Chapter 7
Forecasting And Simulation

To follow the examples in this chapter you will need access to the demonstration model, DEMODL, supplied in the WinSup.EXE file on the website http://www.modler.com; alternatively, the files to create this model may be on your installation CDRom for MODLER. The specific files needed are:

DEMODL.MAC a macro to build the model

DEMODL.MOD the equations of the model

DEMODL.CMF the model in compiled form

DEMODL.SOL a solution file with data for 197701-198402

This model is the one used in the previous chapter to demonstrate aspects of model-building. It contains equations to predict employment and wages conditional upon assumptions about the growth of real GNP. If you run DEMODL.MAC, this will create the MOD and CMF files. The creation of DEMODL.SOL is described in this chapter, and can also be done using DEMSOL.MAC, which is supplied in the WinSup.EXE file as well.

The Model Solution Process: Action Plan

If you had just designed and built your own model and compiled it, then tested it to make sure that it was likely to provide at least adequate results, you would probably begin the forecasting/simulation process itself by making assumptions about the exogenous variables, then entering these assumptions into the solution file. The first attempt to forecast would thus follow a period of setting up to forecast that can in fact be both lengthy and involve considerable detail.

However, in order to describe MODLER's capabilities, it may be best initially to ignore such complications, and instead present the process as

simply as possible. The aim is to provide you with an overview of MODLER's facilities. The appropriate way to do this may be to begin from the presumption that the model exists as a working model, and that the baseline solution file is ready.

Thus, assuming that the model has been created—by running DEMODL.MAC—the first step is to attach it and its solution file (possibly created using DEMSOL.MAC), then solve it. Following this, we can print and plot the solution, and after that compare it to an alternative. Only then will we consider the process of entering assumed values into the solution file; at that point, the degree of detail will increase.

Attaching a Model and Solution File

The process of managing the use of a model can begin by clicking on the main menu item **Model** from the Central Control screen and then **Use**. The effect will be to invoke the Model Solution Manager screen shown in Figure 7-1. As illustrated, you should next click on **Solve** and then **Attach Model**. The presumption in doing this is that a least one previously compiled model exists and that its name will then be displayed in the list of available models. When this list appears on the screen, double click on DEMODL.MOD, which should in turn cause the display of the expanded version of the Model Solution Manager screen shown in Figure 7-2 at the top of the next page.

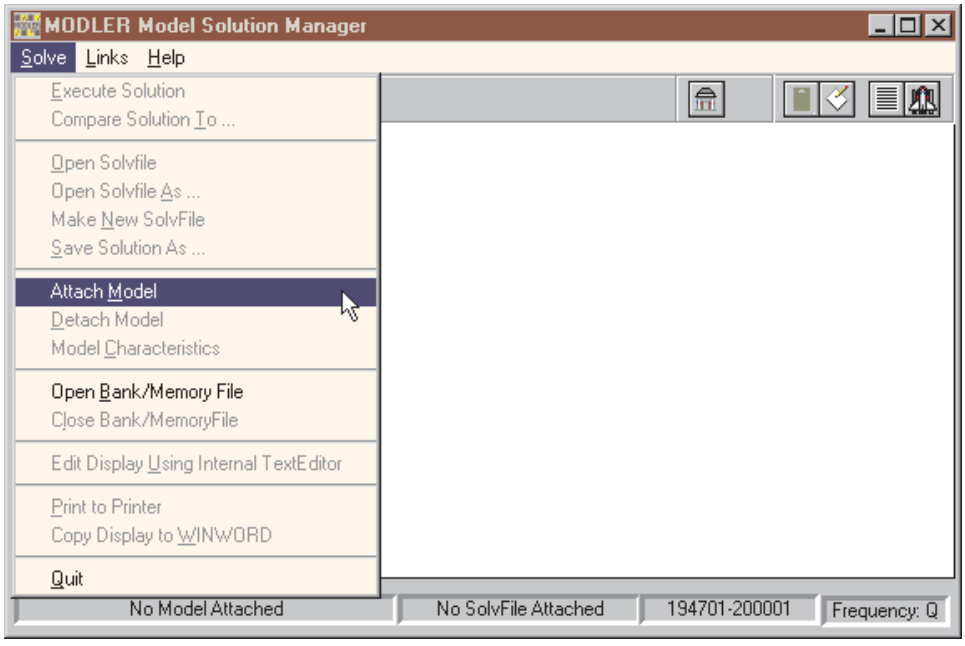


Figure 7-1. Model Solution Manager Opening Screen

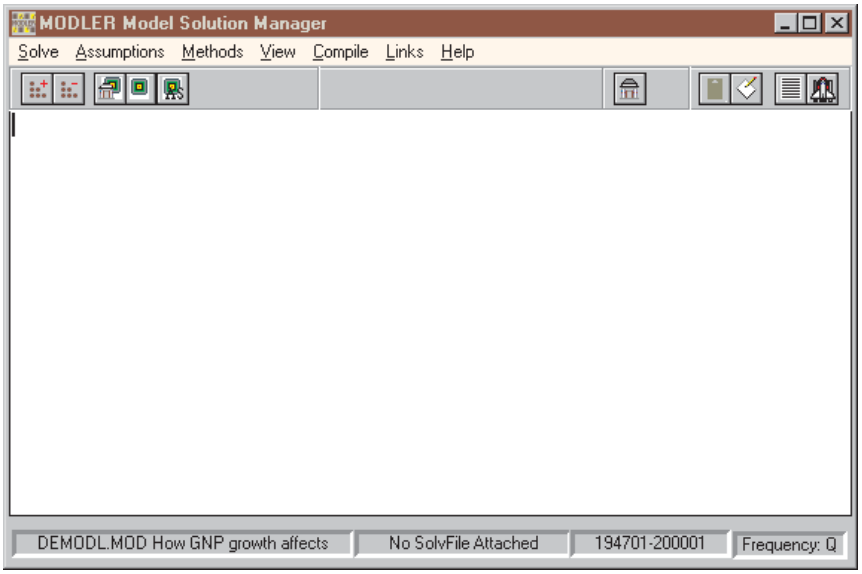


Figure 7-2. Expanded Model Solution Manager Screen

However, you might instead see an error message. If, at this stage, you have not yet successfully compiled the model, you will see in the middle of the screen the error message "Cannot Find the CMF File for this Model" and you will observe that an additional menu item has appeared: **Compile**. Before you can use a model, it must first be successfully compiled. Click on **Compile** followed by **Execute**. The compilation process should be nearly instaneously, at least in part reflecting the model's small size.

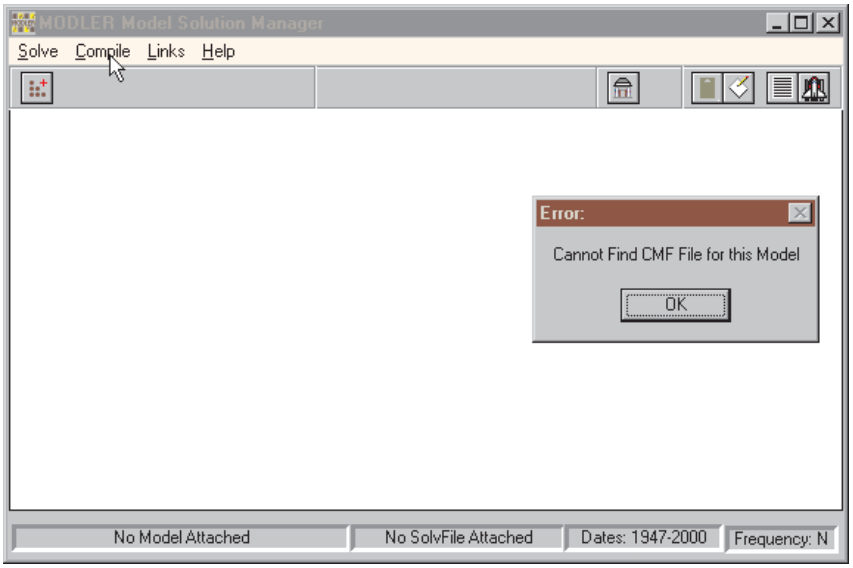


Figure 7-3. Uncompiled Model Error Message

If the model successfully compiles, on the Solution Manager screen you should then see the menu choices shown in Figure 7-2. Alternatively, if there is a problem, you will need to go back to the model creation stage, by returning to the Central Control menu and clicking on **Model | Build or Edit**. That is, return to chapter 6 and re-run the macro to rebuild the model.

Looking at the screen display shown in Figure 7-2 or 7-4 below, note the menu choices: Solve, Assumptions, Methods, View, Compile, Links, and Help. **Solve** manages the solution process, as well as providing access to data files used in that process. **Assumptions** makes available MODLER facilities that allow you to specify and change the assumed values upon which solutions depend. **Methods** permits you to establish the methodology of a particular solution, although initially you will probably wish to rely upon defaults. **View** allows you to display solution values in various ways, including both plots and tables. **Compile** will seldom be used in this context, except as just described. Finally, **Links** and **Help** have an obvious role, although it should be noted that context specific help can be obtained either by clicking on **Help** or by pressing the <F1> function key.

