
WoodProds	0.13	0.04	0.01	0.08	0.09	0.18	0.00	WoodProds	-0.10	3.13
PaperPrint	0.06	0.02	0.02	0.02	0.03	0.18	0.00	PaperPrint	-0.11	1.45
Petrol_CoalP	0.06	0.01	-0.01	0.06	0.08	0.15	0.00	Petrol_CoalP	-0.01	0.31
Chemicals	0.09	0.02	0.01	0.06	0.14	0.38	1.00	Chemicals	-0.08	1.46
RubberPlastc	0.09	0.03	0.03	0.04	0.04	0.32	0.00	RubberPlastc	-0.10	2.00
NonMetlMinrl	0.05	0.02	0.01	0.02	0.03	0.13	0.00	NonMetlMinrl	-0.09	1.43
BasicMetals	0.13	0.06	0.00	0.06	0.39	0.14	1.00	BasicMetals	-0.06	1.87
FabMetalPrd	0.10	0.04	0.02	0.04	0.04	0.15	0.00	FabMetalPrd	-0.12	2.79
TransportEqp	0.13	0.02	0.05	0.05	0.11	0.41	1.00	TransportEqp	-0.09	1.95
OthMachnEqp	0.12	0.01	0.01	0.10	0.19	0.62	1.00	OthMachnEqp	-0.09	1.68
MiscManuf	0.09	-0.01	0.03	0.08	0.09	0.25	0.00	MiscManuf	-0.14	2.98
ElecGasWater	0.01	0.01	0.00	0.00	0.00	0.00	0.00	ElecGasWater	-0.11	0.23
Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Construction	-0.12	1.08
Trade	0.06	0.06	0.00	0.00	0.00	0.00	0.00	Trade	-0.15	1.42
Repairs	0.02	0.02	0.00	0.00	0.00	0.00	0.00	Repairs	-0.13	0.59
Hotel_Cafe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Hotel_Cafe	-0.14	2.81
Transport	0.07	0.01	0.00	0.06	0.16	0.12	1.00	Transport	-0.10	0.74
CommunicSrvc	0.05	0.01	0.00	0.04	0.05	0.06	0.00	CommunicSrvc	-0.13	0.61
FinanceInsur	0.03	0.01	0.00	0.01	0.02	0.02	0.00	FinanceInsur	-0.17	0.68
OwnerDwellng	0.00	0.00	0.00	0.00	0.00	0.00	0.00	OwnerDwellng	-0.12	0.00
PropBusSrvc	0.05	0.03	0.00	0.02	0.03	0.03	0.00	PropBusSrvc	-0.15	1.43
GovAdminDfnc	0.01	0.00	0.00	0.00	0.00	0.00	0.00	GovAdminDfnc	-0.16	11.94
Education	0.04	0.00	0.00	0.04	0.04	0.01	0.00	Education	-0.20	7.19
HealthCommun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HealthCommun	-0.18	3.73
CultuRecreat	0.01	0.00	0.00	0.00	0.00	0.01	0.00	CultuRecreat	-0.14	1.63
OtherService	0.00	0.01	0.00	0.00	0.00	0.16	0.00	OtherService	-0.16	5.00

Questions:

Why did Hotel_Cafe output not increase? *Sells mainly to consumption*

Why did OwnerDwellng output not increase? *Sells mainly to consumption: inelastic supply*

Why is the LocalMarket component of DrinksSmokes and MeatDairy negative? *Export sales held prices up...households switched to other goods.*

5.1 Why did industry costs decrease?

The chief mechanism by which cheaper TCF (both domestic and imported) leads to cost reductions elsewhere is via the assumption that wages for all sectors are indexed to the CPI. This works as follows:

(a) Cheaper TCF reduces the CPI directly; we call this the *impact effect*.

(b) Wages everywhere go down with the CPI.

(c) Reduced wages reduce costs (and output prices) for all the other sectors.

(d) Generalized reduction in output prices further reduces both the CPI and all sectors input costs: we call this the *second-round effect*.

(e) The further reduction in the CPI reduces all wages.....go back to (c).

