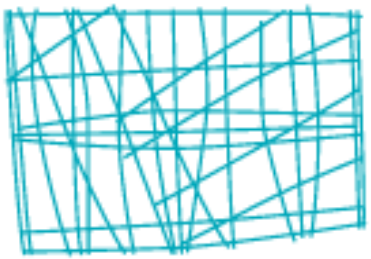


NEREUS

Núcleo de Economia Regional e Urbana
da Universidade de São Paulo

fipe

Fundação Instituto de
Pesquisas Econômicas

# Course in Applied CGE Modeling

21st International Input-Output Conference
Kitakyushu, Japan – July 2013

Eduardo Haddad

# Outline

- ✓ Introduction
- How to carry out a simulation?
- How to implement the SJ model in GEMPACK?

# Overview of GEMPACK Software

✓ Introduction

- GEMPACK is a suite of general-purpose economic modelling software especially suitable for general and partial equilibrium models.
- It can handle a wide range of economic behaviour and also contains powerful capabilities for solving intertemporal models
- GEMPACK provides software for calculating accurate solutions of an economic model, starting from an algebraic representation of the equations of the model.

# Overview of GEMPACK Software

✓ Introduction

- GEMPACK provides:

a) a simple language in which to describe and document the equations of your economic model;

b) a program which converts the equations of your model to a form ready for running simulations with the model;

c) options for varying the choice of exogenous and endogenous variables and the variables shocked;

d) utility programs to assist in managing the database on which the model is based.

# Overview of GEMPACK Software

- ✓ Introduction

- The GEMPACK programs:

- ➢ WinGEM – windows interface to GEMPACK
  - ➢ GemEdit – Text editor
  - ➢ ViewHAR – for looking in the data in a Header Array File
  - ➢ ViewSOL – for looking at Solutions files
  - ➢ RunGEM – for automating simulations with models
  - ➢ TABmate – text editor for developing TABLO Input files

# Outline

Introduction

✓ How to carry out a simulation?

How to implement the SJ model in GEMPACK?

# Overview of GEMPACK Software

✓ How to carry out simulations with models

- In this part we will explain some of the terms used in GEMPACK;

  ***Implementation***

  ***Simulation***

  ***Levels and percentage-change variables***

- ***Implementation:***

  A model is implemented in GEMPACK when:

# Overview of GEMPACK Software

- ✓ How to carry out simulations with models

a) the equations describing its economic behaviour are written down in an algebraic form following a syntax. (TABLO Input File)

b) data describing one solution of the model are assembled to be used as a starting point for simulations (ViewHAR)

# Overview of GEMPACK Software

- ✓ How to carry out simulations with models

- ***Simulation:***

- ➢ Many simulations are the answer to "WHAT IF" question such as:

*"If the government were to increase tariffs by 10 percent, how much different would the economy be in 5 years time from what it would otherwise have been?"*

# Overview of GEMPACK Software

- ✓ How to carry out simulations with models

- From the original solution supplied as the starting point, a simulation calculates a ***new solution*** to the equations of the model.
- Within GEMPACK, the results of a simulation are usually reported as percentage changes from the original solution.
- Solving models within GEMPACK is always done in the context of a simulation.

# Overview of GEMPACK Software

- ✓ How to carry out simulations with models

- ➢ The process: there is a specification of the values of certain variables ("the exogenous ones" and the software calculates the values of the remaining variables ("the endogenous ones").
- ➢ The new values of the exogenous variables are usually given by specifying the percentage changes (increases or decreases) from their values in the original solution given as part of the implementation.

# Overview of GEMPACK Software

✓ How to carry out simulations with models

- ***Levels and Percentage-Change Variables***

- When the model is implemented, the equations may be linearized (that is, differentiated).
- The variables in these linearized equations are usually interpreted as percentage changes in the original variables.
- The original variables (prices, quantities, etc) are reffered as the **levels variables.**

# Overview of GEMPACK Software

- ✓ How to carry out simulations with models

- ➢ The (usually nonlinear) equations relating these levels variables are called **the levels equations.**

- ➢ **Levels equations:**

$$D = PQ$$

- ➢ The equation relates the dollar value, D, of a commodity to its prices P (*$ per ton*) and its quantity Q (*tons*).