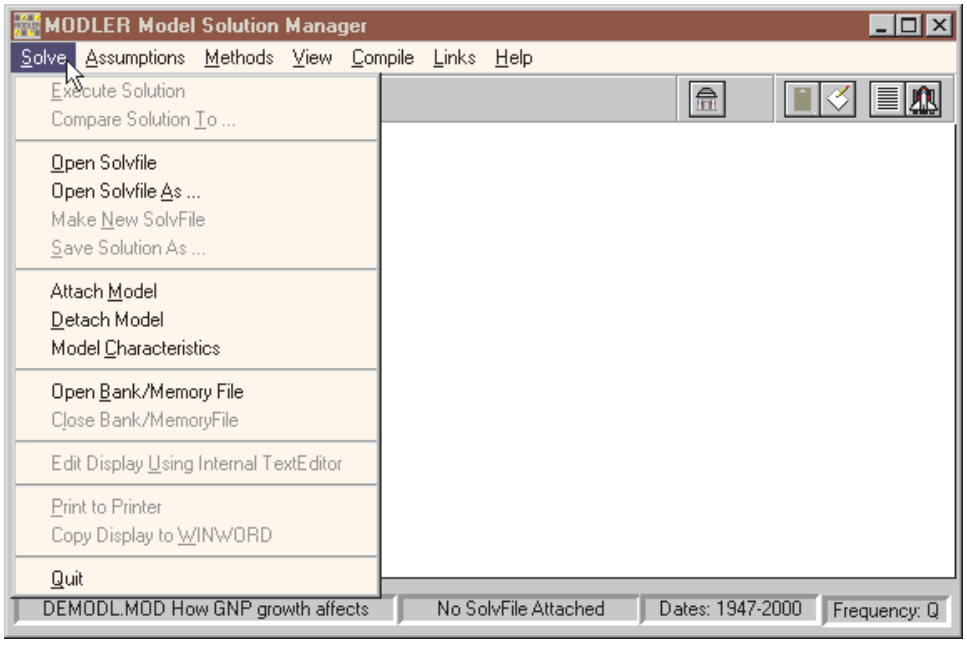


Figure 7-4. Solve Options

Considering **Solve**, the display shown in Figure 7-4 illustrates the elements of the dropdown list that appears when you click on this item. Note in particular the elements **Make New Solvfile** and **Open Bank/MemoryFile**.

The *Solvfile* referred to, as its name implies, is the data file that is used whenever a model is solved. Since this file is necessary, once a new model has been compiled the required next step is almost always to create (or "make") such a file. To make a Solvfile, it is generally necessary, among other things, to retrieve historical data from one or more data banks or the Memory File, which explains the importance of **Open Bank/Memory File**.

For a complete description of the various aspects of the solution process, you should finally consult the online help, which via hyperlinks will provide you with all the details. As mentioned earlier, here the aim is to provide a fairly straightforward and possibly somewhat simplistic example in order to give you an overview of the process. However, there are certain details that cannot be avoided. In particular, it is important to understand that a solution file will contain historical data that predate the period (the "solution period" or "forecast horizon") for which the model is solved, as well as the values for the solution period. There are generally two reasons for this. First, it is often desirable to consider a solution in the context of history, therefore the solution file needs to contain historical data on all the variables. Second, as a technical characteristic, MOLDLER requires that a solution file contain as many historical data periods as the longest lag on any variable that appears in the model, and even when no lagged variables are present, a solution file must contain a minimum of one historical period prior to the first period for which the model is solved.

There is also the fact that whenever a model is solved at least some of the values in a solution file will be overwritten. In addition, you may wish to make alternative sets of assumptions. Consequently, as you begin to work with the model, for these and other reasons you will quickly find that a single solution file is not enough. That Solvfile values are subject to being over-written also helps to explain the logic of having solution data files, rather than directly using just an existing data bank or Memory File in the solution process. Later we will explore as well the idea of comparing one solution to another or, in some cases, to the historical values in a data bank or Memory File, which are further reasons separate files make sense.

Given these considerations, once you have created a baseline Solvfile, you will probably very soon thereafter wish to create two or three copies to serve as the starting point for each of the alternative solutions. Note the items in the Solve dropdown list in Figure 7-4 that relate to solvfiles, just below the top of the list, most specifically **Open Solvfile As** and **Save Solution As**. Once you have created an initial solvfile, these options permit you to make copies of it.

Let us now create the solution file. To begin, make sure that the data bank DEMOBANK.BNK has been accessed. Then, using the Solve dropdown list (shown in Figure 7-4), click on **Make New Solvfile.** You should immediately see a dialogue form like that shown in Figure 7-5. Note that there are spaces for you to provide a filename for the solution file and a description, if you wish. The Solvfile name must be 8 characters or less and begin with an alphabetic character. MODLER will automatically add .SOL as an extent. You can also control the date range, but the observation frequency at this stage is fixed by the prior choice of quarterly for the model, which is why that entry is greyed out.

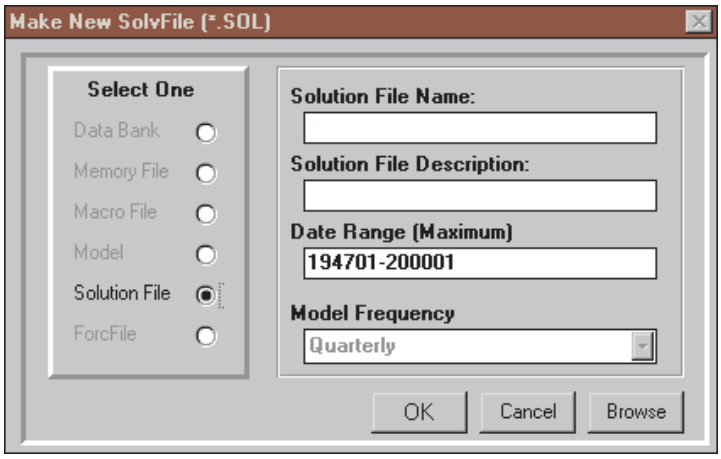


Figure 7-5. Make New Solvfile

An important characteristic of the Make Solvfile process is that the observation dates you set are *not* restricted to the date range of the shortest data series in any accessed data bank or Memory file. That is, for any date range set, MODLER will copy to the solution file the available observations it finds in these data sources and will fill any missing observations with the value NA (Not Available). The significance of this is the flexibility it provides: in particular, one way to establish assumed values for the exogenous variables of a model is to put these—or at least the default values of these—into a data bank, then set the Make Solvfile date range to include both history and the (future) solution period. MODLER will retrieve all these exogenous values and will specify NA for all the missing endogenous variable values for the solution period. However, be sure that you supply values for all the exogenous before you attempt to solve the model: for a solution to be successful, the exogenous variable values must be valid observations for each period of the forecast horizon; that is, *they* cannot be NA.

The commands that correspond to the Menu choices that have been discussed so far are rather few in number:

```
ACC DEMOBANK
USE DEMODL
MAKE SOLVFILE DEMODL 75-8402
```

The first of these commands opens the demonstration data bank for access. The second attaches the DEMODL.CMF file (the Compiled Model File), as well as the DEMODL.MOD file. The final command creates the solution file for the date range 197501 through 198402. Note that for these commands to execute successfully, you must have the MOD and CMF files in the directory that you have specified as your model files directory; the new Solvfile will automatically be put into this directory as well. At any time, in order to discover which directory this is, from the Central Control screen, click on **Settings | Directories**. You will recall that these directory settings were considered at the end of Chapter 1 of this user guide, as well as in the MODLER *Getting Started Guide*.

Calculating A Solution Of The Model

At this point, you should have successfully created DEMODL.SOL. From the Central Control screen, to solve the model using this solution file requires only the command, where the dates specify the solution period:

```
SOLVE 198301-198402
```

Alternatively, if you wish to use the menus, from the Model Solution Manager screen, click on **Solve** and then **Execute Solution**. In response to latter, MODLER should display the form shown in Figure 7-6. Simply fill in the solution dates 8301 and 8402, as illustrated, and then click the **OK** button. The convergence criteria, lagseed values, and minimum and maximum iterations are defaults and do not need to be changed, at least not now.