The general equilibrium effect will be produced by an endless repetition of steps (c) to (e).

To measure the impact effect of cheaper TCF on the CPI, find the appropriate equation:

```
E_p3tot # Consumer price index #
  p3tot = sum{c,COM, sum{s,SRC, [V3PUR(c,s)/V3TOT]*p3(c,s)}};
```

What is the value of p3tot? *-0.21*

Next select and **Evaluate** the phrase above "[V3PUR(c,s)/V3TOT]*p3(c,s)" to see the contributions of each commodity (dom and imp) to the CPI change.

What is the total contribution to the final change in p3tot from Textiles and ClothingFtw, domestic and imported (add 4 numbers together)? *-0.11*

You should see that the direct or impact effect of cheaper TCF is responsible for just over half the CPI change.

Assertion: The remaining drop in the CPI is due to second-round effects [steps (c) to (e) above].

How can we test the assertion above? One way would be to reason as follows. A 1% direct reduction in the CPI will reduces wages 1%. Let S be the share of wages in GDP. The 1% wage reduction will cause costs generally *and the CPI* to fall by S%. So CPI and wages fall by another S%. This in turn reduces costs by S^2%, and so on. The total eventual reduction in the CPI would be:

$$1 + S + S^2 + S^3 + ... = T\%$$

We can add up the infinite series by noting:

$$ST = S + S^2 + S^3 + S^4 + ... = T - 1$$

So $T = 1/[1-S]$

Find and evaluate the coefficient INCGDP. What is the share of wages in GDP, S? *0.456*

So what is T? *1.84*

You should find that the total effect T is just under double the initial 1% CPI rise. This means that indirect or second-round CPI falls will be slightly less than half the impact effect—which agrees with the assertion above.

Summary: the benefits of the tariff cut arise mainly[1] from the effect of the tariff cut on the CPI, and on the link between the CPI and wages. If we dropped the wage indexation assumption, or we reduced

[1] A small amount of ClothingFtw is sold directly to other industries, so providing another route for cheaper ClothingFtw to benefit other sectors.

tariffs on goods sold mainly to some other final demander (say, investment) we would not expect to see expansion in the other sectors.

Our argument, that lower wages are the main cause of non-TCF expansion seems to explain why p1var fell more for the nontraded industries at the bottom of Table 1: for these industries labour accounts for a larger share of costs.

Decompose the RHS of equation E_p1var to find out whether wages (p1lab_o) or materials (p1mat) make the bigger contribution to reduced input costs for non-traded sectors? for traded sectors? *Wages make a bigger contribution than materials for non-traded sectors, for traded sectors wage and material contributions are of similar size.*

6 Macro results

We will not analyse macro results at length here, since results analysis from the macro point of view is the focus of a later exercise: analysis of a wage-cut simulation. Nevertheless, AnalyseGE can make a useful contribution.

What happened to real GDP? *up 0.0331%*

Which expenditure aggregates contributed to this change? *contGDPexp*

Exports *0.0726%*

Imports *-0.0395%*

Now find equation E_x0gdpinc and decompose the RHS by variable

How much did employment and taxes respectively contribute to real income-side GDP?

employment contributed: *0.0224%*

taxes contributed: *0.0106%*

of taxes, tariffs contributed: *0.0088%*

What is the terms-of-trade loss as a percent contribution to GDP? *-0.0079*

How does the terms-of-trade loss compare with the allocative efficiency gain? *About the same !*

6.1.1 Sector-specific shocks have tiny macro effects

Sometimes it is embarasssing to report the tiny GDP % effects that result from shocks to one small sector. To avoid this, you can report results, not in per cent terms, but in base-period-dollars-worth. For example, **Bring AnalayseGE to Front**, clear the expression box, and type in:

```
0.01*sum{i,ind:employ(i)<0, employ(i)*V1LAB_O(i) };
```

Then press the **Evaluate** button.

This gives the value[2] of employment losses. What is it? *-54.07 base-period-million-dollars*

Use a similar method to find value of employment gains. What is it? *149.99 base-period-million-dollars*

[2] It gives the value in base-period-currency units. The initial data is measured in million 93-4 dollars.

