Chapter 7

Implementing the Dynamic GTAP model in the RunDynam Software

Ken Itakura, Elena Ianchovichina, Csilla Lakatos and Terrie Walmsley[1]

1. Introduction

The purpose of this chapter is to introduce the reader to the publicly available software – RunDynam – which is used to carry out the applications presented in Part III of this book. The RunDynam program is based on the GEMPACK suite of software (Harrison and Pearson, 1999), which is specifically designed to solve non-linear general equilibrium models. Other general equilibrium models solved using the GEMPACK software suite include the standard GTAP model and the Monash model of Australia. The RunDynam program has been specially tailored to the needs of the GDyn model and other dynamic models. It offer the user a great deal of flexibility in constructing simulations. It is available from the Centre of Policy Studies at Monash University, Australia.[2]

Using the RunDynam software, you can examine the data, construct and modify simulations, solve simulations, and examine results. Users who wish to alter the underlying theory of the model will need to acquire additional software from the Centre of Policy Studies at Monash University, Australia. Also for those who wish to make their own aggregations they will have to purchase the GTAP Data Base from the Center for Global Trade Analysis, Purdue University, USA[3]. Altering the standard model and/or the data aggregation are not discussed in this chapter.

The RunDynam program requires a PC running Microsoft Windows XP or later, with at least 512MB of RAM and at least 1GB of free disk space;

1 The authors would like to thank Anna Strutt and Horacio Santander for their help with the welfare decomposition section of this chapter.
2. http://www.gempack.com.au
3. http://www.gtap.agecon.purdue.edu/

The chapter is organized as follows. Section 2 demonstrates how to install the program and load up the applications. Section 3 shows how to view the data. Section 4 provides an introduction to running simulations. Section 5 examines how to view simulation results. Section 6 outlines the notation used to denote the chapters presenting the applications in Part III of this book.

2. Installing the RunDynam Software and loading up applications

Installing RunDynam

The following steps allow us to install RunDynam:

- Double click on the install EXE in the RunDynam CD-ROM.
- RunDynam Installation program starts and a Welcome pop up box appears on your screen. Click **Next**.
- You will be asked which directory you wish to install RunDynam. Default destination folder is **c:\RunDynam**. **Click Next.**
- If you are ready to install, then click **Next**.
- Once installation is completed, click **Finish**.

The RunDynam icon will then appear on your desktop ready for use.

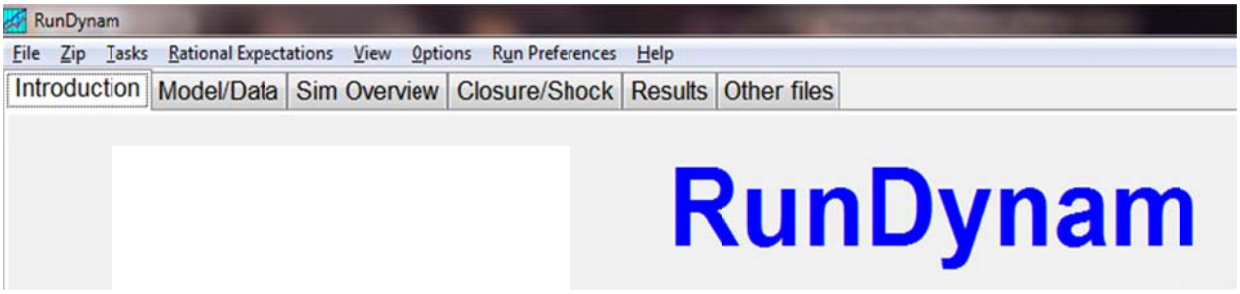
Downloading the RunDynam application archive

Once you have installed the RunDynam software you can obtain the applications for this Chapter and the other Chapters in this book, from the GTAP web site (https://www.gtap.agecon.purdue.edu/models/Dynamic/applications.asp). Each application is a RunDynam zip file. Download the zip files from the web site and place into the following RunDynam sub-directory **c:\RunDynam\archive**.

Opening RunDynam

The first step is to open up RunDynam. This is achieved by double clicking on the **RunDynam** icon on your desk top. If a dialogue box appears to ask if you would like to load a model and simulation from zip archive: click **No**.

The following should appear at the top of your screen:



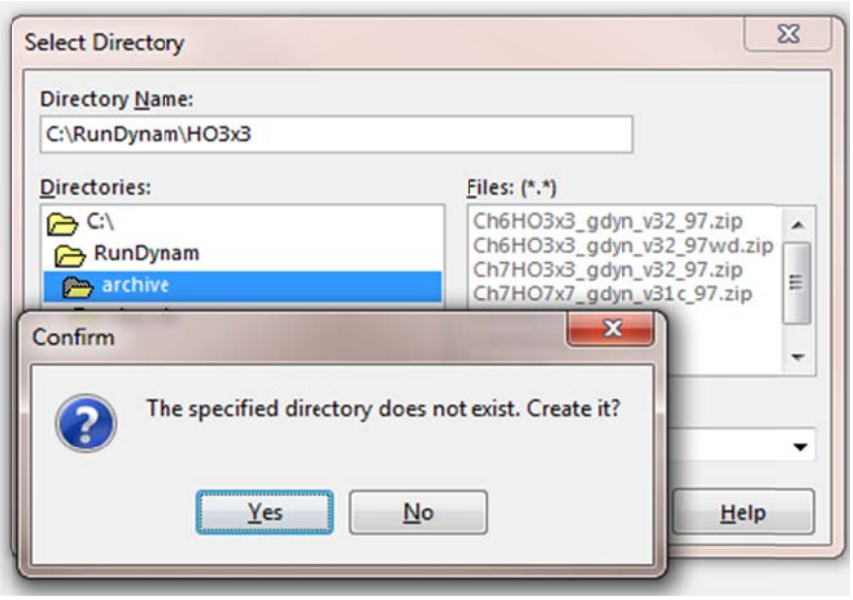
Once inside RunDynam you will notice two sets of toolbars at the top of the page. The first toolbar (File, Zip, Tasks, View, Options, Run Preferences and Help) is similar to those you may have seen in other Windows programs. This menu is referred to as the **main menu**. This main menu allows you to carry out various functions such as opening, saving, viewing data and seeking help. The second toolbar (Introduction, Model/Data, Sim Overview, Closure/Shock, Results and Other files) looks like a notebook or card index. Each of the pages in the notebook or card index contains an essential element of the simulation design. Each card is referred to as a page (i.e., the **Model/Data** page). Each label is referred to as a **tab**. You click on a tab to go to the required page.

Restoring the Ingredients of a Simulation

At this stage, we will use a simulation which was created previously for RunDynam. It uses the GDyn model to simulate the effects of a productivity shock on the Rest of World (ROW). The ingredients of this simulation have been saved to a zip file and can be restored into RunDynam using the following instructions:

- On the main menu first choose: **Zip | Restore Ingredients from ZIP Archive.** A drop down menu will appear. Move down in the drop down menu until you find **Restore Ingredients from ZIP Archive** and then click.
- A "ZIP File to Restore From" box will appear. Choose the following file from the archive directory where you downloaded them: **Ch7HO3x3_gdyn_v3_97.zip**, and click on the **OPEN** button.
- An information box appears and shows history of the ZIP archive. Click **OK**.

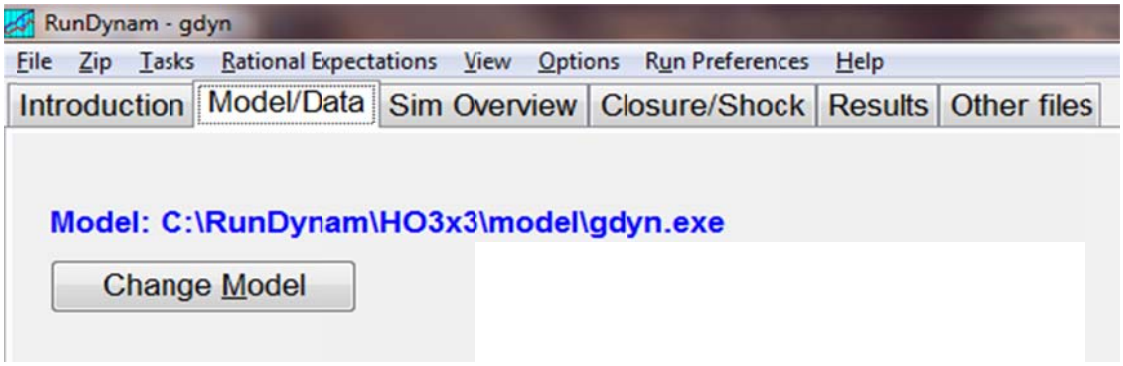
- Another information box appears and asks you to specify the directory you want to restore the files in the ZIP archive. Click **OK**.
- Choose the following directory: **C:\RunDynam\HO3x3**. Click **OK**. If the directory you specified does not exist, the software will create it for you. Click **Yes**.