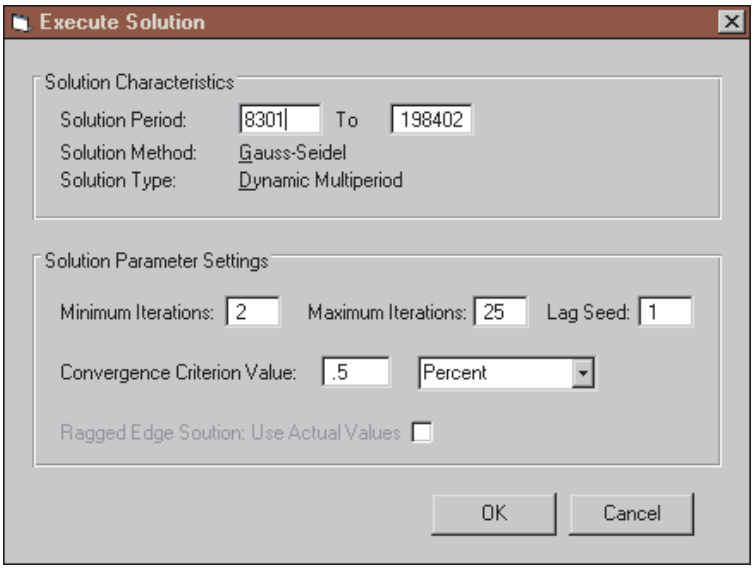


Figure 7-6. Solution Execution Form

MODLER should immediately respond to either type of solution command by displaying the following information:

```
Solution Information
Dynamic Solution
Solution Period: 198301-198402
Convergence Test: All Variables
Convergence Criterion = 0.5 %   Lagseed = 1
Iteration Values:
   Minimum = 2
   Maximum = 25
Method: Gauss-Seidel

Convergence Requirements:
198301: 3 Iterations
198302: 3 Iterations
198303: 3 Iterations
198304: 3 Iterations
198401: 3 Iterations
198402: 3 Iterations
```

This response indicates that a new set of endogenous values for 1983 first quarter to 1984 second quarter have been calculated and included in the solution file.

Displaying Solution Values

To display the solution values, from the Model Solution Manager screen, click on **View** and then **Standard Solution Table**. Or from the Central Control screen, issue the command:

PRINT SOLUTION

Because the model has just been solved, the dates for this operation are set by default to the solution period—198301 through 198402. You should next see the display:

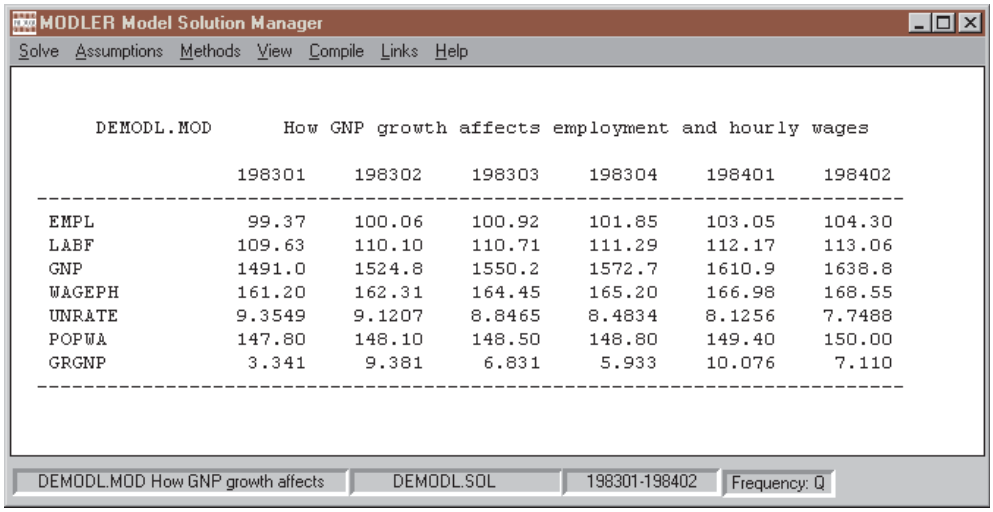


Figure 7-7. Standard Solution Table

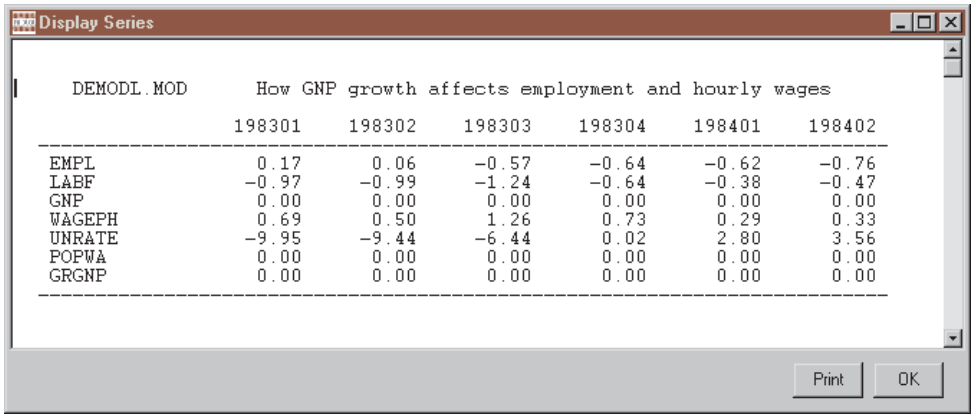
Evaluating Solutions

Considering any model solution, there are questions that naturally arise, particularly in the case of an historical simulation. For example: How does the new solution compare to the economy's actual performance? In order to answer such questions, MODLER offers a choice of comparison tables. To evaluate the model's 'tracking' performance, from the Model Solution Management screen, click on **Solve** and then **Compare Solution To...** Then enter DB (for Data Bank), followed by **View** and then **Percent Differences**. Or else, from the Central Control screen, type the commands:

COMPARE SOLUTION TO DB
PRINT SOLUTION PERCENTAGE DIFFERENCES

Note that **DB** is shorthand for 'the Memory File and currently-accessed Data Banks'. MODLER will look for comparison values first in the Memory File and then in the one or more (presumably) open Data Banks. Therefore, be careful to make sure that MODLER finds appropriate comparison values; in particular, you may wish to clear the Memory File before issuing the above commands, if it is likely to contain extraneous data series.

MODLER should respond to the above, comparative PRINT SOLUTION command (or its menu analogue) by displaying the table:



	198301	198302	198303	198304	198401	198402
EMPL	0.17	0.06	-0.57	-0.64	-0.62	-0.76
LABF	-0.97	-0.99	-1.24	-0.64	-0.38	-0.47
GNP	0.00	0.00	0.00	0.00	0.00	0.00
WAGEPH	0.69	0.50	1.26	0.73	0.29	0.33
UNRATE	-9.95	-9.44	-6.44	0.02	2.80	3.56
POPWA	0.00	0.00	0.00	0.00	0.00	0.00
GRGNP	0.00	0.00	0.00	0.00	0.00	0.00

Figure 7-8. Comparison Table: Percent Differences

Here, the differences for GNP and POPWA are zero because these series are assumptions of the model. The figures for employment, labor force, hourly wage rates and the rate of unemployment show the percentage discrepancies of the model solution compared to history. (But when considering the figures in this table, remember that the discrepancies for UNRATE are actually percentages of percentages).

Aligning The Model

The model can be forced to agree with history by the inclusion of 'add factors' (additive adjustments). Leaving aside for the moment any attempt to justify proceeding in this fashion, begin from the Central Control screen by creating a new solution file with historical data for 197701-198402, using the command:

MAKE SOLVFILE NEWSOL 7701-8402

Having called it NEWSOL, now copy it into another file, NEWHIST.FRC, which has the physical format of a Solution file, but which henceforth will be called a Forcfile and is explicitly given the extent .FRC:

COPY SOLUTION TO NEWHIST.FRC

Then attach the Forcfile, using the command word **FORCFILE**, and execute the FORCE command:

FORCFILE NEWHIST
FORCE 8001-8402

The FORCE command is obviously similiar to the SOLVE command, except that it executes a solution for the express purpose of generating add factors that will cause a subsequent solution to match the values in the forcfile over the period of the Force (here 198001-198402).

These commands, incidentally, have menu analogues: from the Solution Manager screen, click on **Assumptions** and note the options **Attach ForcFile** and **Create Forcfile**. The Force command in turn represents a type of solution: **Forced Dynamic Multiperiod**, found under the heading **Methods**. Under certain specific conditions, this approach can be given a control theoretic interpretation, but to consider the various issues and those conditions would take us too far afield at present.

Finally, make a copy of the aligned solution for future use:

COPY SOLUTION TO NEWHIST

This new file will be called NEWHIST.SOL, inasmuch as MODLER will automatically assign the extent .SOL to it by virture of the rules of this command, since the extent has not been explicitly stated, unlike above.

If you now repeat the process of calculating a solution and displaying a table of differences—as in the case of the earlier example:

```
SOLVE 198301-198402
COMPARE SOLUTION TO DB
PRINT SOLUTION DIFFERENCES
```

you will find that the model 'tracks' history rather precisely.

Essentially the same procedure can be used to align a model with some given 'baseline forecast,' treated for this purpose as if it were 'history'. See MODLER's online help facility for further details concerning solution alignment, including the *selective* Force option.