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Lab Exercise:
Adding new behaviour to the ORANI-G model

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Centre of Policy Studies

April 2003

Contents

this exercise requires the additional file NEW.BIT.

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1. Introduction

ORANI-G is a generic model which is designed to be used with a variety of national databases. Usually, country-specific versions of the model include some additional equations (and perhaps data) describing country-specific behaviour. For example, the basic ORANI-G model does not include equations modelling tourism exports. Indeed, foreign visitors' purchases of hotel rooms, meals, and airfares are often not consistently reported in input-output tables. If you wanted to build a CGE model of a country which relied heavily on tourism, you would need to add equations and data describing tourist demand to the basic ORANI-G framework.

Particular modelling projects also call for new equations and data. Suppose you want to know by how much an increase in electricity prices will reduce industrial electricity demand. According to the basic ORANI-G model, all intermediate demands are Leontief—they move in proportion to industry outputs. The Leontief assumption would have to be modified if you wanted to capture the effects of price-induced electricity savings.

In short, it will often be useful or necessary to add equations and data to the core model. This exercise aims to lead you through that process.

2. Linking household consumption to post-tax income

Like the original version of ORANI, ORANI-G makes no explicit link between household incomes and household spending. Two reasons are:

- The input-output table underlying the database includes indirect (commodity) taxes but has no data about direct taxes or transfers between household and government. Thus the IO table tells us the value of household spending, but not of household disposable income.
- Originally, ORANI was part of a suite of 4 models: BACHUROO (demographics/population), MACRO (quarterly macro model), SNAPSHOT (long-run CGE), and ORANI (short-run CGE). ORANI's role was to predict detailed sectoral shortrun effects. The MACRO model was to predict the values of major expenditure aggregates (like consumption and investment). ORANI was rather under-developed from the macro standpoint.

The lack of macro detail sometimes raises questions. For example, in the tariff cut simulation that you studied earlier, employment (and the purchasing power of total wage payments) rose, yet household consumption was fixed. Should not increased earnings have boosted consumption? Again, reduction of tariffs reduced government tax receipts, suggesting (since government spending was fixed) a move towards government budget deficit. Should not some other tax be raised to cover the lost tariff revenue?

Answering these criticisms, Peter Dixon and others argued that fiscal or monetary policy (raising taxes or interest rates), not modelled by ORANI, could be used in the short run to manipulate or stabilize aggregate demand. Thus, if an ORANI simulation showed employment to increase whilst consumption was held constant, we could presume that the government must be raising income taxes [unseen by

ORANI]. Higher income taxes could meet the tariff revenue shortfall, and at the same time explain how consumption failed to rise with employment.

The aim of this exercise is to make some of these mechanisms more explicit. In particular we wish to specify that:

- primary factor incomes are subject to direct (income) tax;
- household disposable income is *proportional* to [primary factor income *less* direct tax].
- government income is *proportional* to [direct taxes + indirect taxes].
- labour supply depends on *post-tax* real wages.

Please note that above, we say "proportional" rather than "equal". A complete accounting treatment should include transfers between households, government and the ROW [rest of the world]. Pension payments (from government to households) and repatriated profits (from factors to ROW) are two important examples. If we measured *all* of the payments between firms, households, government and ROW, we would have enough data to construct a complete Social Accounting Matrix [SAM][1]. That is beyond the scope of this exercise. Nevertheless, the simple addition to the model framework of direct taxation allows us to make predictions of changes in household disposable income and government revenue, and perhaps could improve our simulations of the effects of tariff reduction.