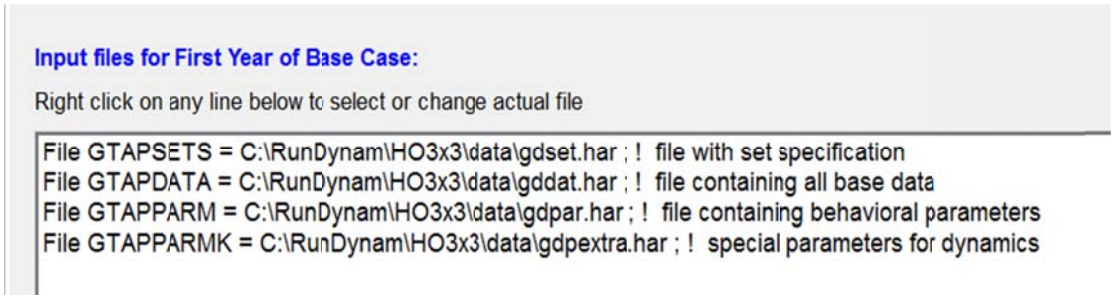
- A confirmation box appears. Click **OK**.
- After the files are unzipped, you will be asked "Do you want to load these Simulation Details into RunDynam now?" Click **Yes**.
- The software reminds you that the restored application is now the current application. Click **OK.**

Note that under the directory you specified three new folders, **C:\RunDynam\HO3x3\data**, **C:\RunDynam\HO3x3\model** and **C:\RunDynam\HO3x3\tabetc**, have automatically been created to store the files.

- Click the tab labeled **Model/Data** to turn to the Model/Data page.
- Listed at the top in blue should be the model. Check that the model is gdyn.exe.



- Also make sure you have all the data ingredients in the white box in middle. The data ingredients should be as follows:



Notice again that the model (gdyn.exe) is stored in the directory - **model** and the various data input files are stored in the directory - **data**.

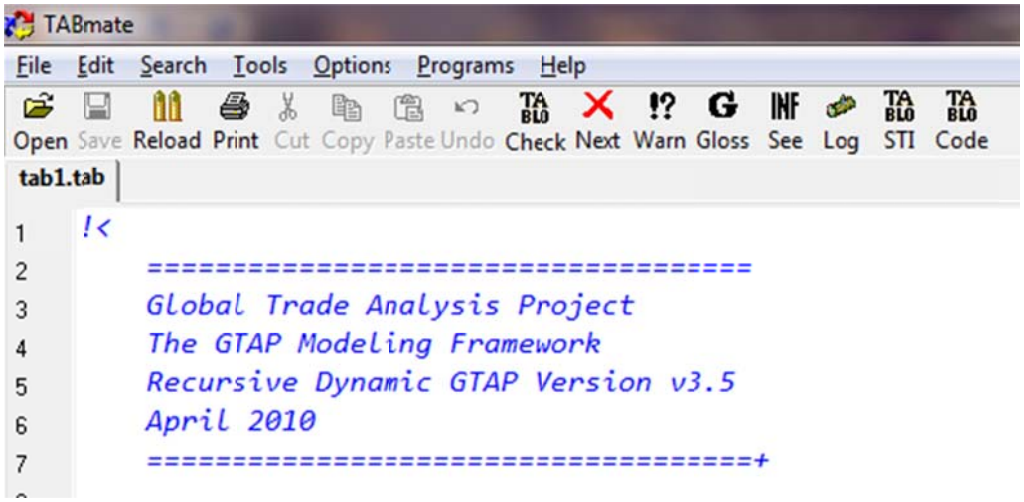
3. Viewing the Data

In this section, we use RunDynam to look at the GDyn model and the associated data files. Two examples are undertaken to examine the sets data and the core data. In each of these examples, we first look at how the data is used by the underlying model or TABLO file and then we examine the data files themselves. The underlying equations of the GDyn model are defined in the TABLO file (gdyn.tab). The TABLO file is the human readable version of the executable file gdyn.exe.

As we saw above, four data files are required by the GDyn model: four header array files (extension *.HAR) one containing the sets and the other containing the base data and other two files containing the parameters for the standard GTAP model and the dynamic extension, respectively. The header array file containing the base data includes both the standard GTAP data and some additional data required for the dynamic extension.

Example 3.1: Viewing the Set Data.

- The TABLO code can be viewed by choosing **View | Main TABLO file** from the main menu. TABmate opens a copy of the gdyn.tab file, and the copy may be labeled **tab1.tab**.



The TABLO file contains the essential elements of the model including the variables, coefficients and equations. In order for the software to understand the model equations set out in gdyn.tab, there are a number of rules which must be adhered to. Some of these include:

1. All variables, coefficients, sets, parameters, and files referred to in the TABLO file must first be defined in the TABLO file.
2. All coefficients must either be read from a file or derived from other coefficients that have been previously defined and read;
3. In order to assist the user of the model comments have been added to the TABLO file; these comments are always placed between two exclamation marks.

You will need to refer to the TABLO file constantly when seeking any information about equations, variables and coefficients or when interpreting your results.

- In TABmate (or other editor), select **Search | Find** from the main menu to find the word **File**. You should find the following statement (**F3** will repeat the search):

```
File
```

```
GTAPSETS # file with set specification #;
```

This statement defines a file with logical name GTAPSETS. The words between the # #'s are the label given to this logical file name. The name indicates to the user what is contained in the file i.e., set information.

- If you now use **Search | Find** to find **Set**, you should find a list of set statements, such as:

```
Set
   REG # regions in the model #
   maximum size 10 read elements from file GTAPSETS header "H1";
```

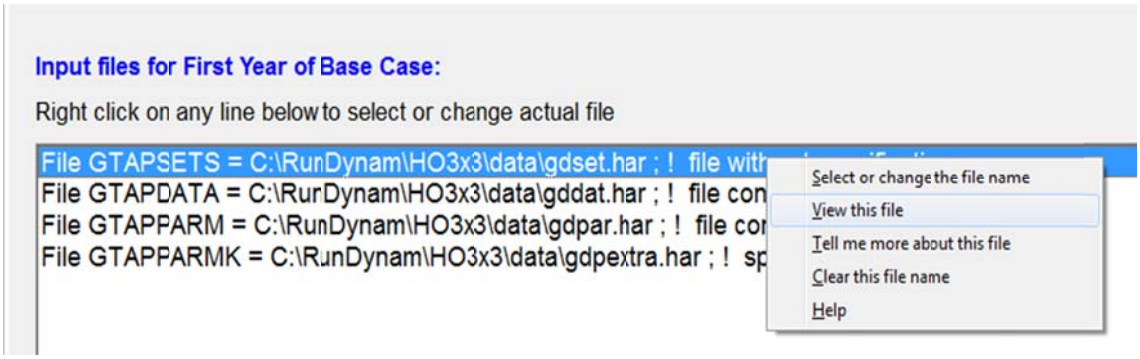
The second line of each set declaration defines the set and gives it a name. The third line states that the set should contain no more than 10 elements and is read from header **H1** of the file with logical filename **GTAPSETS**.

- If you now use **Search | Find** to find REG you will see that many of the variables, coefficients and equations are defined over the set REG. You will also see variables defined in terms of the other sets (e.g. TRAD_COMM).
- You can now close the TABmate by clicking **File | Exit**.
- Back in RunDynam, you should still be on the page labeled **Model/Data**. If you look at the white box containing the data files you will see the name of the file corresponding to the logical name GTAPSETS.