Of course, this process, as described, abstracts from the issue of setting compensating add factor values to associate with *future* values of the endogenous variables. These often will be computed as an average of recent historically observed errors. However, such a procedure raises a number of complicated questions, such as how to deal with preliminary historical values, how far back to go in computing the average, and whether or not a simple average of past add factor values is appropriate. At present, the aim is simply to describe MODLER facilities, not to establish normatively a model solution methodology that anyone should necessarily follow.

Making Your Own Assumptions

Developing solution alternatives requires alternative assumptions about the values of the exogenous variables. At a more abstract level, it may also involve determining appropriate values of add factors and even multiplicative factors, which are also—in some sense—assumptions about the model and its solutions.

As an introduction, consider a simple case: using the model to predict what would have happened if GNP growth had been a constant 3% annual rate from the first quarter of 1980 onwards instead of what it was. To analyze such alternatives, it is first necessary to consider how to introduce this particular set of assumption values.

SIMSET: A Solution File Editor

One method of imposing a new set of assumption values is to use the SIMSET facility, which initially requires only the command:

SIMSET

Or, from the Model Solution Manager screen, clicking on **Assumptions** and then **Endogenous** or **Exogenous**.

The response to this command should be a screen like that shown in Figure 7-9; this assumes that all the executable supporting files (including SIMSET.EXE) were either placed in the main Windows directory or in a directory you placed in the Path.

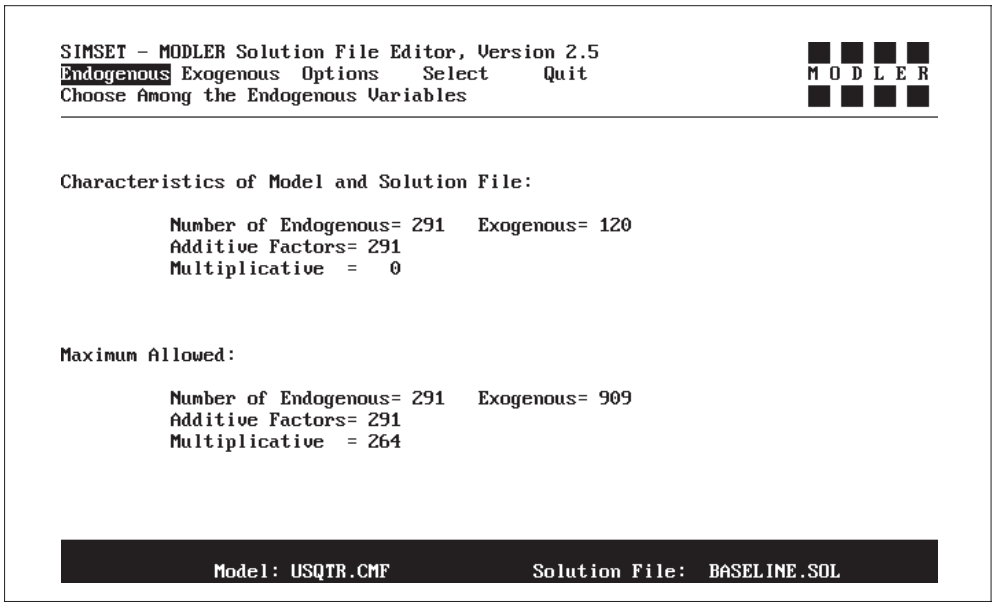


Figure 7-9. Simset Model Specification Screen

Note the menu options shown in the figure:

Endogenous Exogenous Options Select Quit

which respectively permit the display of endogenous and exogenous variable values, allow you choose among several options that control the display, select the model and solution file to use, and, finally, quit SIMSET. Note also—as shown at the bottom of the screen—that the model and the solution

file are already automatically identified, although as just indicated you could choose these manually using the SELECT option.

The central portion of the screen displayed in Figure 7-9 shows that SIMSET determines specific characteristics of the model and solution file; in addition, this display lists allowable maximums. Obviously, the model referenced here fits within the maximums allowed. This model, rather than DEMODL, has been used because, being larger, it provides a better demonstration of SIMSET's facilities.

Relying upon defaults, we can select **Exogenous** from the main menu line, which will result in the screen display shown in Figure 7-10. The onscreen variable window in the middle of the screen, which displays names of the model exogenous variables, is scrollable whenever the number of these variables is greater than 11. In addition, by simply pressing the first letter of a variable name, the set of variables with names beginning with that letter can be brought into the window.

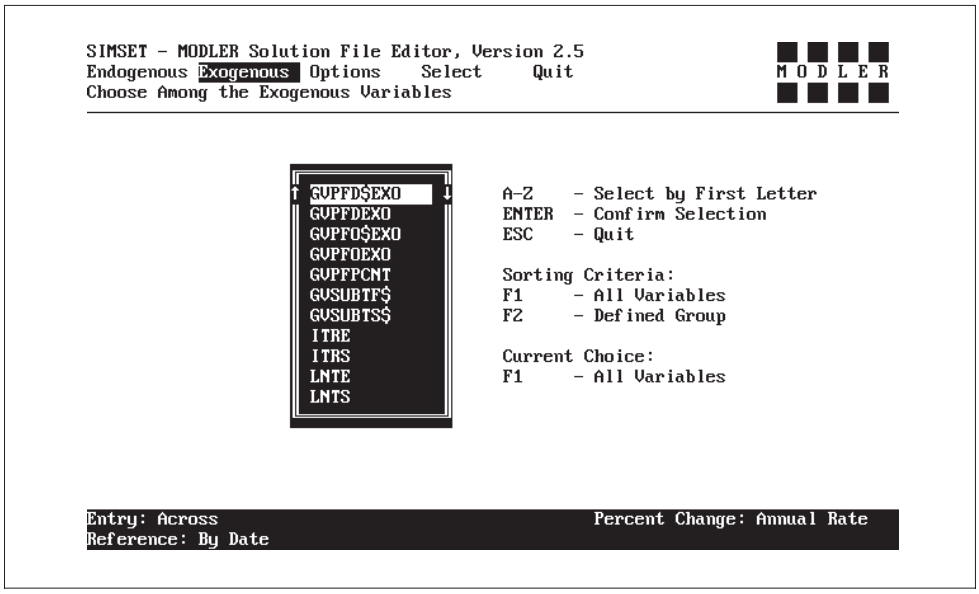


Figure 7-10. Selection of Exogenous Variables

To the right of this window is important further information. We are told that the Enter and Esc keys respectively confirm and abandon the selection, and that the A-Z keys are live. Next, we are told that there are two sorting criteria for variable selection: all the exogenous variables and those in a defined Group; the default is the first of these, as noted. The F1 and F2

function keys can be used to change the sorting criterion; if you press the F2 key, you will be asked to select a Group file.

Group files used by SIMSET have exactly the same structure and format as those used elsewhere with MODLER; see pages 85-86 for details. However, in the context of SIMSET, they can be used in a way that may be initially surprising: Group File variables will be treated as endogenous or exogenous based upon the SIMSET menu category selected, whether or not individually they suit that category. This treatment does *not* change the way MODLER treats the variables, it simply allows you to work with the variables in a particular way within SIMSET. Thus, for example, if you have *Exogenized* an endogenous variable or are intending to use it as a Selective Force variable, you can set its values in SIMSET together with those of the (other) exogenous variables by including it in a Group File containing all these variables. However, this treatment does *not* mean, in contrast, that exogenous variables will magically acquire add factors if you identify them as "Endogenous" within SIMSET. This is simply a matter of access to the variables.

The initial Endogenous Variable Selection screen, shown in Figure 7-11, has a similar format to that for the the exogenous variables. But there are certain differences. Specifically, the sorting criteria include variable selection on the basis of non-zero add factors and non-unitary multiplicative factors (if any). Since the solution file for the model illustrated here contains as adjustments only non-zero add factors, the multiplicative factors are not mentioned. However, if you should create one or more of these, the next time this category would be explicitly represented.

The purpose of allowing selection by Group File or by adjustment factors is to allow you to work with a convenient subset of model variables, rather than necessarily to have to work with the complete set. In the case of small models the size of DEMODL, this ability to deal with variable subsets may not be a significant benefit, but SIMSET is designed to work with a wide range of models, including those containing as many as 1000 or more variables.