2.1. Relevant parts of the existing model

First we review existing variables, coefficients and equations which we may use in our modification. Open TABmate, and search for and Gloss on the following items:

Description	Coefficient	Variable
Aggregate revenue from all indirect taxes	V0TAX_CSI	w0tax_csi
Nominal total household consumption	V3TOT	w3tot
Aggregate primary factor payments	V1PRIM_I	w1prim_i
Average real wage	n/a	realwage

2.2. New equations, variables and coefficients

We aim to define the following new relations (in levels):

(a) VDIRTAX = DTAXRATE*V1PRIM_I flat rate income tax

(b) VINCPTAX = V1PRIM_I - VDIRTAX income after tax

(c) VTAXTOT = VDIRTAX + V0TAX_CSI total tax revenue

(d) V3TOT = F3INC*VINCPTAX consumption function

(e) REALWAGEPT = REALWAGE*[1-DTAXRATE] post-tax real wage

using the following new coefficients and variables: All the new variables are percent change variables[2].

[1] A SAM is a diagram enforcing the rule of double-entry book-keeping: every cash flow goes from one agent to another agent. It is a square table with matching row and column labels listing various agents (firms, factors, household, government, ROW, savings/investment). Cell(i,j) of the SAM shows the payment made to agent i by agent j. Row and column sums of the matrix must match—since the income of agent k must equal her [expenditure+saving]. If we have an input-output table, we have 90 or 95% of the numbers needed to construct a SAM.

[2] If there was any chance that the income tax rate could be zero or negative, we would have to define it as an ordinary change variable. Unfortunately such a possibility seems remote in Australia.

Description	Coefficient	Variable
Revenue from direct taxation	VDIRTAX	wdirtax
Rate of direct tax	DTAXRATE	dtaxrate
Post-tax factor income	VINCPTAX	wincptax
Sum of income and commodity tax revenue	VTAXTOT	wtaxtot
Ratio: [household consumption]/[post-tax factor income]	F3INC	f3inc
Average post-tax real wage	REALWAGEPT	realwagePT

Translating formulae (a) to (e) above into percent change form, we get the equations:

(a') wdirtax = w1prim_i + dtaxrate

(b') VINCPTAX*wincptax = V1PRIM_I*w1prim_i - VDIRTAX*wdirtax

(c') VTAXTOT*wtaxtot = VDIRTAX*wdirtax + V0TAX_CSI*w0tax_csi

(d') w3tot = wincptax + f3inc

(e') VINCPTAX*realwagePT = VINCPTAX*realwage - VDIRTAX*dtaxrate

Can you see how we derived Equation (e')? First we split:

(e) REALWAGEPT = REALWAGE*[1-DTAXRATE] into two equations:

REALWAGEPT = REALWAGE*V and V=[1-DTAXRATE]

giving percent change forms:

realwagePT = realwage + v

and Vv=-DTAXRATE*dtaxrate or v=-[DTAXRATE/V]*dtaxrate

Substituting the equation for v back into the first of the above equations, we get:

realwagePT = realwage -[DTAXRATE/V]*dtaxrate

or realwagePT = realwage -[DTAXRATE/(1-DTAXRATE)]*dtaxrate

It is customary for coefficients of percent change equations to be expressed in terms of flows (ie, values) which are stored on the data file. To achieve this we multiply top and bottom of the square bracketed term above by V1PRIM_I, thus:

[DTAXRATE/(1-DTAXRATE)] = [V1PRIM_I*DTAXRATE/(V1PRIM_I-V1PRIM_I*DTAXRATE)]

Using (a): VDIRTAX = DTAXRATE*V1PRIM_I the above becomes:

= [VDIRTAX/(V1PRIM_I-VDIRTAX)]

Using (b): VINCPTAX = V1PRIM_I - VDIRTAX the above becomes:

= [VDIRTAX/(VINCPTAX)]

The entire equation now becomes:

realwagePT = realwage -[VDIRTAX/(VINCPTAX)]*dtaxrate

Multiplying through by VINCPTAX we get[3]:

VINCPTAX*realwagePT = VINCPTAX*realwage - VDIRTAX*dtaxrate

[3] You can mentally verify (e') as follows: with tax rates fixed (dtaxrate=0) a 1% rise in realwage must lead to a 1% rise in realwagePT -- so the coefficients on realwage and realwagePT should be the same. The left-hand term equals 100 times the ordinary change in post-tax income. With realwage fixed (=0), the term VDIRTAX*dtaxrate equals equals 100 times the ordinary change in income tax revenue.

