Using AnalyseGE to examine an ORANI-G tariff cut simulation

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Summary

General equilibrium modellers need to explain their results. This requires them to identify and quantify the main mechanisms of the model which are producing the results. To do this, they must bring together details of the equations of the model, the base data, consequences of that data (totals etc) and the simulation results (percentage changes etc).

AnalyseGE is a software tool which is aimed at assisting 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 exercise for the reader to follow.

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

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?

What type of closure is used?

Using TABmate, search through ORANIG03.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\ORANIG03.

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, ORANIG03.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?

What other import changed, and by how much?

Now have a look at the industry outputs, x1tot.

What happened to output of ClothingFtw?

What happened to output of Textiles?

Can you see a pattern in the other industry outputs?

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				
ClothingFtw				

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.

Now look at the **macro variables**. Macro variables are scalar variables which 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.

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 (but leave the file open).

Fill in the table of macro variables below.

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

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. Return to the GEMSIM window in WinGEM and click 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 ORANIG03.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***.

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 this, find the declaration of variable *t0imp* (for example, using the Search menu). **Left-click** anywhere in this declaration. 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.

Write down the initial ad valorem tariff rate for ClothingFtw:

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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.

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:

Write down the percentage change in t0imp("ClothingFtw"):

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"):

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 shows us which demanders are responsible for these changes.

Fill in the following delSale values:

delSale (c,"imp",u)	Intermediate	Household	Rest
Textiles			tiny
ClothingFtw			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

In the remainder of this document we will:

- first, analyse more results for the ClothingFtw sector (section 3).
- next, 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).

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 for imports 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.

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

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[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.

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		
2 SIGMA3		
Total		

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			*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) = 0.592 * (-.746) + 0.402 *(-4.801)) = -2.378

the price of ClothingFtw composite has decreased,

x3(c,"dom") = x3_s(c) - SIGMA3(c) * [p3(c,"dom")-p3_s(c)]

x3(c,"dom") = 0.554 – 3.54 * [-.746 – (-2.378)] = 0.55 - 5.77 = -5.22

there is substitution away from the domestic good, towards the imported good.

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 IntDec3", "ClothingFtw", "All SRC" and choose Column Shares.

Fill in the table below.

	1 dom	2 imp
V3BAS		0.471
V3TAX		
V3MAR		
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?
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		

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?

Why are the two estimates not identical ? [hard]

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).

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[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.

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				
imp	48.3	204.7	0	253.0
Total	–14.3		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%.

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)		

[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.

3.5.1 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 ?

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?

What fraction of ClothingFtw industry output is ClothingFtw commodity?

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.