Once you have selected the set of variables you wish to work with and have set the scroll pointer to the first variable you would like to see, if you press the <Enter> key, the SIMSET screen will clear and you will be presented with a display similar to that shown in Figure 7-12. Note the spreadsheet-style format of the work window—except that rows are grouped in a particular way. As illustrated, when displaying endogenous variables, the groupings consist of each variable on one line with its add and multiplicative

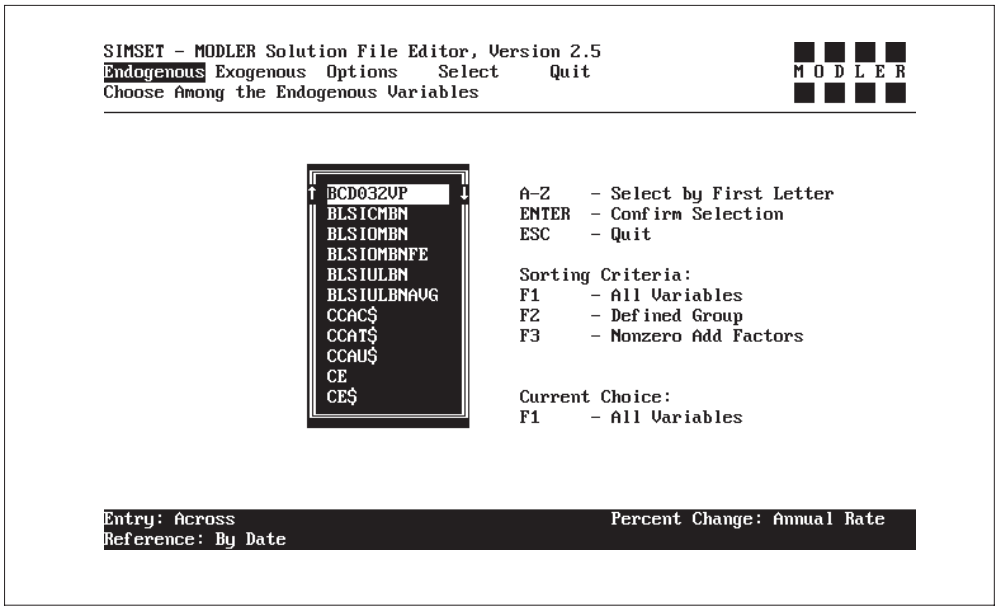


Figure 7-11. Selection of Endogenous Variables

factors following on the next two lines, respectively. When displaying exogenous variables, the groupings consist of a row of exogenous variable values followed on the next line by a transformation of this variable: the default transformation is the annualized period to period percentage changes of the variable, but you can instead opt either for simple period-to-period changes, percent change since a year ago, or period-to-period differences; the F2 function key gives you this choice.

The “Hot Keys” are displayed by pressing F1. Pressing the star (“*”) displays the variable scroll window, to allow you to jump to another group of variables; the slash key displays various options, which will be described in just a moment; the F2 key controls the computation of associated transformations, as just described; and the F3 key allows you to highlight particular numbers. Note also that at the bottom of the screen is a status bar, telling you the entry method (across or down), the way in which periods are referenced (by date or by number relative to cursor position), and the way in which associated transformations are currently being made. Entry method and period refererence are controlled by the Options selection in the main menu; they cannot be changed at this stage.

The cursor keys, plus the Pg Up and Pg Dn keys, are live, allowing you to move right, left, up or down, either one cell at a time, or a screen. In addition, the number keys are also live, allowing you to change the number in the cell to which the cursor points. Thus you can directly edit the solution file, value

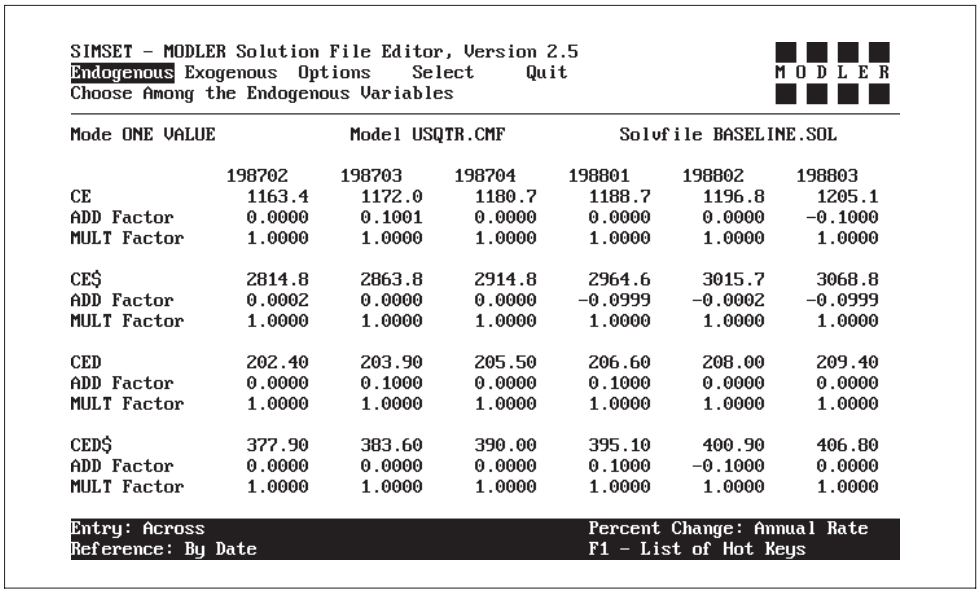


Figure 7-12. Endogenous Variable Work Screen

by value. However, exactly what occurs depends upon the current "Mode." Initially, this is set to "One Value," as illustrated in Figure 7-12, which means that each number is treated independently of all other numbers. However, there are a number of other possibilities, as shown in Figure 7-13 and described in 7-14.

Because SIMSET is simply a solution file editor, you should not expect the changes you make to result immediately in compensated changes throughout—as occurs in a spreadsheet recalculation. Changes in add and multiplicative factors will only cause changes in the endogenous variable values when you solve the model subsequently. As a rule, changes made are at most reflected in chronologically later values along a row, when you are in a mode other than ONE VALUE.

However, in the case of the Exogenous variable Work Screen, an example of which appears in Figure 7-15, the values of the Exogenous variables and the percentage changes (or differences) shown in the next row *are* linked; they are *by definition* complementary. Changes made to entries in one row will be immediately reflected in the values in the complementary row. This can be put to good use: for example, using the REPEAT mode you can specify that the percent changes in a particular variable should be constant over some period of time. Alternatively, you can construct scenarios that specify some progressive change in the percent change. Or you might specify a constant period-to-period difference over some span of time.

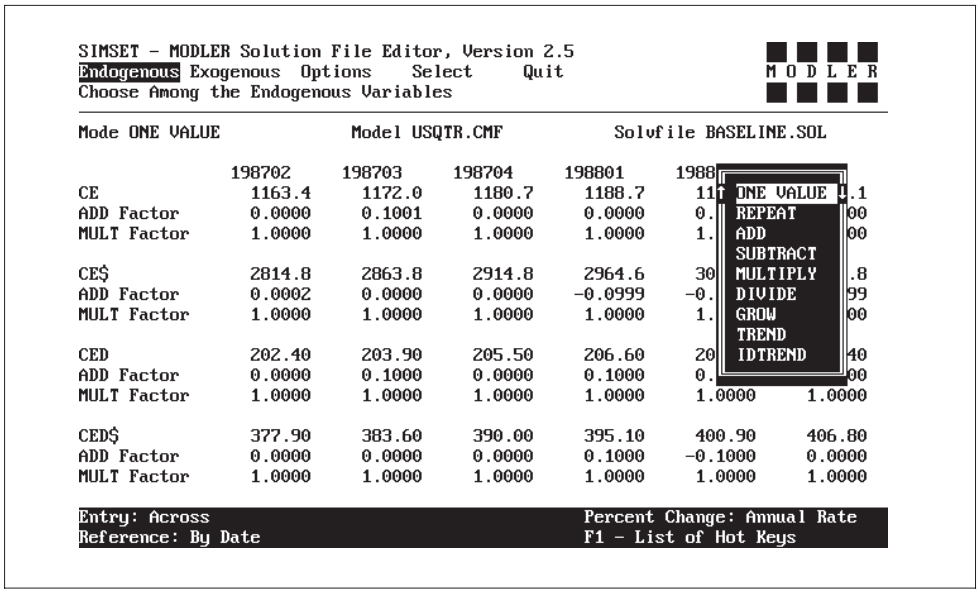


Figure 7-13. Work Screen Displaying Data Mode Window

A related matter is the Entry Method, mentioned in passing earlier. By default, when you press the <Enter> key to confirm the entry of a particular number, you will observe that the cursor moves to the next value in the same row—at least if you are in ONE VALUE mode. The presumption is that you wish to enter a sequence of values on a particular variable. However, you can also enter values for the same time period but for successive variables, by setting the Entry Method to **Down**. But not only can you do this, you can also set the Entry Method to **Skip**, which causes the cursor to move down, skipping to like items; for example, you can use this facility to enter just add factor values or just percent changes on the exogenous variables.

Another useful SIMSET facility is its provision to display variable values graphically, as illustrated in Figure 7-16. With the cursor placed somewhere along a variable row, press the Tab key and you will observe that the screen will clear to display a graph of that variable. In this context, the "variable" can be a true model variable, but it also can be an add or multiplicative factor, or a complementary exogenous variable percent change. Any row can be displayed graphically.