Notice that some of the percent change variables (eg, f3inc, dtaxrate) do not appear as coefficients in the percent change equations. This is quite normal. The new coefficients that we actually need are: VDIRTAX, VINCPTAX and VTAXTOT. If we read the value of VDIRTAX from the data file we can compute VINCPTAX via formula (b) and VTAXTOT via formula (c).

Box 1 below shows the new material that must be added at the bottom of the TABLO input file. We start by defining three new coefficients and six new variables. One new coefficient, VDIRTAX, is read from file; the others are calculated by two formulae.

The equations are the same as (a') to (e') above. The only new point is the system of naming the equations. Each equation name consists of "E_", followed by the name of the new variable which that equation explains[4]. The five new equations will endogenize the corresponding five new variables—leaving one variable—dtaxrate—to be exogenous. With dtaxrate exogenous, the five new equations will compute values for the five new variables—without affecting results for any other variables. Hence, even though we have added new equations we can still replicate solutions computed using the original model[5]. Only when we exogenize f3inc and endogenize the original variable x3tot, will the new equations have a system-wide effect.

Box 1: Addition to bottom of TABLO input file [see file NEW.BIT]

```
Coefficient
 VDIRTAX  # Revenue from direct taxation #;
 VINCPTAX # Post-tax factor income #;
 VTAXTOT  # Sum of income and commodity tax revenue #;
Variable
 wdirtax  # Revenue from direct taxation #;
 dtaxrate # % Change in ad valorem direct tax rate #;
 wtaxtot  # Sum of income and commodity tax revenue #;
 wincptax # Post-tax factor income #;
 f3inc    # Ratio: [household consumption]/[post-tax factor income] #;
 realwagePT   # Average post-tax real wage #;

Read   VDIRTAX from file BASEDATA header "DTAX";
Update VDIRTAX = wdirtax; !the "I" in wdirtax is missing in NEW.BIT!
Formula
 VINCPTAX = V1PRIM_I - VDIRTAX;
 VTAXTOT  = VDIRTAX + V0TAX_CSI;

Equation
E_wdirtax # Revenue from direct taxation #
 wdirtax = w1prim_i + dtaxrate;

E_wincptax # Post-tax factor income #
 VINCPTAX*wincptax = V1PRIM_I*w1prim_i - VDIRTAX*wdirtax;
 ! NEW.BIT has L (el) instead of 1 (one) in V1PRIM_I !
E_wtaxtot # Sum of income and commodity tax revenue #
 VTAXTOT*wtaxtot =  VDIRTAX*wdirtax + V0TAX_CSI*w0tax_csi;
 ! NEW.BIT has the semi-colon at the end of previous line omitted !
E_f3inc # Household consumption proportional to post-tax factor income #
 w3tot = wincptax + f3inc;

E_realwagePT # Average post-tax real wage #
 VINCPTAX*realwagePT = VINCPTAX*realwage - VDIRTAX*dtaxrate;
 ! NEW.BIT has "+" instead of the last "*" !
```

[4] This way of creating equation names is used by the TABmate **Tools...Closure** command, which attempts to automatically work out a closure (ie, list of variables not explained by any equation).

[5] The capacity to replicate the solutions obtained with the original, un-enhanced model, is an important checking device. See Appendix I of the ORANI-G document: *Formal Checks on Model Validity; Debugging Strategies.*

2.3. Adding new statements to the TABLO input file

The next step is to make new versions of the TAB, STI and CMF files. In Explorer:

- make a copy of ORANIG.TAB named ORANIGDT.TAB (DT=direct tax)
- make a copy of ORANIG.STI named ORANIGDT.STI
- make a copy of TARFCUT.CMF named TARFCUT1.CMF

Start TABmate directly (no need for WinGEM at this stage) and open ORANIGDT.TAB. You have to add the contents of Box 1 at the bottom of the TAB file. To help you, we have supplied the Box 1 contents in a text file, NEW.BIT. Open this file, and copy the entire contents into the bottom of ORANIGDT.TAB. Then press the **TABLO Check** button.