# Overview of GEMPACK Software

- ✓ How to carry out simulations with models

- ➢ **Linearized version:**

$$p\_D = p\_P + p\_Q$$

- ➢ The percentage change p_D in the dollar value is equal to the sum of the percentage changes p_P n the price and p_Q in the quantity.

# Overview of GEMPACK Software

✓ How to carry out simulations with models

- ***Data:***

- The data for a model often consists of input-output data (giving dollar values) and parameters (including elasticities).
- The data are usually sufficient to read off an initial solution to the levels equations (usually all basic prices are taken as 1 in the initial solution).

# Overview of GEMPACK Software

✓ How to carry out simulations with models

- ***Example of a simulation using Stylized Johansen***

➢ Stylized Johansen described in Chapter 3 of Dixon et al (1992) and explained by Prof. Eduardo Haddad.

➢ Model:

Single country

Two sectors “s1” and “s2” producing a single commodity

# Overview of GEMPACK Software

✓ How to carry out simulations with models

One household sector

Two primary factors

- Initial input-output database
- Households consume 4 (millions) dollars' worth of commodity 2 and industry 2 uses 3 (millions) dollars' worth of labor
- Totals are presented in the last row and column.

# Overview of GEMPACK Software

## Input-output Data Base for Stylized Johansen

| | | | Industry | | Households | Total Sales |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | | |
| | Commodity | 1 | 4.00 | 2.00 | 2.00 | 8.00 |
| Sectors | | | | | | |
| | Commodity | 2 | 2.00 | 6.00 | 4.00 | 12.00 |
| | Labor | 3 | 1.00 | 3.00 | | |
| Factors | | | | | | |
| | Capital | 4 | 1.00 | 1.00 | | 4.00 |
| Total Production | | | 8.00 | 12.00 | 6.00 | |

# Overview of GEMPACK Software

## Levels Variables of Stylized Johansen

| GEMPACK variable | Meaning | DPPW Notation |
|---|---|---|
| Y | Value of households income | Y |
| PC(i) | Price of commodity i | Pi (i = 1,2) |
| PF(f) | Price of factor f | Pf (f = 3, 4) |
| XCOM(i) | Supply of commodity i | Xi (i = 1,2) |
| XFAC(f) | Supply of factor f | Xf (f = 3,4) |
| XH(i) | Household use of commodity i | Xio (i = 1,2) |
| XC(i,j) | Intermediate input of commodity i to industry j | Xij (i,j = 1,2) |
| XF(f,j) | Input of factor f to industry j | Xfj (f - 3,4; j = 1,2) |
| DVCOMIN(i,j) | Dollar values for intermediate inputs | (i, j = 1,2) |
| DVFACIN(f,j) | Dollar values for factor use by industry | (f = 3,4; j = 1,2) |
| DVHOUS(i) | Dollar values for household consumption | (i = 1,2) |

# Overview of GEMPACK Software

- Most of variables have one or more arguments (indicating sectors and/or factors).
- They are **vector variables.**
- Variables which have no argumens ("Y" is the only one here) are referred to as **scalar or macro variables.**
- **Examples:**

# Overview of GEMPACK Software

- PC (i) is regarded as a vector variable with 2 components, one for each sector, namely PC("s1") and PC("s2").

- XF(f,j) is regarded as a vector variable with the following 4 components:

  - component 1 XF ("labor", "s1"): input of labor (factor 1) to sector 1.
  - component 2 XF ("capital", "s1"): input of capital (factor 2) to sector 1.
  - component 3 XF ("labor", "s2"): input of labor (factor 1) to sector 2
  - component 4 XF ("capital", "s2"): input of capital (factor 2) to sector 2.