In addition, if you press the "I" key (for Insert), you will be able to change the values of the graphed variable, and the graph will redraw to reflect the values you enter. Moreover, since each graphed variable is shown both as a level variable and in terms of complementary percent changes, you may

ONE VALUE	indicates that you wish to enter values one at a time.
REPEAT	indicates that any value keyed in at the cursor is to be repeated k times in the following k periods; depending upon whether the period reference style has been set to DATE (the default) or PERIOD, you will be asked to specify the date or number of the period, k; if you specify the date, SIMSET internally computes k.
ADD **SUBTRACT** **MULTIPLY** **DIVIDE**	respectively allow you to add to, subtract from, multiply, or divide the given variable value by another value. Procedurally, once one of these options is chosen, first type in the value of the solution value (or simply press enter to confirm the existing value), then you will be asked to specify the value to be added (subtracted, multiplied by, or divided by) and then, once you have pressed Enter, the date or period until which the modification is to be repeated.
GROW **TREND**	These are, roughly speaking, the converse of each other. GROW allows you to specify the percent by which a given value should increase over a given number of periods (or until a given date). TREND allows you to specify the value in a future period (or later date), with the intervening values computed as lying along a linear trend. The growth rate under GROW will be interpreted as an annualized or period rate depending upon the PERCENT setting, which can be set or changed using the F2 key
IDTREND	(Increment-Decrement TREND) allows you to specify an additive trend for a set of values (endogenous, additive adjustment, or multiplicative adjustment). You will be asked to specify the contemporaneous additive value, the value in the future, and the date or period to which that second value refers. The implicit growth rate will be computed (including 0, implying simply the addition of some constant value)

Figure 7-14. Optional Data Entry Modes

choose to enter either new level values or percent changes; both the graph and the column(s) of data values will adjust appropriately. All changes you make while the graph is displayed will be local; they will not be transferred to the solution file until you have both pressed the Tab key again (to cause the Work Screen to reappear) and then pressed the Enter key. Instead of pressing Enter, you can press Esc to erase your graphical screen changes.

However, in general, all changes that are made in SIMSET are instantly

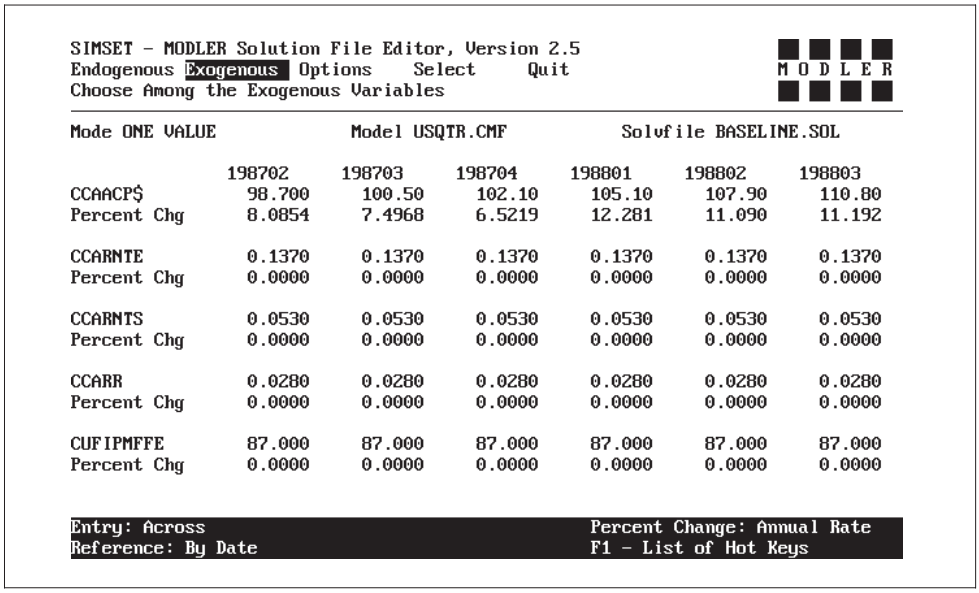


Figure 7.15 Exogenous Variable Work Screen

transmitted to the solution file. As a rule, to protect yourself against unintentional solution file changes, you should make a copy of your solution file before executing SIMSET.

Changing DEMODL Assumptions

We can utilize what we have learned about SIMSET to make the proposed change in the rate of growth of GNP. The question was, what would happen if GNP growth were to have been a constant 3% from the first quarter of 1980 onwards instead of what it was?

To impose a steady rate of growth of 3% from 1980 through 198402, it is sufficient to specify a value of 3.0 for GRGNP—the Growth Rate of GNP—for the period from 1980. As illustrated in Figure 7-17, we can set the Entry Mode to REPEAT and enter the number once, specifying that it should be entered over the whole of the period to 198402. The GNP identity on page 138 mandates a value of 3.0, instead of 0.03.

To effect this change, it is then only necessary to press the Ctrl and End keys together followed by Q (for Quit). Quit causes SIMSET to ask for verification that we intend to quit; however, given that we do, the screen will clear, returning us to the MODLER prompt. The model is then re-solved by reissuing the command:

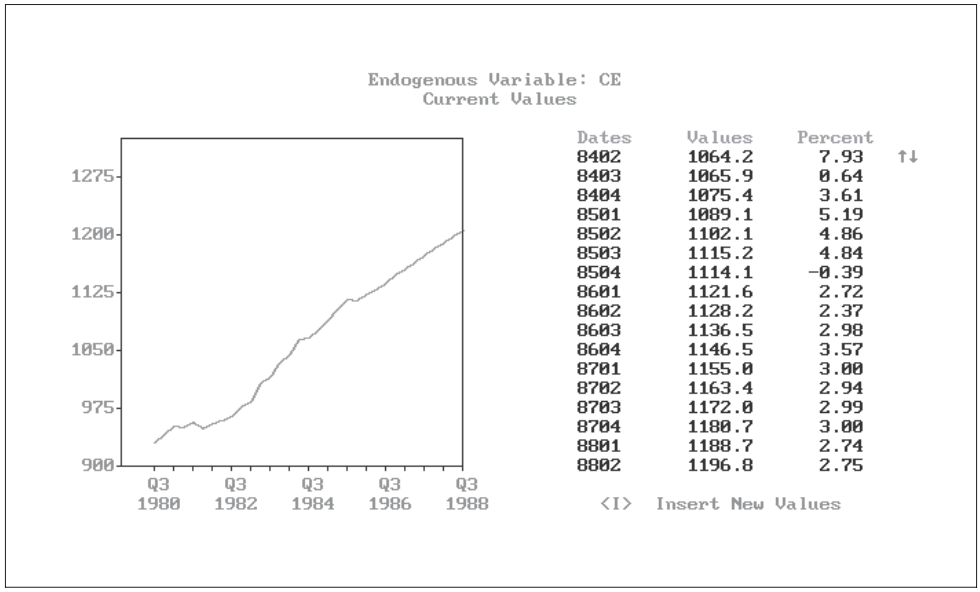


Figure 7.16 Graphical Display of SIMSET variable

SOLVE 8001-8402

Or using the menu equivalent, clicking **Solve** then **Execute Solution**.

The next step is to produce a comparative display of the two solutions. First, we can select representative series, using the VLIST (Variable LIST) command; or click **View** then **Variable List Selection**. Then we can request a comparison, variable-by-variable, between the new solution and the historical outcome. The set of commands, issued at the Control Center screen, are:

VLIST:GNP,EMPL,UNRATE,WAGEPH
COMPARE SOLUTION TO DB
PRINT SOLUTION COMPARISON

Note that the **COMPARE SOLUTION** command simply declares that the solution should be compared to any open Memory File and Data Banks. It does *not* open any Data Banks for access. The comparison is not executed until the **PRINT SOLUTION COMPARISON** command is issued, a command that differs from the **PRINT SOLUTION** command only by the addition of the word COMPARISON. The **VLIST** command may be used to select as many as 50 model variables.