You will discover that there are two or three errors or typos in the newly added equations—this is quite normal! TABmate underlines each error in red[6]. If you click on the underlined text, an error message appears in the panel at the bottom[7]. The "Next" button at the top (marked with a red cross) takes you to the next error. Study the error messages and the correct equations in Box 1 above and attempt to fix the problems. Then press **TABLO Check** again. Continue till you see the message "No errors found". [There are 4 errors shown in red on the previous page.]

2.4. Creating new STI and CMF files

Without closing the TAB file, press the button **TABLO STI** and **Edit** the file ORANIGDT.STI. Use **Search...Replace** to change every occurrence of ORANIG into ORANIGDT. Then save and close the STI file.

Back at the TAB file, again press the button **TABLO STI** but this time choose **Run**. This causes TABLO to "implement" the model, that is, to produce GSS and GST files which GEMSIM can use. After a short wait a success message should appear. Click OK, and close the TAB file.

Open the file TARFCUT1.CMF and use **Search...Replace** to change every occurrence of ORANIG into ORANIGDT. Then find the lines:

```
! All tax rates are exogenous
exogenous  delPTXRATE f0tax_s  f1tax_csi f2tax_csi f3tax_cs f5tax_cs t0imp
           f4tax_trad f4tax_ntrad f1oct ;
```

and add in "dtaxrate" just before the last semicolon above. The line above should now read:

```
           f4tax_trad f4tax_ntrad f1oct dtaxrate;
```

Save the CMF file and close TABmate. As explained previously, by making dtaxrate exogenous (but not f3inc) we aim to replicate our previous TARFCUT simulation. We will "swap" f3inc with x3tot at a later stage.

2.5. Adding new data to the BASEDATA input file

We next must add the new input data for VDIRTAX to a new header DTAX on the input data file. According to ABS publication 5206.0, *National Income, Expenditure and Product*, June Quarter 1997, Table 33, in 1993-94 total direct taxes on income summed to 66,383 million dollars.

Start ViewHAR and open the BASEDATA file, BASEDATA.HAR.

Can you see the Edit menu item at the top of ViewHAR? If not, choose **File..Use advanced, editing, menu**, and the Edit menu should appear[8].

---

[6] More precisely, TABmate underlines where a problem is noticed. Sometimes the real error is in a line nearby.

[7] The error message at bottom vanishes after 4 seconds, but will return if you click the bottom panel.

[8] ViewHAR can run in either *read-only* or in *editing* mode. Editing mode offers the full set of menu options, while the read-only menus are simpler and do not allow files to be modified. Read-only is the default. The File menu lets you switch between the two modes.

Select **Edit...Create New Header**. In the window which appears, enter in:

- *Header Type:* Real [RE]
- *4 Character header:* DTAX
- *Default value:* 0.0
- *Coeff name:* VDIRTAX
- *Long Name:* Revenue from direct taxation
- *No of Dimensions*[9]*:* 0

Select **OK**. A new header DTAX should appear at the bottom of the Contents page. Double-click on this line to examine its contents. You should see a single number, 0.0.

Right-click on the zero—an edit box appears—type in 66383 and click the green tick-mark button[10]. The title bar at the top of ViewHAR will now show that the file has changed. Choose **File..Save** to save your changes.

2.6. Check simulation: TARFCUT1

Start WinGEM and use ***File | Change both default directories*** to ensure that the working directory is C:\GPWORK\ORANIG.

Choose **Simulation...GEMSIM Solve** and **Select** the command file TARFCUT1.CMF[11]. Click **Run**. After a short while, you should get a success message[12]—click **Go to ViewSOL**, and examine the macro variables in TARCUT1.SL4. If possible, use ViewSOL to open the original solution TARFCUT.SL4 that you computed in previous days[13]. You should see that the results are the same. However, some useful new variables have been computed: f3inc, realwagePT, wincptax, wdirtax and wtaxtot. To see the results for these new variables, select tarfcut1 (rather than tarfcut) in the second drop-down menu ("Choose which solution to view") in ViewSOL. Then, on the page containing results for **macros,** you will see **n.a.** (not available) for these new variables in the tarfcut column of results.