# Overview of GEMPACK Software

- Corresponding to each of these variables, there is an associated percentage change variable.
- TABLO adds the prefix “p_” to the name of the levels variable to indicate a percentage change.
- For example, p_XF is the percentage change in the levels variable XF.

# Overview of GEMPACK Software

- Simulation:

- We have to choose a closure:

  - Supply of the two factors, labor and capital, are the exogenous variables

- Thus we will specify the percentage changes in the variable XFAC, namely p_XFAC, and solve the model to find the percentage changes in all the other variables.

# Overview of GEMPACK Software

- For this simulation, we increase the supply of labor by 10 per cent and hold the supply of capital fixed

- The starting point for any simulations with Stylized Johansen model are:

  - the TABLO Input file (called SJ. TAB) and

  - the data file (called SJ.DAT)

# Outline

Introduction

How to carry out a simulation?

✓ How to implement the SJ model in GEMPACK?

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Starting WinGEM:

  In Windows, double click on the WinGEM icon to start GEMPACK.

  This should give the main WinGEM menu

File Simulation HAFiles OtherTasks Program Options Window Help

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Preparing a Directory for Model SJ

  To keep all example files for the SJ model together in one area, we show you how to create a separate directory \SJ for these files and how to copy the relevant files into this directory.

  (a) To copy these files within Windows.

  - Change to Explorer in Windows by the usual Windows method.

  - Use Explorer to create a new folder or subdirectory called \sj and copy all the sj*.* files to it.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Preparing a Directory for Model SJ

  - Return to WinGEM to continue the examples.

- Setting the Working Directory

  - Choose a working directory.

  - For SJ model the working directory needs to be the directory \SJ you have just created.

  - To set this, first click on ***File*** in the mains WinGEM menu.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Setting the Working Directory

  - In the drop-down menu, click on the menu item

  ***Change both default directories…***

  - So the sequence of clicks (first File then Change both default directories) is

  ***File|Change both default directories…***

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Looking at the Data Directly using ViewHAR

  - The input-output data used in SJ model are contained in the data file ***SJ.DAT***.

  - This is a special GEMPACK binary file ***– called Header Array file.***

  - Thus to look at SJ.DAT you have to use a special program to read Header Array files, called ViewHAR.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Looking at the Data Directly using ViewHAR

  ***HA Files*| *View VIEWHAR***

  - The viewHAR window will appear.

  - Click on ***File*|*Open...*** and selected the file SJ.DAT

  - This will open the file SJ.DAT and show the contents on the Contents screen.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Looking at the Data Directly using ViewHAR

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

| | Header | Type | Dimension | Name |
|---|---|---|---|---|
| 1 | CINP | RE | SECT*SECT | Intermediate inputs of commodities to industries - dollar values |
| 2 | FINP | RE | FAC*SECT | Intermediate inputs of primary factors - dollar values |
| 3 | HCON | RE | SECT | Household use of commodities - dollar values |

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Looking at the Data Directly using ViewHAR

  - The first array is the "Intermediate inputs of commodities to industries – dollar values"

  - The Header CINP is just a label for this array. (Headers can have up to 4 characters).

  - The array is of Type RE. The R means this is an array of real numbers. The E means that this array has set and element labelling.

  - Double click on CINP to see the numbers in this array.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Looking at the Data Directly using ViewHAR

| DVCOMIN | 1 s1 | 2 s2 | Total |
|---|---|---|---|
| 1 s1 | 4.000 | 2.000 | 6.000 |
| 2 s2 | 2.000 | 6.000 | 8.000 |
| Total | 6.000 | 8.000 | 14.000 |

- Compare this numbers with the Input-Output data for SJ model.

- To return to Contents Screen, click on ***Contents*** in the ViewHAR menu.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Looking at the Data Directly using ViewHAR

  - Look at the other Header Arrays called FINP and HCON to see where their numbers fit in the input-output data base.