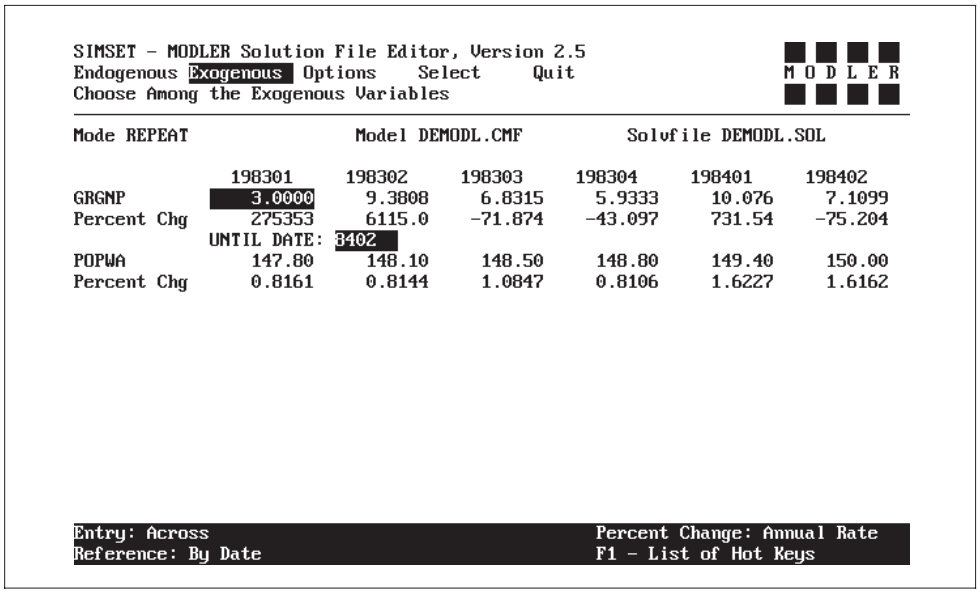


Figure 7-17. Changing DeModl Assumptions with SIMSET

The solution comparison is shown in Figure 7-18. Note that for each variable both differences and percentage differences are computed and displayed, in addition to the level values from each solution.

This tabular display provides a precise description of the effects of the assumption changes. However, to make a visual comparison, you can also plot solution results, including the comparison above, by first clicking **View** and then **Current Solution Plots**, simply to see the solution graphically, or **Alternate Solution Plots**, for a direct comparison variable by variable. Press the <Enter> key to display the variable values progressively. However, if you wish to see specific variables, in an arbitrary order, use theVLIST command (or click **Variable List Selection** under **View**) to choose them. The command equivalents are:

PLOT SOLUTION

simply to see the solution graphically, or, for a comparison:

PLOT SOLUTION COMPARISON

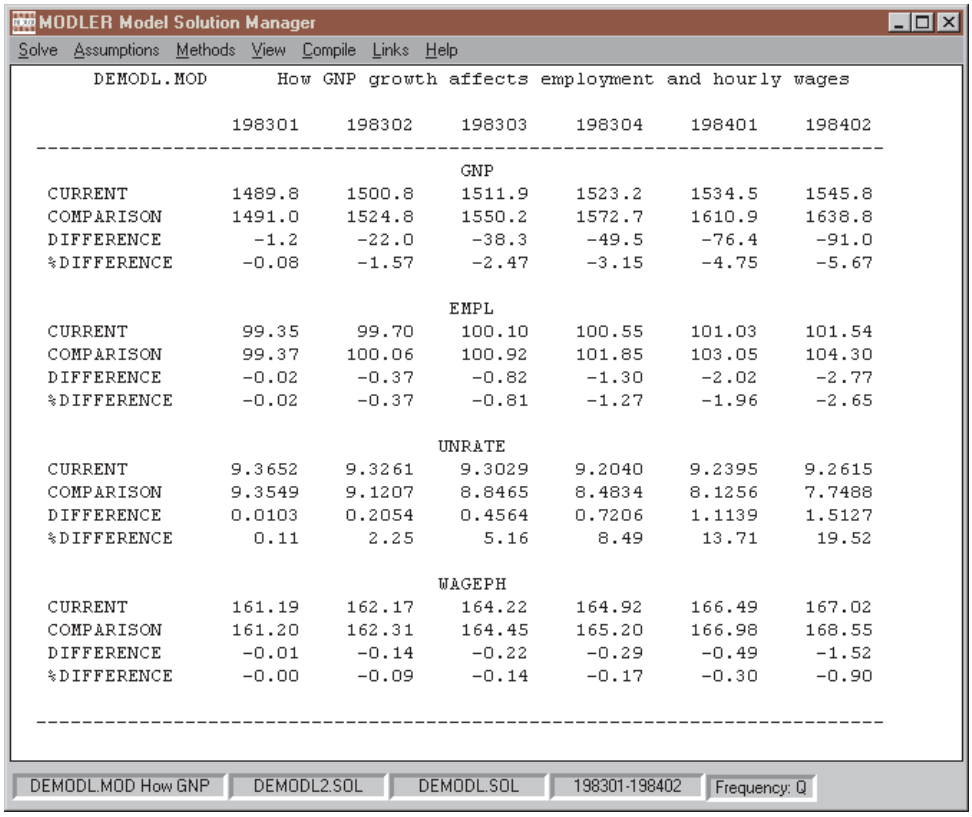


Figure 7-18. Solution Comparison Table

One of the comparison plots is shown in Figure 7-19. Of course we could have annotated this plot extensively, describing on the plot itself the differences between the historical values in the Data Bank and the solution values. Furthermore for each solution or solution comparison plot, MODLER's dropdown graphics menu can be used, thus allowing particular annotations to be made. The plot can then be copied to the Clipboard or otherwise tranformed into a presentation item.

This plot may be one of several produced by the PLOT SOLUTION COMPARISON, the particular details depending upon whether or not the VLIST command has been executed and which variables are listed. The PLOT SOLUTION command displays the variables in the order they appear in the VLIST command, if it has been used. Pressing the <Enter> key progressively displays the variables until the list is exhausted. Pressing the <Esc> key at any time immediately stops the display of plotted results.

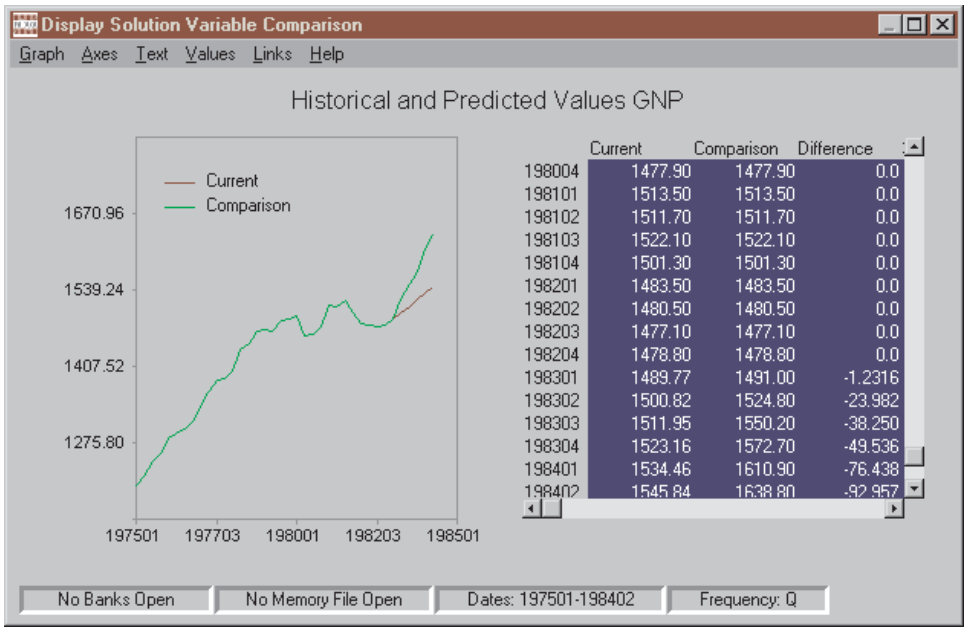


Figure 7-19. Solution Comparison Plot

Forecasting

So far, conceptually, we have dealt mainly with the past. In contrast, to make predictions about the future you need to supply ex ante assumptions for all exogenous variables. A way of doing this, alternative to SIMSET, is by using the READ ASSUMPTIONS command. Particularly if the number of exogenous variables is numerous, it is usually best when doing this to create a Macro file containing the assumptions—a file such as the macro file DEMXTRA.MAC that is supplied on the demonstration disk, which contains the following:

```
READ ASSUMPTIONS 198403-198604
POPWA,8403: 150.0 150.5 151.0 151.5 152.0 152.5
POPWA,8601: 153.0 153.5 154.0 154.5
GRGNP,8403: 6 5 4 4 3 3 4 4 5 5
SAVE
```

Obviously, the use of a macro file in this way seemingly conflicts with the interactive approach that is characteristic of Windows programs. But an aspect of the "modern" approach that can be less attractive is the fact that no audit trail is produced. Changes made on top of changes can make it

difficult in retrospect to determine what is the difference between the latest version of a forecast and an earlier version. It is true of course that a solution comparison table will reveal the net difference, but it will not tell you how that difference came about. But a macro, or a series of macros, can be constructed (and saved) so as to provide a complete statement of the process. It is in this spirit that MODLER offers alternative methods of creating forecast assumptions.