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)}];
```

[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.

Evaluate the p1cst variable and check that

p1cst("ClothingFtw") = p1tot("ClothingFtw") = ?

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	
2 p1oct	
3 p1cap	
4 p1lnd	
5 p1lab	
Total p1cst	

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.

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

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

- 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]]

---

[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).]

[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".

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]

For which industries would land be relevant?

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]

---

[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.]

[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

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.

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 worksheet 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).

---

[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.

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

SK = 1 - SL

x1cap

x1lab_o

RHS(a) = SL.x1lab_o + SK.x1cap

LHS(a) = x1prim

x1tot

p1lab_o

p1cap

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

LHS(b) = p1prim

SIGMA1PRIM

RHS(c) = -SIGMA1PRIM * [p1lab_o-p1cap]

LHS(c) = x1lab_o

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 x1lab_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.

3.6.4 Movements OF the supply curve and ALONG the supply curve

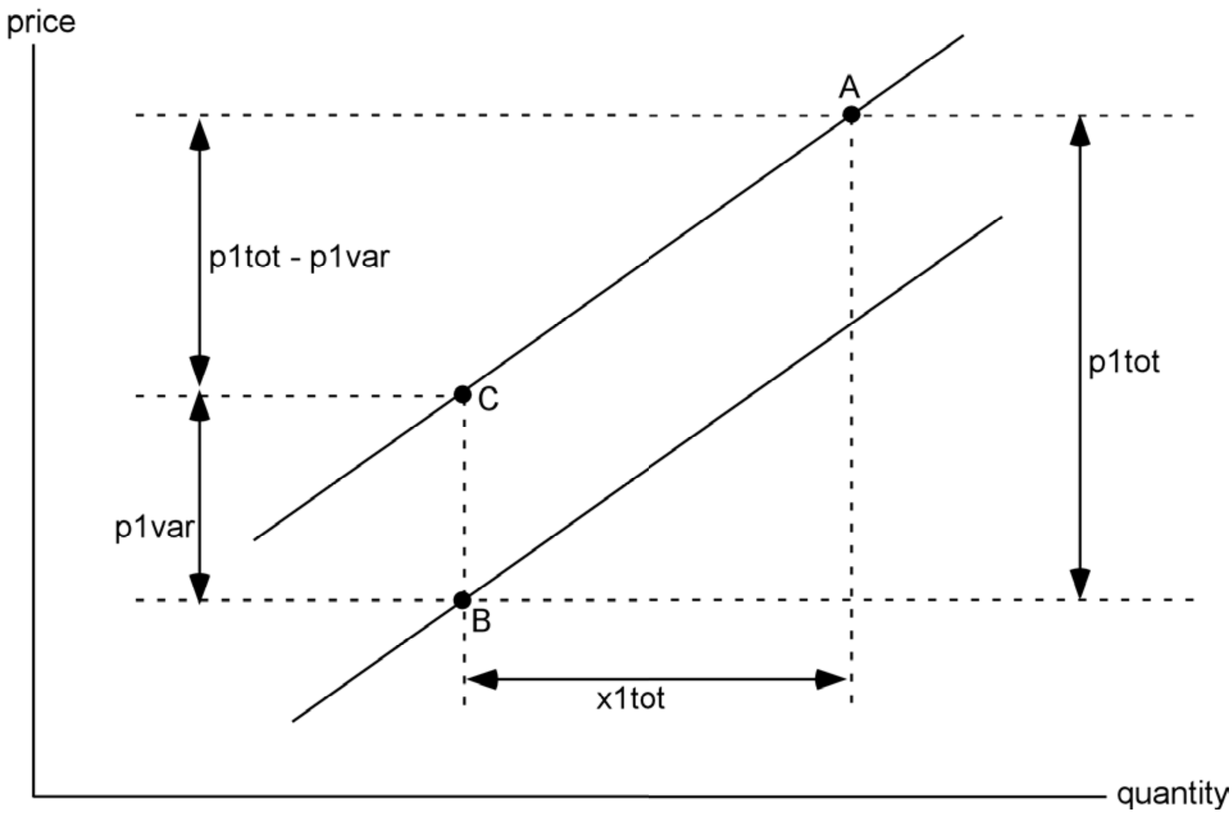
Appendix J of the ORANI-G document (Horridge, *2003)* has a full derivation of the short-run supply elasticity. The formula given there is computed by the SUPPLYELAST coefficient in the ORANI-G TAB file. Find and evaluate this coefficient.

Which industry has most elastic short-run supply? and why ?

Which industry has least elastic short-run supply? and why ?

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

x1tot

p1tot

p1var

x1tot/[p1tot-p1var]

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 ?

Why are the two numbers not identical [hint: up-itself] ?

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.

Find the equation in ORANIG03.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?]

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?

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?

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")?

Hence you can see that

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

---

[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.

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.

3.7.1 The export price p4 of ClothingFtw

What happens to the export price p4 of ClothingFtw?

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

V4MAR

Total

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%.]

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.

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	
HouseH	
Export	
Total[15]	-0.28

[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.

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?

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.]

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?

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?

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?

Why does the price of domestically-produced Textfiles 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?

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 x0dom, 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 x0dom 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 x0dom 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.

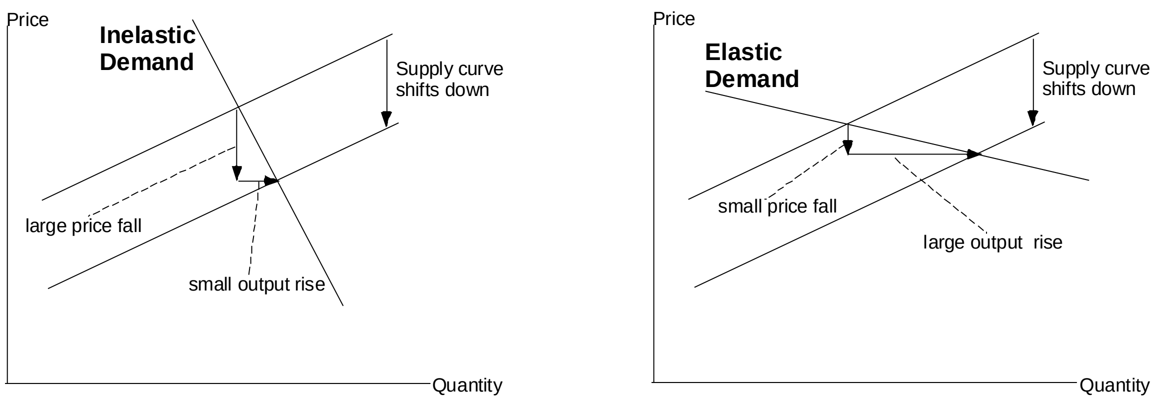


Figure 1. Effects of reduced input costs

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	x0dom	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?

Why did OwnerDwellng output not increase?

Why is the LocalMarket component of DrinksSmokes and MeatDairy negative?

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?

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)?

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:

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

We can add up the infinite series by noting:

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

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

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

So what is T?

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?

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?

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?

Which expenditure aggregates contributed to this change?

Exports

Imports

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:

taxes contributed:

of taxes, tariffs contributed:

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.

---

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

[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.

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?

How does the terms-of-trade loss compare with the allocative efficiency gain?

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?

Use a similar method to find value of employment gains. What is it?

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

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

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.monash.edu.au/policy/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 2.13.3 of GEMPACK document number GPD-1 [see Harrison and Pearson (2002)]. A more technical and complete explanation can be found in Pearson (1991).

12 References

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