  - Close ViewHAR in the normal Windows way by selecting

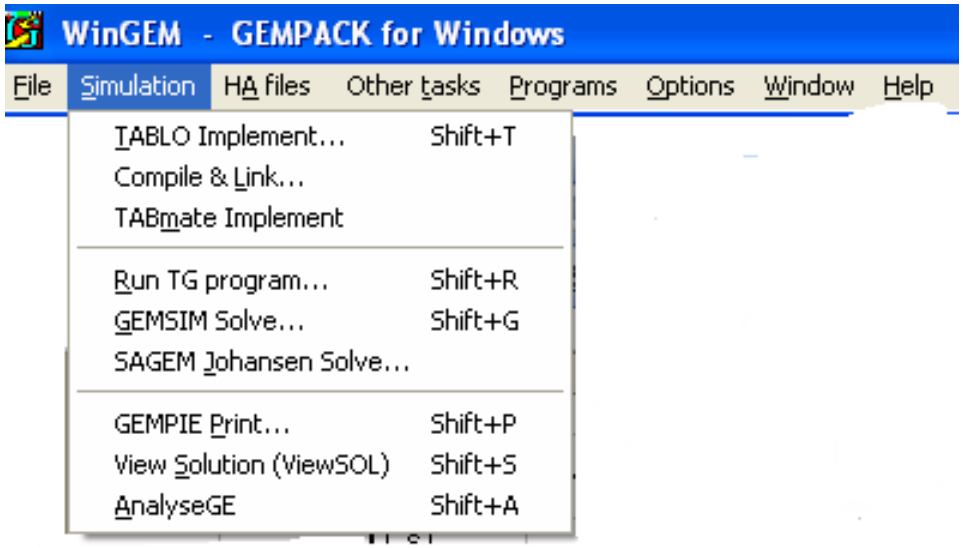
  ***File*| *Exit***

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?
- The Example Simulation using a TABLO-generated Program.

  - From the WinGEM menu at the top of the screen choose ***Simulation***.

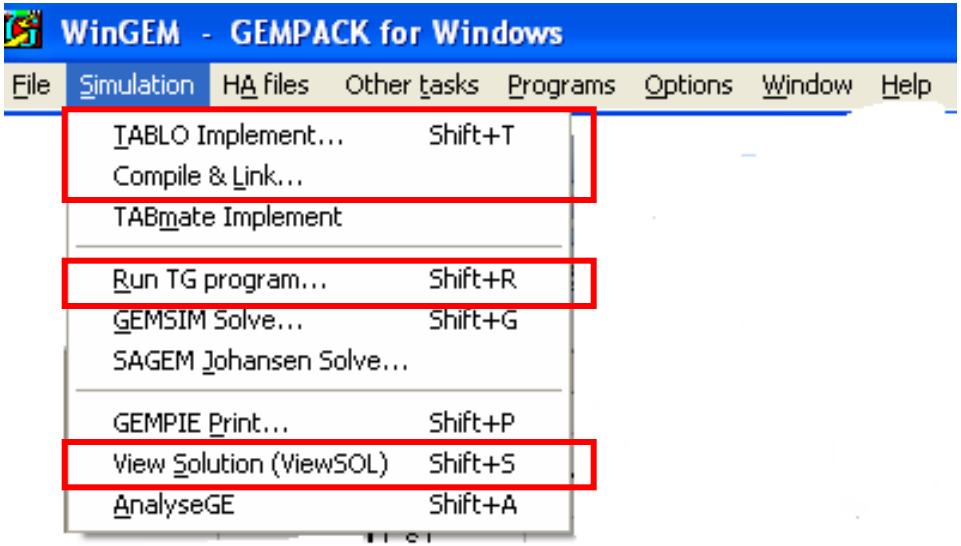
  - In the drop-down menu the choices are



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

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



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - In the TABLO-generated program method, the GEMPACK program TABLO is used to convert the algebraic equations of the economic model into a Fortran program specific to your model.