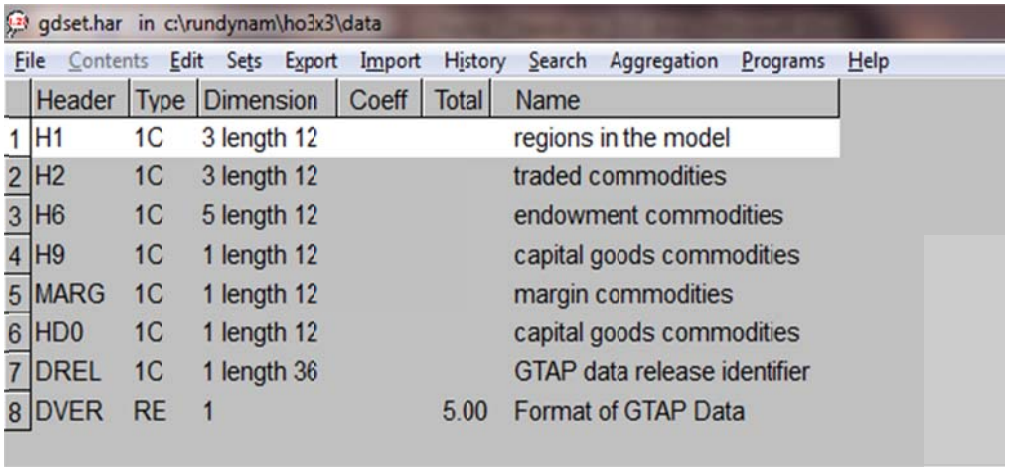
File GTAPSETS = C:\RunDynam\HO3x3\data\gdset.har

This tells us that gdset.har is the file, with logical name GTAPSETS, containing the set information.

- To open this file highlight the GTAPSETS file in the white box and click the right hand button of your mouse to get a menu. Then select **View this file**.



Once in ViewHAR you will see a menu bar and a table containing the sets. Each row in the table corresponds to a set.



	Header	Type	Dimension	Coeff	Total	Name
1	H1	1C	3 length 12			regions in the model
2	H2	1C	3 length 12			traded commodities
3	H6	1C	5 length 12			endowment commodities
4	H9	1C	1 length 12			capital goods commodities
5	MARG	1C	1 length 12			margin commodities
6	HD0	1C	1 length 12			capital goods commodities
7	DREL	1C	1 length 36			GTAP data release identifier
8	DVER	RE	1		5.00	Format of GTAP Data

In the table of sets the first column relates to the **h**eader, the second to the type of data, the third to the size of the data and the last column is a brief explanation of what is in the set. The **1C** in the second column means that the information contained in the header are characters. The **3 length 12** in the third column means that there are 3 elements which may contain up to 12 characters. As we know from the TABLO code (tab1.tab, copy of gdyn.tab) the set of regions (REG) should be located under header **H1**. The comment in the last column is the same comment seen between the ##'s in the TABLO code.

- You can view the regions by **double clicking** anywhere on the row labeled header H1.
- Click on **Contents** on the main menu bar or **click** anywhere on the data to return to the list of sets.

- Now look at the traded commodities (TRAD_COMM) in this data set.
- You can now close the header array file by clicking **File | Exit**.

Example 3.2: Viewing the Core data

Before examining the data let us look again at the TABLO file (tab1.tab, a copy of gdyn.tab).

- Choose **View | Main TABLO file** from the main menu. The core data can be found in the file with logical file name GTAPDATA.
- Using **Search | Find** in TABmate, search for GTAPDATA. You should find the following statement.

```
File
   GTAPDATA # file containing all base data #;
```

This statement defines a Header Array file with logical file name GTAPDATA. Now let us look at an equation containing some data.

- In TABmate, select **Search | Find** and look for TOTINCEQY. This will take you to the following equation labeled TOTINCEQY:

```
Equation TOTINCEQY

# This equation determines the change in total income from equity#
(all,r,REG)
    yqh(r)
        = [YQHFIRM(r) / YQHHLD(r)] * yqhf(r)
        + [YQHTRUST(r) / YQHHLD(r)]  * yqht(r);
```

The first line is the equation name. The second line is a comment providing some information on what the equation does. The third line states that this equation holds for each region r in the set REG (i.e., USA, EU and ROW as seen in Example 1). The rest of the lines define the equation.

In standard GTAP notation, the convention is to use upper case for levels and lower case

for percentage changes or deviations from base case. Here, we are interested in the initial database or the levels coefficients (shown in upper case). We can find out what these coefficients are and how they are calculated by searching the TABLO file. Since all variables and coefficients must be defined prior to use we should be able to find a definition by searching upwards.

- Select **Search | Find** from the main menu of the TABmate and look for *YQHHLD*. Remember to change the find box to search upwards. This is done by clicking on **Back** in the box labeled **Direction** (alternatively you can use CTL-Home to move you back to the beginning of the TABLO file, search from top or gloss). Keep searching (F3 to search again) until you find the following definition and formula for *YQHHLD(r)*:

```
Coefficient (all, r, REG)
    YQHHLD(r) # regional household equity income #;
Formula (all, r, REG)
    YQHHLD(r) = YQHFIRM(r) + YQHTRUST(r);
```

This tells us that *YQHHLD(r)* is defined as a coefficient and is the income earned on equity by the regional household. It is equal to the sum of two other coefficients *YQHFIRM(r)* and *YQHTRUST(r)*. This coefficient is often referred to as a derived coefficient as it is not read directly from the database but is derived from other coefficients.

- You can now use **Search | Find** to find *YQHFIRM(r)* and *YQHTRUST(r)*. You should find the following statements in the TABLO file:

```
Coefficient (ge 0)(all,r,REG)
    YQHFIRM(r) # income of region r from local firms #;
Update (all,r,REG)
    YQHFIRM(r) = yqhf(r);
Read
    YQHFIRM from file GTAPDATA header "YQHF";
Coefficient (ge 0)(all,r,REG)
    YQHTRUST(r) # regional income from global trust #;
Update (all,r,REG)
```

```
    YQHTRUST(r) = yqht(r);
Read
    YQHTRUST from file GTAPDATA header "YQHT";
```

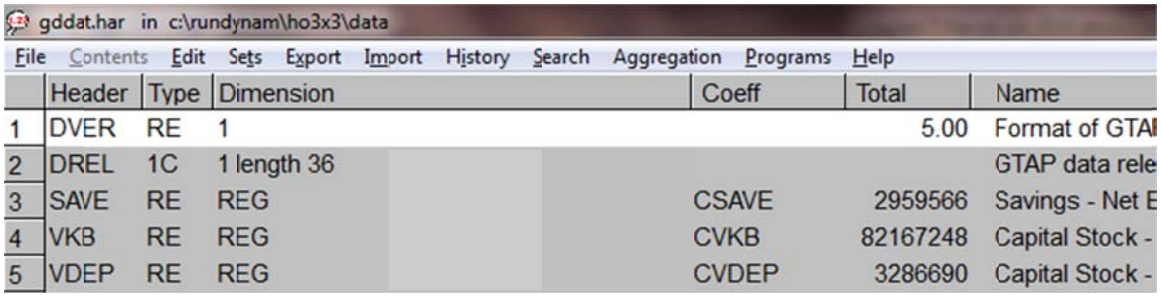
These statements tell us that *YQHFIRM(r)* and *YQHTRUST(r)* are also coefficients defined as income earned by region r from local firms and from the global trust respectively. Unlike *YQHHLD(r)* these coefficients are read directly from headers "YQHF" and "YQHT", respectively, in the file with logical file name GTAPDATA.

- If you scroll up or down from here you will notice a number of other coefficients which are also read from the file GTAPDATA.
- You can now close the TABLO file by clicking **File | Exit**.

Back in RunDynam you should still be on the page labeled **Model/Data**. In the white box containing the data files you should see the name of the file corresponding to the logical file named GTAPDATA.

- To view this file highlight the GTAPDATA file and click the right hand button of your mouse to get a menu. Then select **View this file**.

You should see the following table containing the base data:


gddat.har in c:\rundynam\ho3x3\data

File Contents Edit Sets Export Import History Search Aggregation Programs Help

	Header	Type	Dimension	Coeff	Total	Name
1	DVER	RE	1		5.00	Format of GTAI
2	DREL	1C	1 length 36			GTAP data rele
3	SAVE	RE	REG	CSAVE	2959566	Savings - Net E
4	VKB	RE	REG	CVKB	82167248	Capital Stock -
5	VDEP	RE	REG	CVDEP	3286690	Capital Stock -

- Look for header YQHF containing the values of equity income earned from local firms. You can view the data by **double clicking** on the header "YQHF". Data should be available for each of the three regions. Repeat the same for header "YQHT".