Looking at the macro results for TARFCUT1 (also in Table 1 below), we see:

- price indices p3tot and p0gdpexp fell by about 0.2%. Total tax revenue (wtaxtot) fell by more than this, so that its real value fell (because tariff revenue declined). Total tax revenue also fell more than the nominal value of government demands (w5tot) suggesting that the government budget deficit might be increasing.
- although employment (employ_i) rose by 0.05%, real household consumption was fixed. The ratio f3inc (= household spending/factor income) fell by -0.1%.

Both features of the simulation seem problematic. Would employment rise so much if the government maintained tax revenue by increasing some other tax? Would exports still increase if newly employed people spent some of their earnings? The next simulation addresses these questions.

---

[9] According to GEMPACK, a matrix has 2 dimensions, a vector has 1 dimension, and a scalar (single number) has 0 dimensions.

[10] You can also paste in whole matrices of numbers from Excel, using the **Import...Paste** command.

[11] You might wonder how GEMSIM knows which model to use: ORANIG or ORANIGDT?. The information is contained in the TARFCUT1.CMF, in the line: "auxiliary files=ORANIGDT;". This tells GEMSIM to use the files ORANIGDT.GSS and ORANIGDT.GST which you created earlier in TABmate (by pressing TABLO STI button).

[12] The Accuracy Summary with smiling faces does not appear this time because this was a single-step, Johansen computation. GEMSIM can only judge accuracy by comparing results from, say, 2-step, 4-step, and 6-step computations.

[13] Set the "Choose which solution to view" combo box at top middle ViewSOL to read "TARFCUT1", to ensure that you see values for new variables.

Table 1: Selected macro results from simulations TARFCUT1 and TARFCUT2

Description	Name	TARFCUT1	TARFCUT2
Contribution of BOT to real expenditure-side GDP (change)	contBOT	0.033	0.004
Aggregate tariff revenue (change)	delV0tar_c	-223.471	-223.127
Aggregate revenue from all indirect taxes (change)	delV0tax_csi	-257.626	-256.345
% Change in ad valorem direct tax rate	dtaxrate	**0.000**	0.441
Aggregate employment: wage bill weights	employ_i	0.049	-0.008
Overall wage shifter	f1lab_io	0.000	0.094
Ratio: [household consumption]/[post-tax factor income]	f3inc	-0.105	**0.000**
GDP price index, expenditure side	p0gdpexp	-0.190	-0.114
Terms of trade	p0toft	-0.046	-0.028
Average nominal wage	p1lab_io	-0.214	-0.057
Consumer price index	p3tot	-0.214	-0.151
Average real wage	realwage	**0.000**	0.094
Average post-tax real wage	realwagePT	0.000	**0.000**
C.I.F. local currency value of imports	w0cif_c	0.218	0.211
Nominal GDP from expenditure side	w0gdpexp	-0.157	-0.109
Nominal GDP from income side	w0gdpinc	-0.157	-0.109
Aggregate revenue from all indirect taxes	w0tax_csi	-0.520	-0.518
Revenue from direct taxation	wdirtax	-0.110	0.386
Aggregate nominal value of government demands	w5tot	-0.16615	-0.05776
Post-tax factor income	wincptax	-0.110	-0.149
Sum of income and commodity tax revenue	wtaxtot	-0.285	**0.000**
Aggregate payments to labour	w1lab_io	-0.165	-0.065
Nominal total household consumption	w3tot	-0.214	-0.149
Import volume index, C.I.F. weights	x0cif_c	0.218	0.211
Real GDP from expenditure side	x0gdpexp	0.033	0.005
Real household consumption	x3tot	**0.000**	0.002
Export volume index	x4tot	0.424	0.247
Aggregate real government demands	x5tot	**0.000**	**0.000**

Note: Above, exogenous values are shown bold.

2.7. Second simulation: TARFCUT2

Next you change the closure to activate the new equations so that they affect all parts of the model.