  - This Fortran program (which is referred to as the TABLO-generated program or TG Program in the menu) is compiled and linked to a library of GEMPACK subroutines.

  - The executable image of the TABLO-generated program produced by the compiler is used to run simulations on the model.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - There are three steps involved in carrying out a simulation using GEMPACK

  STEP 1 – Implement the model

  STEP 2 – Solve the equations of the model

  STEP 3 – View the results

  - WinGEM and RunGEM will guide you through these stpes and indicate what to do next.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

STEP 1 – Implement the model SJ using TABLO

Step 1 (a) – Run TABLO to create the TABLO-generated program

The TABLO Input file is called ***SJ.TAB***. It contains the theory of the SJ model.

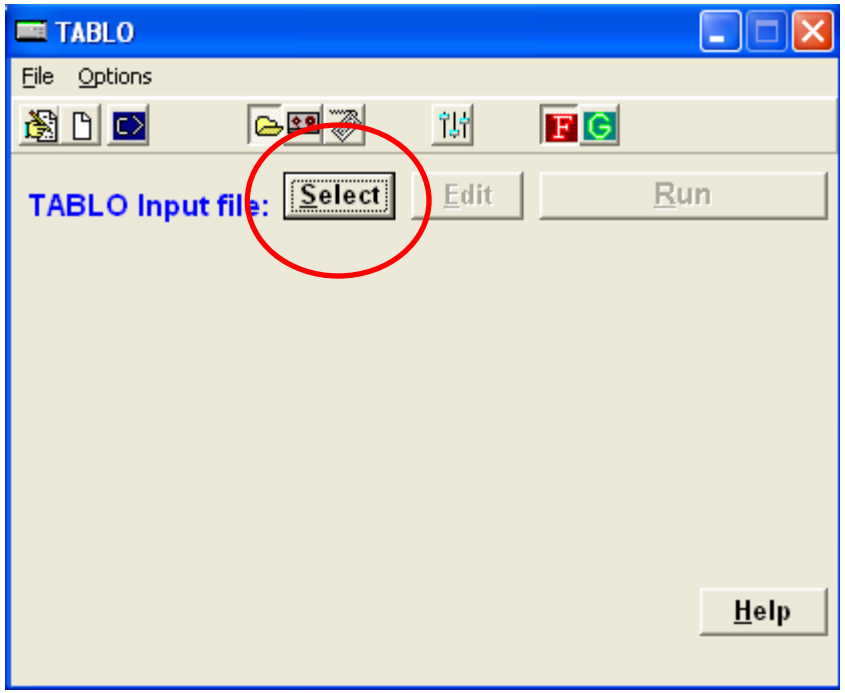
Choose

***Simulation|TABLO Implement....***

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

A window for TABLO will appear



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Click on the ***Select*** button to select the name of the TABLO Input file SJ.TAB. This is all TABLO need to implement a model.