The two parameter files can be viewed in the same way.

4. Running a Simulation

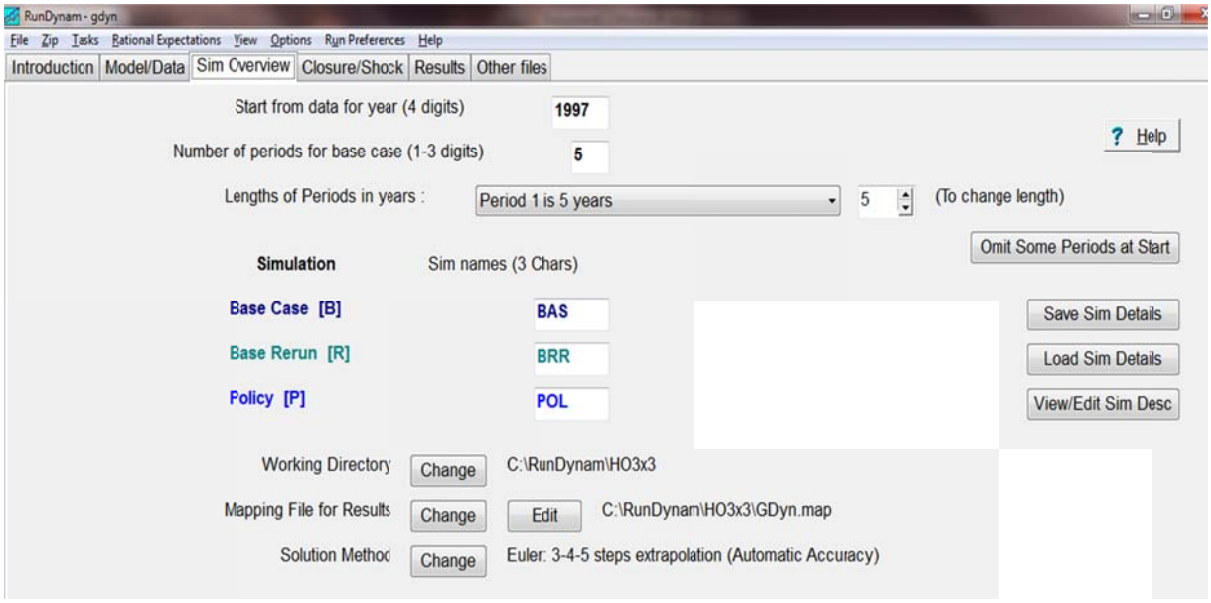
The purpose of this section is for you to gain some hands-on experience at simulating with RunDynam. An increase in total factor productivity in the Rest of World is used to illustrate this. For this purpose we examine the remaining pages of RunDynam. The next two pages, **Sim Overview** and **Closure/Shocks**, relate to the elements required to undertake a simulation with the GDyn model. The third page, **Results**, provides an easy way to view the results of the simulation. The final page, **Other Files**, lists the data files used in the simulation and informs you as to whether they are updated during a typical simulation.

First, we provide a recipe outlining the basic ingredients required to conduct a simulation using RunDynam. The simulation undertaken here is a productivity shock. Two of the main elements of the simulation have already been discussed in the previous section, these were the **Model** (gdyn.tab) and the **Data**. Therefore, the focus here is on the two pages labeled: **Sim Overview** and **Closure/Shocks**. We examine the Sim Overview page, the Closure/Shocks page, a base case shock file, a policy shock file and a closure file. Finally, we run the simulation.

Simulation Overview Page

- Click on the **Sim Overview** tab on the second level of the toolbar to move to the Sim Overview page.

This page contains a number of important aspects about the simulation, including the label for the starting year, the number of periods being examined, the length of these periods and the solution method. The page should look something like the figure provided below.



Starting from the top and moving down:

- The box labeled **Start from data for year (4 digits)** is the first year of the simulation. You may assume this is the current year or it may be the year corresponding to when the data was collected. In this case we start at year 1997. Check that this says 1997.
- In the next box labeled **Number of Periods for base case (1 or 2 digits)**, you are required to determine how many periods you want to examine. In this case we are looking at 5 periods. Check that this figure is correct.
- Following this is a drop down menu for the length of each period. In the GDyn model, a period may differ from 1 year. In this case, the length of each period, except the last one, is 5 years.
- Following this is a list labeled **Simulation** and **Sim names (3 Chars)**. In the GDyn model three simulations are undertaken, the base case, the base re-run and the policy. At this stage you are required to give simulation names to all three of these experiments. In this case, use the names **BAS, BRR** and **HO3** for the **Base Case [B], Base Rerun [R]** and **Policy [P]** simulations respectively. Later when you do more simulations, you may want to label these differently to avoid writing over previous simulation results.

The three simulations are discussed below:

1. The **Base Case** simulation represents how we might expect the economy to look without the policy shock (i.e., without the productivity shock). Depending on what we know about the future state of the world economy, this could include our beliefs about population and labor growth rates, or the state of tariff reductions etc. over the simulation period. How to develop a baseline was discussed in Chapter 5.

2. The **Base Rerun** takes the policy closures and the base case shocks. It is a calibration simulation. If there are any variables which were endogenous in the base case closure and are exogenous in the policy closure the program automatically takes the values of these variables from the base case simulation, and includes them as exogenous shocks to variables in the base rerun simulation. The usefulness of the base rerun simulation is that it allows you to reverse any calibration done in the baseline. For instance in Chapter 5 we exogenized real GDP (qgdp) to ascertain changes in region-wide technological change (afereg) in order to obtain that change in the real GDP. In the base rerun simulation the values for the region-wide technology obtained in the base case are now applied in the base re-run to afereg to endogenizely determine real GDP. If the base re-run has worked correctly, the resulting changes in real GDP in the base re-run should equal those applied in the base case, subject to small differences due to path dependency. The fact that real GDP is now endogenous means that in the policy simulation, real GDP can now respond endogenously to the policy shock.

3. The **Policy** simulation examines the effects of the policy shock, which is applied in addition to the other base case shocks. The policy shock then interacts with the other changes expected to occur in the world economy. Both simulations are undertaken so that the difference between the two scenarios can be calculated, and hence the effects of the policy shock isolated.

- The next step requires us to specify the current working directory: **C:\RunDynam\HO3x3\.** Check that this is in fact the working directory. If not you can change this by clicking on the

change button.

- Next you are asked to specify a mapping file: **GDyn.map**. The mapping file contains a list of variables you would like to place into a spreadsheet file for further analysis. You can view the mapping file by clicking on the button labeled **Edit**.
- Finally, you are asked to specify a solution method. In this case we use **Gragg: 2-4-6 steps extrapolation**. You must also include automatic accuracy. It should appear in brackets next to the solution method. If not, automatic accuracy can be chosen by clicking on the **Change** button. In the bottom left hand corner **click on the box labeled automatic accuracy** and check the options (keep the default options). Then click **OK**.

Closure/Shock Page

Now we can proceed to the closure and shocks file.

- Click on the tab labeled **Closure/Shock** to move to the next page. This page contains a table similar to the one provided below:

Part	Base Closure [BAS]	Base Shocks [BAS]	Policy Closure [BRR]	Policy Shocks [POL]
Pattern	BASBYYYY.CLS	BASBYYYY.BSH	BRRRYYYY.CLS	POLPYYYY.PSH
CMFStart	none	N/A	none	none
Common	none	none	none	none
2002	BASB.CLS	Y97_02.BSH	POL.CLS	none
2007	BASB.CLS	Y02_07.BSH	POL.CLS	AFEREG.PSH
2012	BASB.CLS	Y07_12.BSH	POL.CLS	none
2017	BASB.CLS	Y12_17.BSH	POL.CLS	none
2020	BASB.CLS	Y17_20.BSH	POL.CLS	none

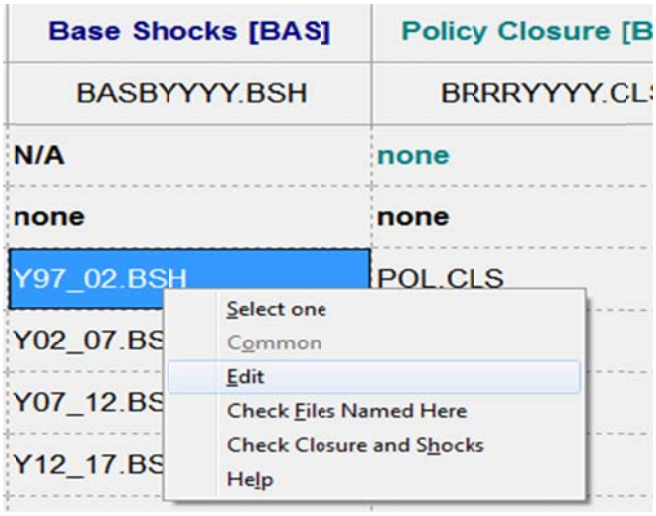
The table lists the shock and closure files for each period of the simulation. You will notice that the labels in the first column of the table relate to the information provided on the previous

page: **Sim Overview**. The labels 2002, 2007, 2012 and 2020 are the last years of each of the periods. For example, the first period starts at 1997 and continues for 5 years to the beginning of 2002.