From WinGEM use **File...Edit File** to open TARFCUT1.CMF in TABmate. Then use TABmate's **File Save As** to save the CMF with a new name, TARFCUT2.CMF.

We wish to make 3 closure changes:

- hold constant the average post-tax real wage (realwagePT) instead of the average pre-tax real wage (realwage). In other words, make labour supply respond to *post-tax* real wages.
- hold constant the sum of income and commodity tax revenue (wtaxtot) instead of the direct tax rate (dtaxrate). In other words, income taxes will increase to make up for lost tariff revenue.
- hold constant the propensity to consume post-tax factor income (f3inc) instead of aggregate real household consumption (x3tot). In other words, make household consumption follow post-tax income.

These changes are summarized in the table below:

Table 2: Closure swaps for TARFCUT2.CMF

Description	Name	tarfcut1	tarfcut2
Average real wage	realwage	exogenous	
Average post-tax real wage	realwagePT		exogenous
% Change in ad valorem direct tax rate	dtaxrate	exogenous	
Sum of income and commodity tax revenue	wtaxtot		exogenous
Real household consumption	x3tot	exogenous	
Ratio: [household consumption]/[post-tax factor income]	f3inc		exogenous

In file TARFCUT2.CMF just after the line "rest endogenous;" add in the following 3 lines:

```
! old exogenous = new exogenous

swap realwage=realwagePT ; ! closure swaps for tarfcut2
swap dtaxrate=wtaxtot ;
swap x3tot=f3inc ;
```

Then find the line:

```
verbal description = ORANIG: ClothingFtw tariff cut, DPSV shortrun closure;
```

and change it to:

```
verbal description = ORANIGDT: ClothingFtw tariff cut, modified closure;
```

Then save TARFCUT2.CMF and close TABmate.

From WinGEM, choose **Simulation...GEMSIM Solve** and **Select** the command file TARFCUT2.CMF. Click **Run**. After a short while, you should get a success message—click **Go to ViewSOL**, and examine the macro variables in TARCUT2.SL4. If it is not already visible, also open the previous solution TARFCUT1.SL4. You should see that most of the results are different. You could **Export** the macro results from ViewSOL to Excel to produce a table much like Table 1.

Comparing the macro results for simulations TARFCUT1 and TARFCUT2, we see:

- in TARFCUT2 income taxes must rise to keep tax revenue constant. [Note: dtaxrate rises by nearly half a percent. 0.5% would mean that an initial tax rate of 25% became 25.125% -- not 25.5%]. With post-tax real wages fixed, the income tax rise means that the pre-tax wage must rise. This makes firms less keen to employ. Consequently.....
- employment (employ_i) rises by less in TARFCUT2. Consequently.....
- real GDP (x0gdpexp) rises by less in TARFCUT2
- consumption (x3tot) rises a little in TARFCUT2. Because more of the [smaller] GDP increase is diverted to domestic use.....
- exports (x4tot) increase less in TARFCUT2, and so....
- the terms of trade loss (p0toft) is less in TARFCUT2.

The more realistic macro closure of TARFCUT2 greatly reduces the employment and output gains from the tariff cut.

2.8. A caveat

If you examine the w5tot, x5tot and wtaxtot rows of the TARFCUT2 simulation, you might notice that while real government spending (x5tot) and nominal tax receipts (wtaxtot) were fixed, the nominal value of government demands declined. Therefore, the government must be moving towards budget surplus. The TARFCUT2 simulation is *revenue-neutral* but not *budget neutral*. Another aspect of the same phenomenon is that in TARFCUT2 we have two exogenous variables measured in $A (phi and wtaxtot). Therefore, a shock to the numeraire (phi) would have real effects. We could fix the [tiny] problem in various ways, perhaps defining a new variable, *real tax collection* (rtaxtot), given by the percent change equation:

rtaxtot = wtaxtot - p5tot

and holding rtaxtot fixed instead of wtaxtot. We would then find that w5tot and wtaxtot moved together, and our model would again be money-neutral (numeraire shocks would have no real effects).