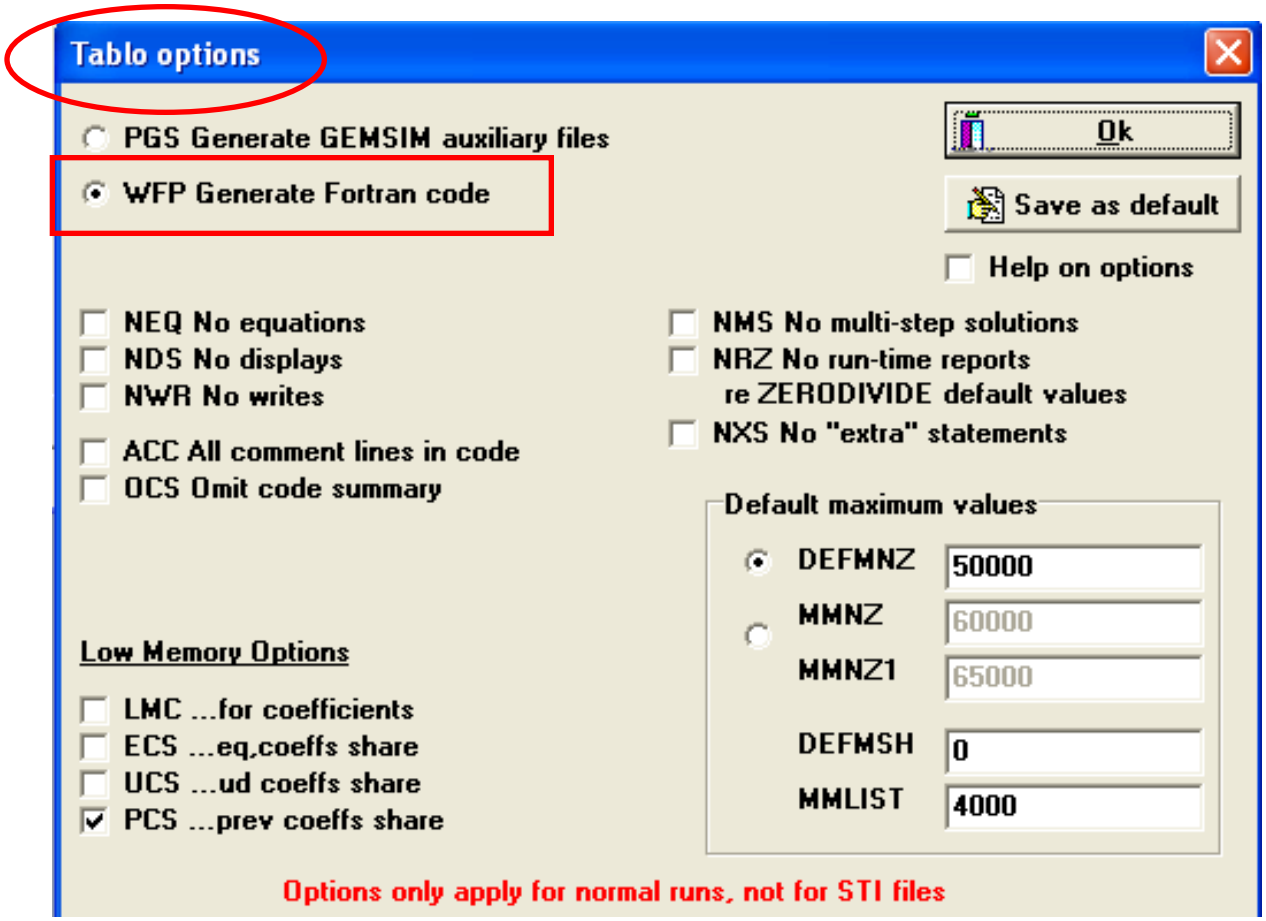
- In the menu for the TABLO window, select ***Options*** menu item. Then in this menu choose

***TABLO Options.....***

- A new TABLO Options window  will appear….

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - We will choose the option ***WFP.....*** Because we want you to create the TABLO-generated Fortran program.

  - Then click on ***Ok*** button to return to the TABLO window.