Base case and Policy, shocks and closures, must be specified for every period. Closures and shocks are specified in files (with extensions **.CLS** for closure, **.BSH** for base shocks and **.PSH** for policy shocks).

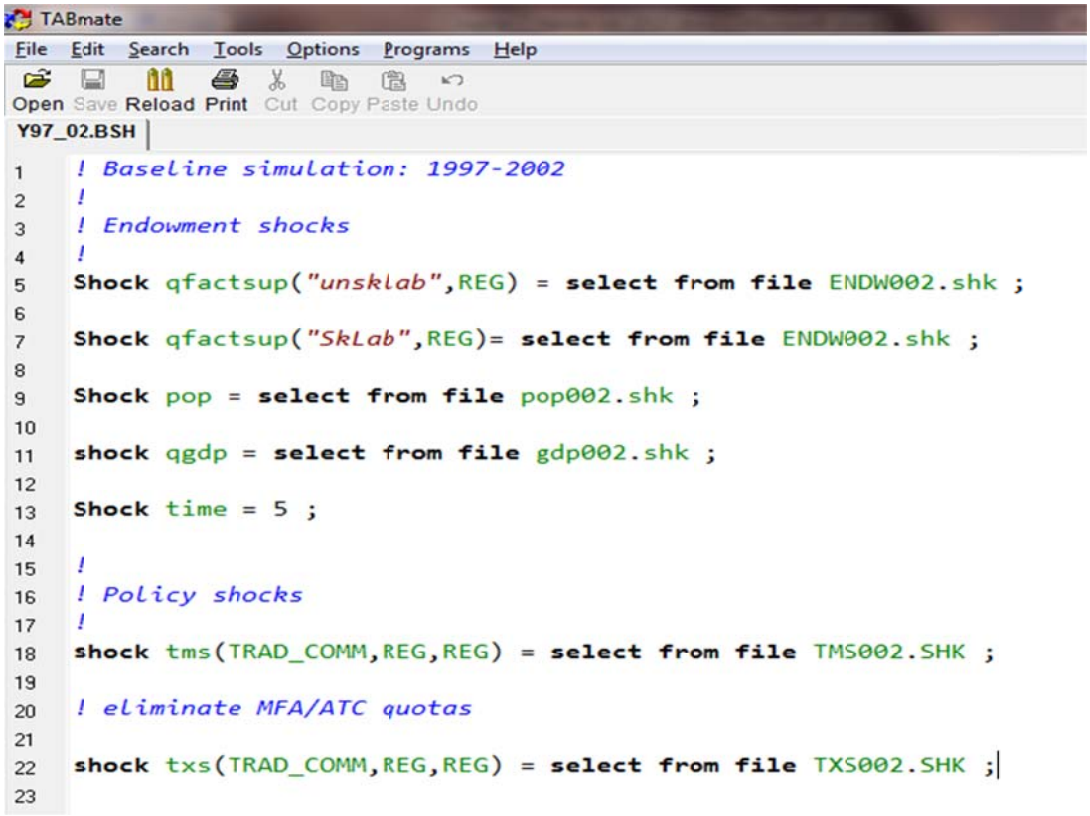
If these are set up correctly, all the files (with extension **.CLS**, **.BSH**, and **.PSH**) are indicated in **black** font. If any of them are in red then these files do not exist in the working directory specified. If any of them are in green then the files exist, but they refer to another (constituent) file which does not exist.

- To view a base case shock file place the cursor on the file you wish to open, click the right hand button on the mouse and select **Edit**.



The shock file contains a list of variables and the corresponding shocks to these variables which are imposed in the base case scenario. As mentioned previously the base case scenario indicates what we might expect to happen in the world economy during the simulation period. In this case there are forecasts for the rate of real GDP growth (*qgdp*), population growth (*pop*), skilled and unskilled labor growth (*qfactsup*), shocks to import tariffs (*tms*) and export subsidies

(*txs*).[4] Finally, time is shocked by 5 to indicate that a 5 year period is being simulated, hence this first simulation is from the beginning of 1997 to the beginning of 2002, and all the shocks refer to changes over a 5 year period.



4. If there are any variable names you are uncertain of, you can always go back to the TABLO file to find out what they are.

In some cases the shocks are located in separate files (e.g. ENDW002.shk) which are referred to hereafter as the base case shock file. These files can be viewed by selecting **File | Open** from the main menu in TABmate. If one of these files were missing, Y97_02.BSH would appear in green in the table on the **Closure/Shocks** page.

The policy shock files are given in the final column of the table on the Closure/Shocks page.

- Again the policy shock file can be viewed by clicking on the file (AFEREG.PSH) with the right click and selecting **edit**.

There are two differences between the policy shock file and the base case shock file:

1. Only the policy shocks in this case a single shock to productivity (***afereg***) are included, even though in the policy simulation all shocks from both the base case shock file and the policy shock file are imposed.

2. the term **ashock** is used to shock this variable as compared to the base case shock file where the term 'shock' was used. The term **ashock** stands for additional shock. Thus *afereg("row")* this variable is shocked in the base case and by an additional -5% in the policy simulation in the period 2002 to 2007.

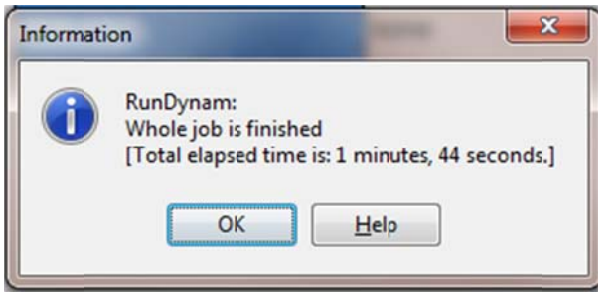
- Finally the closure file (POL.CLS) can be viewed by clicking on the file with the right click and selecting **edit**.

The closure file is used to set out which of the variables are exogenous or fixed and which of the variables are determined endogenously within the model. To close the model, the number of endogenous variables must equal the number of equations; otherwise the model will not solve. In the closure file, there is a list of exogenous variables, followed by the statement "**Rest Endogenous**". The file POL.CLS specifies the standard Gdyn closure.

A comparison of the policy and base case closures will reveal that we are calibrating region-wide technological change to target forecasted real GDP.

Running the Simulation

- In order to run the simulation begin by choosing **Tasks | Run Base, Base Rerun and Policy** to run the base case, base rerun and the policy simulations consecutively.
- An information box will then appear telling you to "Beginning simulation(s)". Click **OK**.
- If successful a message will appear:



- Click **OK**. Notice you have jumped onto the **Results** page.

Altering the Simulation

As you become more confident with the program you will wish to make your own simulations. We suggest making small changes to current applications – changing closures, shocks, and time periods and then eventually making your own aggregations. To alter the closures and/or shocks you simply edit the files we have been examining. To alter the length of periods or extend the time horizon simply edit the ***simulation overview page***. Any changes to the length or extension of time will automatically adjust the ***closure/shock page***, however you will have to alter/make new shock and closure files yourself. Note that if you alter the length of the time periods you will also need to alter the shock to time in the shock files – the program does not do this automatically and it is easy to forget.