However, before executing DEMXTRA.MAC and making a forecast, it is a good idea to make a fresh copy of the solution file, with historical data and add factors. On way to do this from the Central Control screen is with the command:

SOLVFILE NEWSOL FROM NEWHIST

Or, from the Solution Manager screen, you can click on **Solve** and then **Open Solution As..**, at which point you will be asked first for the name of an existing Solvfile and then for the name under which it should be opened. Either of these methods of opening a solution file causes an existing solution file (NEWHIST) to be copied to another file (NEWSOL), creating it, and that new file (NEWSOL) to be attached as the current SOLVFILE. In particular, this facility permits forecasts to be made using temporary copies of the solution file, so that if any mistakes are made they can be easily corrected. Of course, backup copies of even temporary solution files can always be made using the COPY SOLUTION TO… command described earlier.

Now input the extrapolation assumptions (using the macro file DEMXTRA). Then make a forecast, using the SOLVE command, and display the results. The commands are:

RUN DEMXTRA
SOLVE 198403-198604
PRINT SOLUTION,DATES=198601-198604

The last of these commands produces the table shown as Figure 7-20. Incidentally, note that the PRINT SOLUTION command includes an optional local dates command that overrides the date setting in the SOLVE

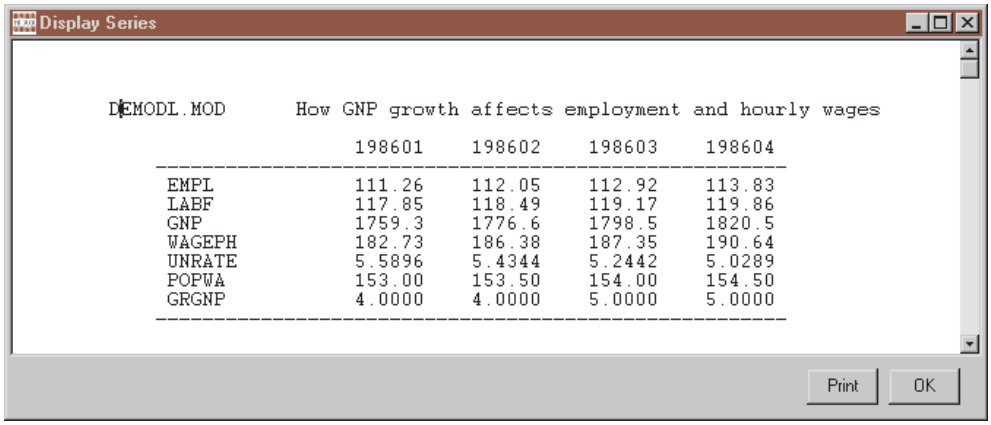


Figure 7-20. Modified Solution Display

command. Here, the choice of dates was made so that the table will fit easily on the page; however, in other instances it may also be useful to be able to display only a small range of the available solution data.

Other useful, related commands are:

EXOGENOUS - which lists the exogenous variables

ENDOGENOUS - which lists the endogenous variables

PRINT SOLUTION ASSUMPTIONS - which prints a table of exogenous variable values

Adjustments

The solution file already contains historical add factors for 198001-198402 computed by the FORCE process described earlier. To display the most recent adjustments type

PRINT SOLUTION ADJUSTMENTS, DATES=198301-8304

which produces the table shown in Figure 7-21.

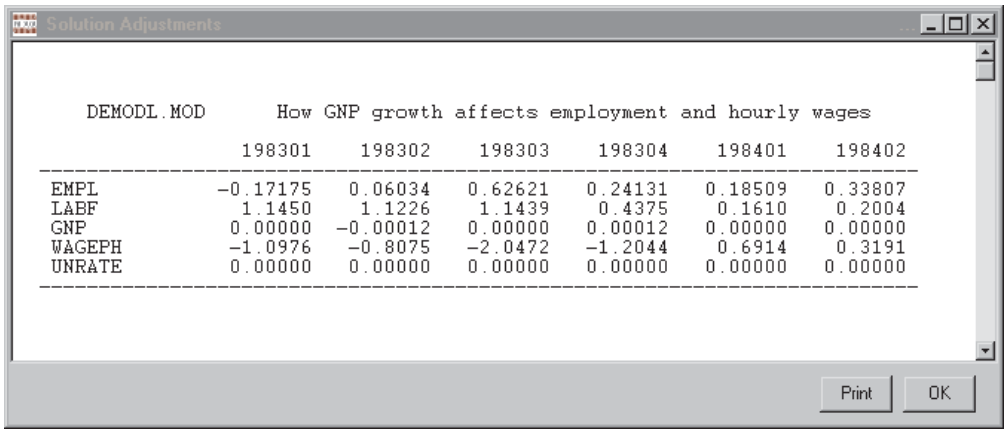


Figure 7-21. Solution Adjustments 198301-198402

However, the FORCE command is not the only way to produce solution adjustments. You can enter your own adjustments for the past or future, using either SIMSET or a set of MODLER commands. For example, to smooth the transition from historical data to forecast you might type:

READ ADJUSTMENTS 198403-198404
ADD LABF,8403: .1
ADD EMPL,8403: .2 .1
ADD WAGEPH,8403: .2 .1
SAVE

where the READ ADJUSTMENTS command identifies the period for which adjustments are to be made and the three middle commands direct that additive adjustments are to be created for each of the variables identified. The SAVE command causes the changes to be made to the solution file. Multiplicative adjustments can also be made; in this case, use the word MULT rather than ADD. Otherwise, the procedures is the same. Other, more sophisticated adjustments are possible as well, such as TREND adjustments.

In order to display the current set of adjustments, use the commands:

PRINT ADJUSTMENTS - prints additive adjustments
PRINT ADJUSTMENTS MULT - prints multiplicative adjustments

Further Analysis of Solution Results

To analyse solution results more fully series by series, copy them into the Memory File (MEMF) using the COPY SOLUTION command:

COPY SOLUTION TO MEMF

in order to copy all the variables, or:

SFETCH mname=sname

to copy individual variables, where **mname** denotes the name to be used for the memory file copy name and **sname** is the name of the variable in the solution file. These names can be the same.

Once the solution has been copied you can use MODLER's regular facilities for data analysis and display.

Defining Alternative Solutions

You can alter a solution using the READ ASSUMPTIONS and READ ADJUSTMENT commands. Alternatively, to systematically change assumptions already in the solution file, you can type:

CHANGE ASSUMPTIONS 8403-8604
INCR POPWA,8403: .1 .2 .3 .4 .5 .6
INCR POPWA,8601: .7 .8 .9 1.0
DECR GRGNP,8403: 2 2 2 2 2 2 2 2 2 2
SAVE

The most significant difference between the READ ASSUMPTIONS and the CHANGE ASSUMPTIONS commands is that the first replaces existing values with the values you provide whereas the CHANGE ASSUMPTIONS command modifies existing values, incrementing or decrementing them by the amounts keyed. Thus, for example, the existing values for POPWA are

here incremented. However, as in the case of the READ ASSUMPTIONS command, the changes are not made permanent until the SAVE command is executed. Incidentally, the INCR and DECR options are only two of several possible options.

To compare solutions, make a copy of the solution file, then change the assumptions and display a comparison table:

```
COPY SOLUTION TO NEWSOL0
CHANGE ASSUMPTIONS 8403-8604
INCR POPWA,8403: .1 .2 .3 .4 .5 .6
INCR POPWA,8601: .7 .8 .9 1.0
DECR GRGNP,8403: 2 2 2 2 2 2 2 2 2 2
SAVE
SOLVE 8403-8604
COMPARE SOLUTION TO NEWSOL0
PRINT SOLUTION COMPARISON
```

Comparisons Using the Memory File

To compare results in the Memory File you must rename individual variables. For example, the series for GNP, employment and hourly wages which were copied from the earlier solution could be renamed as:

```
RENAME GNP GNP0
RENAME EMPL EMPL0
RENAME WAGEPH WAGEPH0
```

Then, after copying a new solution into the Memory File:

```
COPY SOLUTION TO MEMF
```

you can plot comparative results such as:

```
PLOT APCT(4,WAGEPH),APCT(4,WAGEPH0)
```

You can also copy a named solution file to the Memory File, using the command:

COPY SOLUTION solutionfilename TO MEMF

thus allowing you to copy a solution file that is not currently attached.

Using Solution File Data in Tables

The tables that have appeared in this chapter have been specialty tables. However, you can create ordinary tables using solution file data. What you need to do is to include the command:

SOURCE SOLVFILE

among the table definition commands. It generally should be among the very first of these commands, before any commands that cause the actual retrieval of data.

Copying Solution Files to Data Banks

The solution file values can be copied to a data bank opened as a STORAGE bank, using either of the commands:

COPY SOLUTION TO DB
COPY SOLUTION solutionfilename TO DB

The data will be copied for the dates set using the SET DATES command. The series copied will be either those designated by a VLIST command, or–if no such command is in force–all the model series. It is also possible to copy current solution file adjustments, either additive or multiplicative, using commands of the form:

COPY ADJUSTMENTS TO DB
COPY ADDITIVE TO BD
COPY MULTIPLICATIVE TO BD