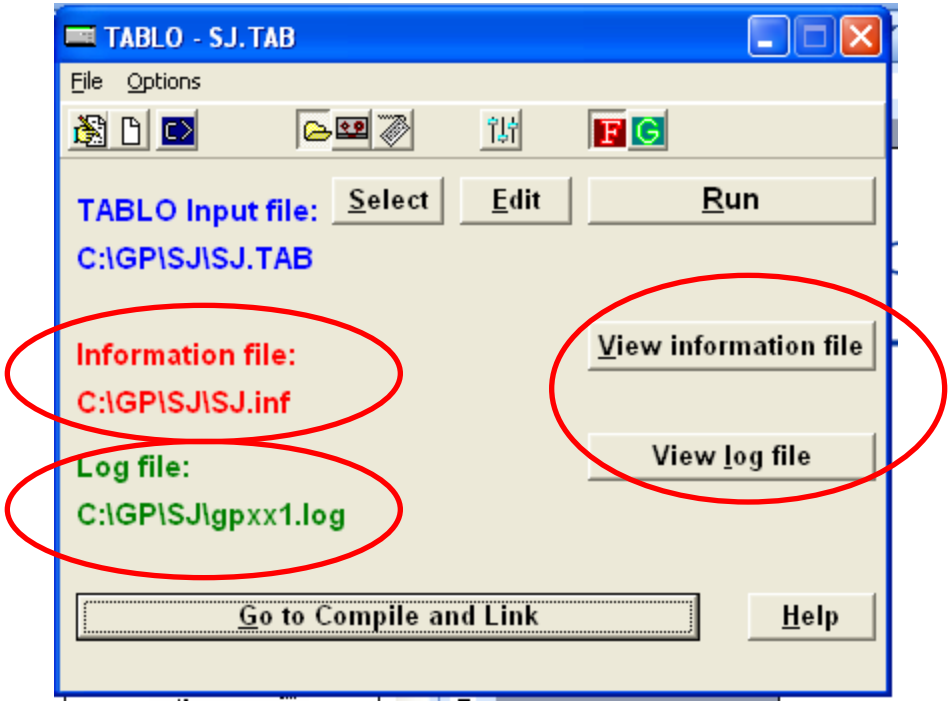
  - Click on ***Run*** button

  - The program runs TABLO in a DOX box and when complete, returns to the TABLO window with the names of files it has created: the information file SJ.INF and Log file.

  - To look at files click on ***View*** buttons beside them.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

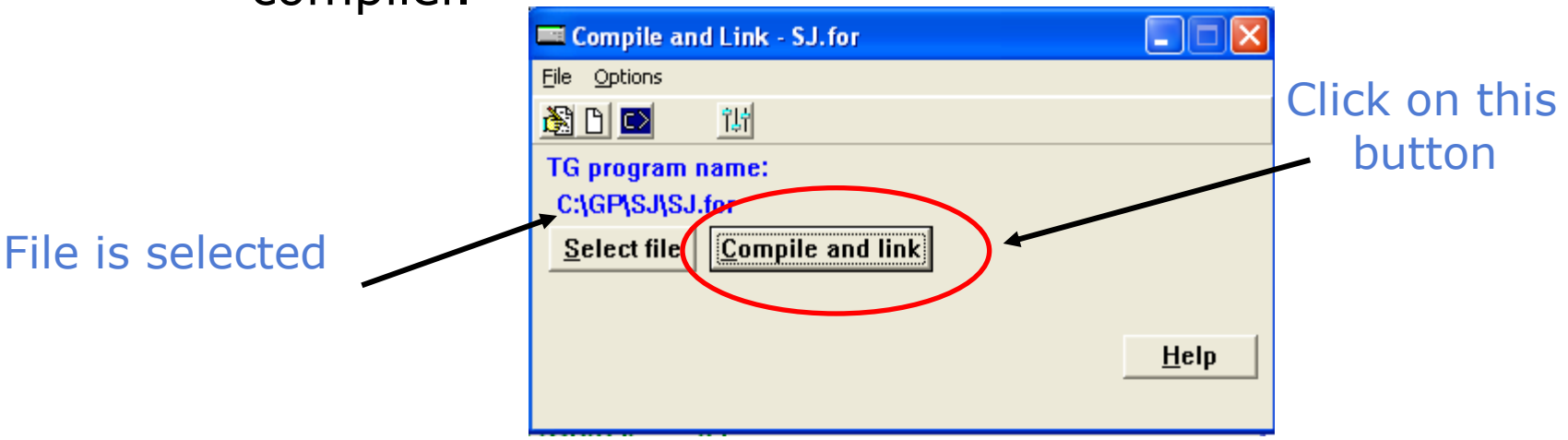


# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - Step 1 (b) Compile and Link the TABLO-generated Program

  - Click on the ***Go to compile and Link*** button at the botton of the TABLO window to run the Fortran compiler.