When you start making your own simulations you should also:

1. Rename three letter extensions given to the base, base rerun and policy on the **simulation overview page**. This will stop you from overwriting previous results, as changing these extensions will store the results under alternative names.
2. You should also edit the simulation description by clicking on **edit sim description** on the **simulation overview page**. This allows you to write a short description of the

simulation which will help you to remember what this simulation was when you come back to it at a later date.

3. It is important to save the ingredients of your simulations.

- First you can save the details of the simulation by selecting **File | Save simulation details as**. Then provide a name for the simulation. These details can then be reloaded at any time by selecting **File | Load simulation details** and selecting the relevant file. The disadvantage with this is that it only saves the simulations details[5], not the ingredients[6] themselves, thus if you change an ingredient this will change the simulation.
- An alternative method is to zip up the ingredients of the simulation. This is done by selecting **File | Save ingredients as Zip archive**. We suggest you do this here. Save the ingredients as **Example1f.zip**. The disadvantage/advantage of this method is that it does not save the results. With all the ingredients and simulation details saved, the results are just a click away. If you wish to keep the results you need to zip them up yourself.

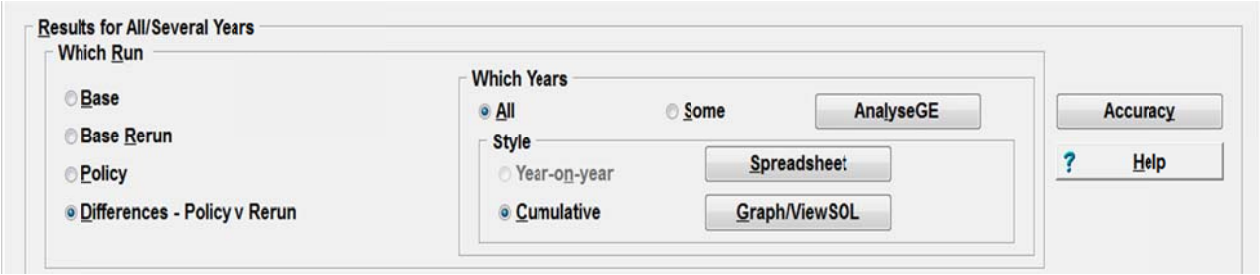
5. Viewing the Results

Results are obtained for each period of the Base Case, Base Rerun and the Policy simulations and can be viewed in a variety of ways. The **Results** page is divided into two parts. The first section allows you to look at the results for all periods at once; while the second is for viewing individual periods.

Viewing the Results for All Periods.

The first section looks something like this:

5 The simulation details refer to the setup in RunDynam and includes information recorded on the sim overview and closure pages.
6 The ingredients are the closure and shock files.



There are three parts to this first section:

1. Results for the base case, the base rerun, the policy and the difference between the base rerun and the policy can be viewed by selecting one of these options in the first column. The difference between the two simulations shows the effects of the policy shock and is comparable to the output of a comparative static model.

2. The results for some period(s) or all periods can be displayed in the AnalyseGE program, a spreadsheet or within the ViewSOL program. Clicking the **AnalyseGE** box starts the AnalyseGE program. Similarly, you can see the simulation results by clicking the **Spreadsheet** box or the **Graph/ViewSOL** box.

3. The third part relates to style. Results can be displayed year-on-year (or in the GDyn model period-on-period) or cumulative[7]. Year-on-year results show the percentage change in the variable occurring during that period, while cumulative results show the total percentage change in that variable occurring between the initial period and the period specified.

Example 5.1: Viewing the Results Using ViewSOL.

The ViewSOL program is similar to the program ViewHAR used previously to examine the data. ViewSOL is much more adept at viewing the results than the spreadsheet. In order to view the results using ViewSOL you must first select the simulation you wish to view.

- Click on the **Difference – Policy v Rerun** option. A small black dot should appear in the white circle next to the selected option.
- Next select the style: year-on-year or cumulative results. Select year-on-year by clicking on

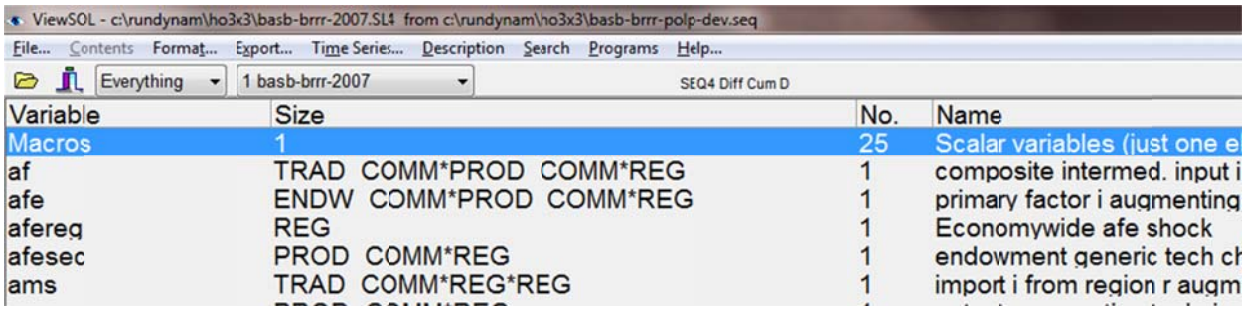
7 Note that when using AnalyseGE you can only view cumulative results.

Year-on-year in the **Style** box.

The choice of style at this stage is not important as both are available from within ViewSOL. The choice of simulation is however important. If you select Base Case then only the Base Case results will be available, however if you select either Policy or Difference, all simulations will be available to view once in ViewSOL.

- Now click on the box labeled **Graph/ViewSol**.

You are now in ViewSOL. The screen will look something like the following:



- Once in ViewSOL you will see a menu bar and a table of results. The table is divided into four columns. The first one shows the variable name, the second displays the size of the variable or its dimensions, the third shows the number of variables in the list, and the final column provides a short description of the variable. You will notice that the cumulative difference results appear regardless of the options you selected in RunDynam. Your selections need to be made once again inside ViewSOL. To view the policy simulation you need to select **Time series... | Show.. Pert | Perturbed Solution**[8]
- To view the year-on-year results for the policy simulation you need to select **Time series... | Show.. YonY | Year-on-year**
- Very little appears to change, except you will notice that the phrase "SEQ4 Diff Cum d" in the top right hand corner has changed to read "SEQ4 Pert YonY p." Check that this has

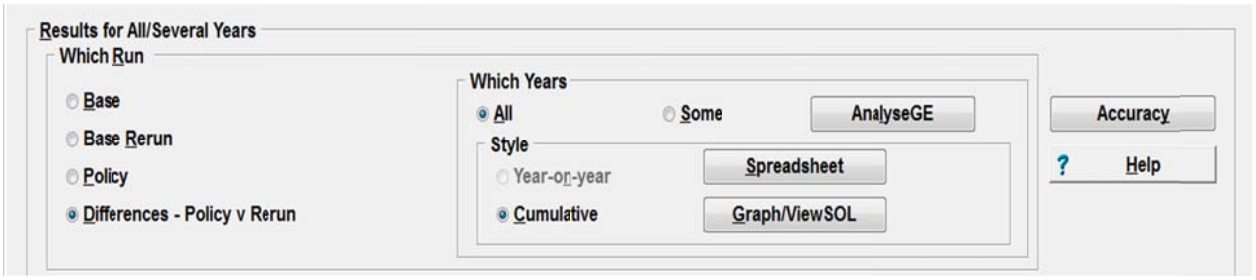
8. Note: If you opened the base case simulation in RunDynam this option would not be available to you

changed.[9]

- You can now view one of the variables by double clicking on the variable name. Move down and find **qgdp** the variable for percentage change in real GDP.
- You can now click on **Contents** in the main menu to move back to the table of variables.
- You can also check that the value of the shock to afereg was as expected. Find and click on *afereg*. Remember that this shock will depend on the shock imposed in the base case scenario and in the policy scenario.
- The cumulative results can also be viewed by selecting **Time series... | Show.. YonY | Cumulative**. Again check that the phrase in the top right hand corner reads "SEQ4 Pert Cum P."
- You can now exit from ViewSOL.

Example 5.2: Viewing the Results Using AnalyseGE.

Cumulative results can also be examined in AnalyseGE. AnalyseGE is a program which is well suited for analysis (see Pearson, Hertel and Horridge, 2002). The program brings together the model code (tab file), the underlying data and the solution file. Open the cumulative differences in AnalyseGE by selecting differences, all and cumulative and then click on the AnalyseGE button.

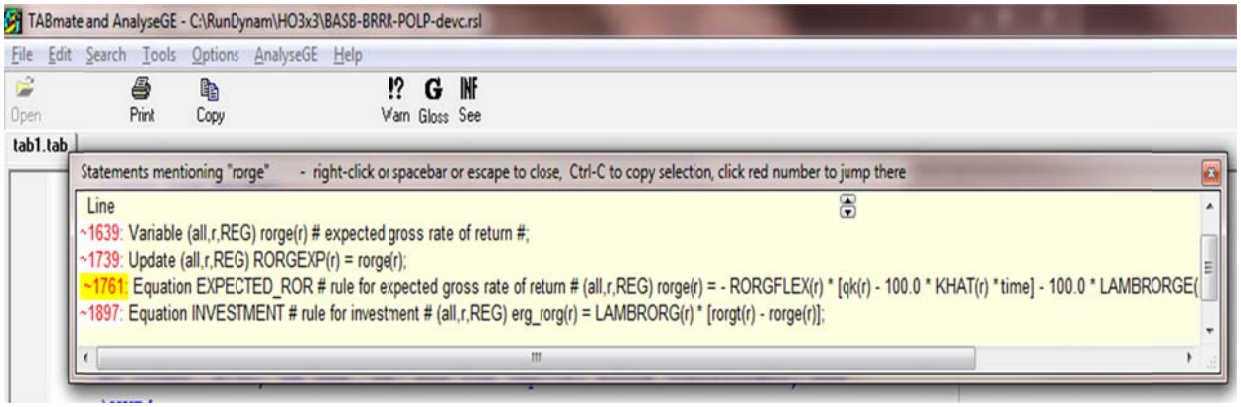


AnalyseGE will load the model tab file, the cumulative differences between the baseline and the policy for the final period (2020) and the initial data base; which in this case is the updated

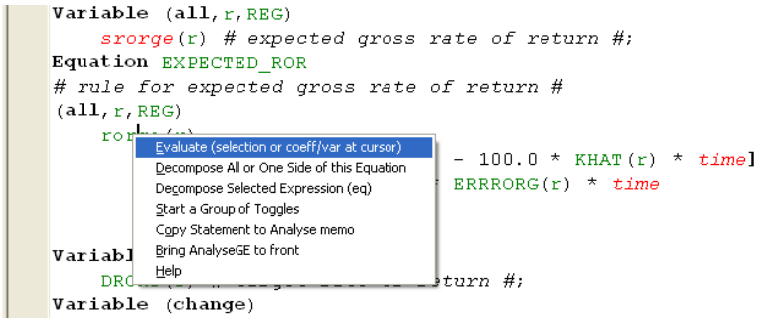
9. If you cannot see this click on the small box (next to the cross) in the very top right hand corner to enlarge the screen.

data for period preceding the final period (i.e., 2017). Using the gloss and evaluate/decompose features in AnalyseGE you can analyze the results for each equation. For example:

- Search for rorge, the expected rate of return.
- Once you have found rorge, select the Gloss button to see all occurrences of that variable.



- The line numbers are given in red on the left hand side and the highlighted lines indicate instances where the variable is on the left hand side of the equation. Click on line 1754 to move to that line and the equation.
- You can now view the value of rorge (cumulative difference) by placing your cursor on the variable (left click) and then using right click to call up the menu.



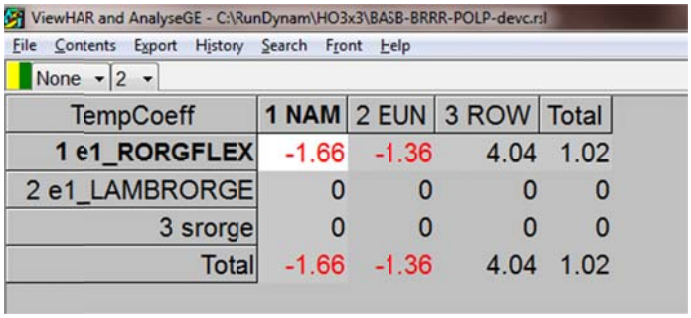
- Clicking on "Evaluate (selection or coeff/variable at cursor) will give you the value of rorge.
- The decompose options on the other hand will allow you to decompose the equation or

selection. Right click on *rorge* and select “decompose all or one side of this equation”.

- You will be asked how to decompose, select RHS, intelligent and first toggle position.

.

- Once selected viewhar will open up and you will obtain the following:



TempCoeff	1 NAM	2 EUN	3 ROW	Total
1 e1_RORGFLEX	-1.66	-1.36	4.04	1.02
2 e1_LAMBRORGE	0	0	0	0
3 srorge	0	0	0	0
Total	-1.66	-1.36	4.04	1.02

- This is a decomposition of the equation for *rorge*.

```
rorge(r)
        = - RORGFLEX(r) * [qk(r) - 100.0 * KHAT(r) * time]
        - 100.0 * LAMBRORGE(r) * ERRRORG(r) * time
        + srorge(r);
```

- Intelligent decomposition breaks the equation up according to the brackets and assigns a label (TempCoeff) to each section of the equation. The coefficients from each section of the equation are used for labeling purposes. For example 1 e1_RORGFLEX refers to the first part of the equation `- RORGFLEX(r) * [qk(r) - 100.0 * KHAT(r) * time]`

and e1_LAMBRORGE refers to the second part `100.0 * LAMBRORGE(r) * ERRRORG(r) * time`

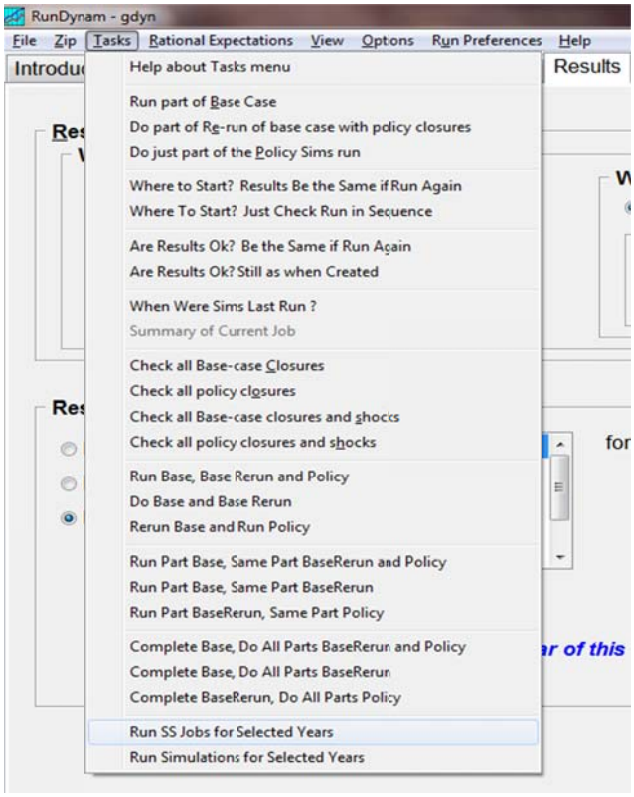
- So this tells us that in NAM *qk* rises relative to *KHAT*. Further decomposition will show that in this case *qk* is 1.66, since the cumulative difference in time and hence `100.0 * KHAT(r) * time` is zero.
- While intelligent decomposition is usually best, this is not always the case. Try decomposing complete by variable to see the other features of AnalyseGE.
- Close AnalyseGE and return to the RunDynam results page.

Viewing the Results for Some years.

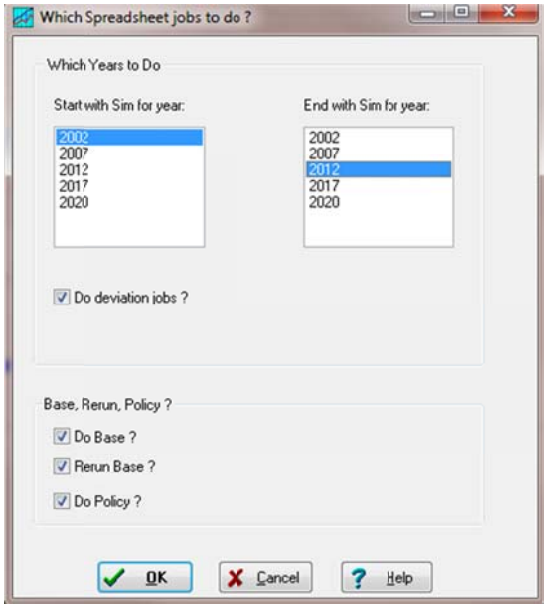
Example 5.3: Viewing some of the Results using AnalyseGE

In some cases you may not want the cumulative differences for all of the years.

- On the results page of RunDynam if you select ‘some’ and then click on AnalyseGE, RunDynam will ask for an rsl file. To obtain an RSL file you will need to cancel and go back to RunDynam.
- Next select Tasks | Run SS Jobs for selected Years



- RunDynam will then ask you to select the starting and end years, and the simulation.



- Select 2002 as the initial year and 2012 as the end year, then click ‘ok’. Yes, check the prerequisites and click ok.
- RunDynam will then run the SS job. Now when you select AnalyseGE there is an RSL file for 2002 to 2012 which you can load up.

Viewing the Results for Individual Periods.

This section allows you to view the base case and policy simulation results for each period as well as the updated data and log files for the end of each period. Moreover this section allows you to examine the GDYNView, GDYNVol and Welfare results for individual periods. The second part of the **Results** page looks like this.

Example 5.4: Viewing the Updated Data

To look at the 2012 updated database for the base case simulation you must:

- First select which of the simulations you would like to view - Base Case or Policy. In this case, select **Base**.
- Second, select the output type you wish to view. You can choose from the **Solution file** containing the results for the variables, the **Log file** containing a log of the simulation including any errors which may have occurred or **Accuracy Summary** of the simulation or the **GTAPDATA** containing the updated database. In this case, select the updated database by clicking on **GTAPDATA**.
- Third, select the label corresponding to the period you are interested in. In this case **2012**.
- Finally click on the **view** button to view these results.

The ViewHAR program for viewing header array files is automatically opened. This should look familiar since you have used the same tool to look at the core database.

- Exit from ViewHAR by selecting **File | Exit**.

Release 9 of GEMPACK also makes it possible to undertake post-simulation processing. Hence, in addition to the Solution file and GTAPDATA users now have access to a more detailed updated data file through WELVIEW, GDYNView, TAXRATES and GDYNVol[10].

When taking a closer look, you'll be able to find that in fact GDYNView as well as GDYNVol and TAXRATES are all placed at the end of the TABLO file inserted between the following two statements:

```
PostSim (Begin);
PostSim (End);
```

Post-simulation processing thus makes it possible to carry out calculations with values of variables and coefficients which depend on previous simulation results within a single tablo file.

GDYNView gathers certain parts of the global data, with important information about certain macro variables and others regarding trade, transport and protection.

Follow the same steps to examine the GDYNView file and the GDYNVol file for selected periods. These files are similar to those in RunGTAP (Pearson and Nin Pratt, 1999), with some minor modifications to include useful data for the GDyn model, such as rates of return and foreign income. The formulas for GDYNView, GDYNVol and WELVIEW are included in the standard GDyn tab file as post-sim processing.

Example 5.5: Viewing the Welfare Decomposition

The welfare decomposition (WELVIEW) results are viewed in the same way as the GTAPView and GTAPVol results. Note however that the simulation will give zero results if time is shocked. Valid results will only appear in WELVIEW when time = 0; i.e., when you undertake the comparative static simulation to create a valid welfare decomposition. Users wanting to

undertake the welfare decomposition for the dynamic simulation should re-run this simulation (CH7HO3x3_gdyn_v35_97.zip) but set automatic accuracy at 90%[11] and then refer to Chapter 6 for details on the special closure and shocks used in the baseline.

Below is a summary of the steps required to undertake welfare decomposition simulation:

- Re-run the dynamic simulation (CH7HO3x3_gdyn_v35_97.zip) but set automatic accuracy at 90%. Open the results in ViewSOL and leave open for later use.12
- Model/Data Page: Change base data to the updated data file from the final year of the base re-run (eg dat-basb-brrr-2020.har)
- Sim Overview page: Change labels so as not to over-write your files
    - Year and time period (you need just one year, start 2019 and length 1 year)
    - Alter File names (WDB, WDR, WDP). Although you will not need all three it is so easy to mistakenly over-write one of the simulations by clicking the wrong button.
- Closure/Shock page: Change closure file by swapping the following (Remember to save the new closure under a different name and load into the baseline):
    - Time variables

      swap srorge = rorge ;
      swap SDKHAT = DKHAT ;
      swap sqk = qk ;
      swap swqh = wqh ;

    - Numeraire, e.g.

10 GDYNVOL output is placed in the updated GTAPDATA file, there is no special GDYNVOL file produced.
11 Note higher automatic accuracy assists with ensuring accuracy of the comparative static welfare decomposition simulation. The application CH6HO3x3_gdyn_v35_97.zip and the welfare decomposition of that application Ch6HO3x3_gdyn_v35_97wd.zip can be downloaded from the GTAP website at: https://www.gtap.agecon.purdue.edu/models/Dynamic/applications.asp.
12 Closing the file will not delete it, however you will need to re-open is later and switching between results can be time consuming. An alternative way of loading up other sequences of results is to use time series | load sequence. See

swap psavewld = ps("food","ROW") ;

- Closure/Shock page: Change shocks file (again remember to save and load into RunDynam)
  - Shock the following variables by the amount from the solution file for the cumulative difference between the policy and the base re-run.
    - *rorge*
    - *DKHAT*
    - *qk*
    - *wqh*
  - *ps* for one commodity and region e.g., *ps("food","ROW")*
  - Shock all the policy variables (by the cumulative differences from the dynamic policy simulation)
- Run base
- Open WELVIEW for the base year to view the welfare decomposition. (Note that if all the welfare results are zero then there is a shock to time and you have made a mistake.)

This will give the (more-or-less) correct EV and decomposition. To check you can compare the resulting database, from the comparative static welfare simulation, with the final database from the dynamic simulation. There will be differences however they should be relatively small, less than 0.01% of the values for a simple simulation like this one. If differences are larger than this then try increasing the accuracy of the dynamic and comparative simulations.

6. Book Applications

Several applications are provided with this book and with the RunDynam software. The

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help for details.

file name containing the application is labeled Ch#_model_v#_##.zip, where Ch# refers the chapter number in this book (e.g. Ch7 refers to the application used in Chapter 7), model refers to the model variant used (e.g., GDyn, Savings or Farm variant etc), v# refers to the tab file version used if relevant (e.g. v3 is the latest version of GDyn.tab at the time of writing) and ## refers to the year of the initial GTAP 5 Data Base used (e.g. 97 is 1997 which corresponds to the GTAP 5 Data Base, as it has a reference year of 1997). These files are available on the GTAP website at: https://www.gtap.agecon.purdue.edu/models/Dynamic/applications.asp.

Chapter 6	Ch6HO3x3_gdyn_v35_97.zip[13]
	C6HO3x3_gdyn_v35_97wd.zip
Chapter 7	Ch7HO3x3_gdyn_v35_97.zip
Chapter 8	Ch8_gdyn_r19_95.zip
Chapter 9	Ch9_gdyn_r19_95.zip
Chapter 10	Ch10_dfarm_95.zip
Chapter 14	Ch14_gdyns_34_97.zip
Appendix A	Ch7HO7x7_gdyn_v31c_97.zip

7. References

Harrison, J. and K. Pearson (1998): "Getting started with GEMPACK: Hands-on Examples" GEMPACK document No. 8, Centre of Policy Studies and Impact Project, Monash University, Clayton, Vic, 3168, Australia.

Pearson, K., Hertel, T. and M. Horridge (2002): "AnalyseGE: Software Assisting Modellers in the analysis of their results" Centre of Policy Studies and Impact Project, Monash University, Clayton, Vic, 3168, Australia.

Pearson, K. and A. Nin Pratt (1999): "Hands-on Computing with RunGTAP and WinGEM to Introduce GTAP and Gempack" Center for Global Trade Analysis, Purdue University, West

13 This is the same application as Ch7HO3x3_gdyn_v35_97.zip but with automatic accuracy of 90%.

Lafayette, IN, 47907-1145, USA. Prepared for the July 1999 Short Course at Purdue University.