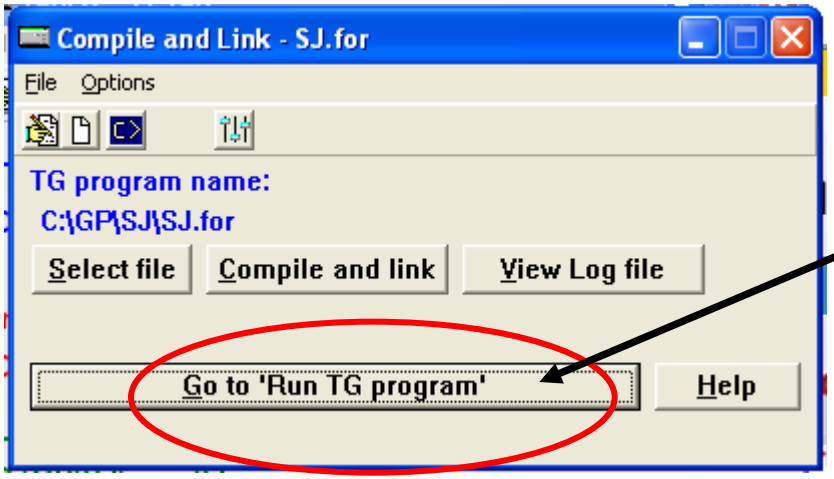


# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - The compiler converts the Fortran file SJ.FOR into the executable image SJ.EXE.

  - When finished click on the button Go to ***'Run TG program' or go to RunGEM module***




Click on this button or go to RunGEM module

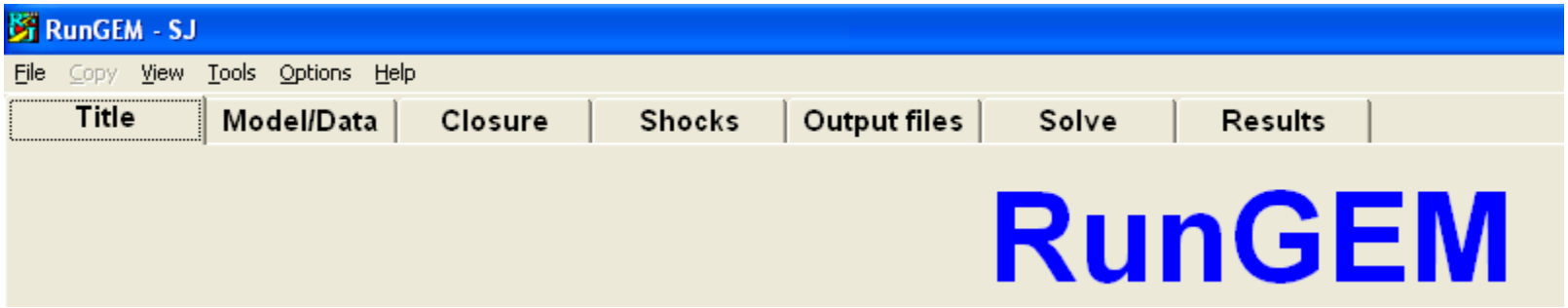
# Overview of GEMPACK Software

➢ How to implement the SJ model in GEMPACK?

- STEP 2 – Solve the equations of the model

- Starting RunGEM

  - Double click on RunGEM icon to stard RunGEM module. This is the first parte of RunGEM



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Starting RunGEM

  - To change from Title to Model/Data for exemple is only necessary to click on the names.

  - Select the Model

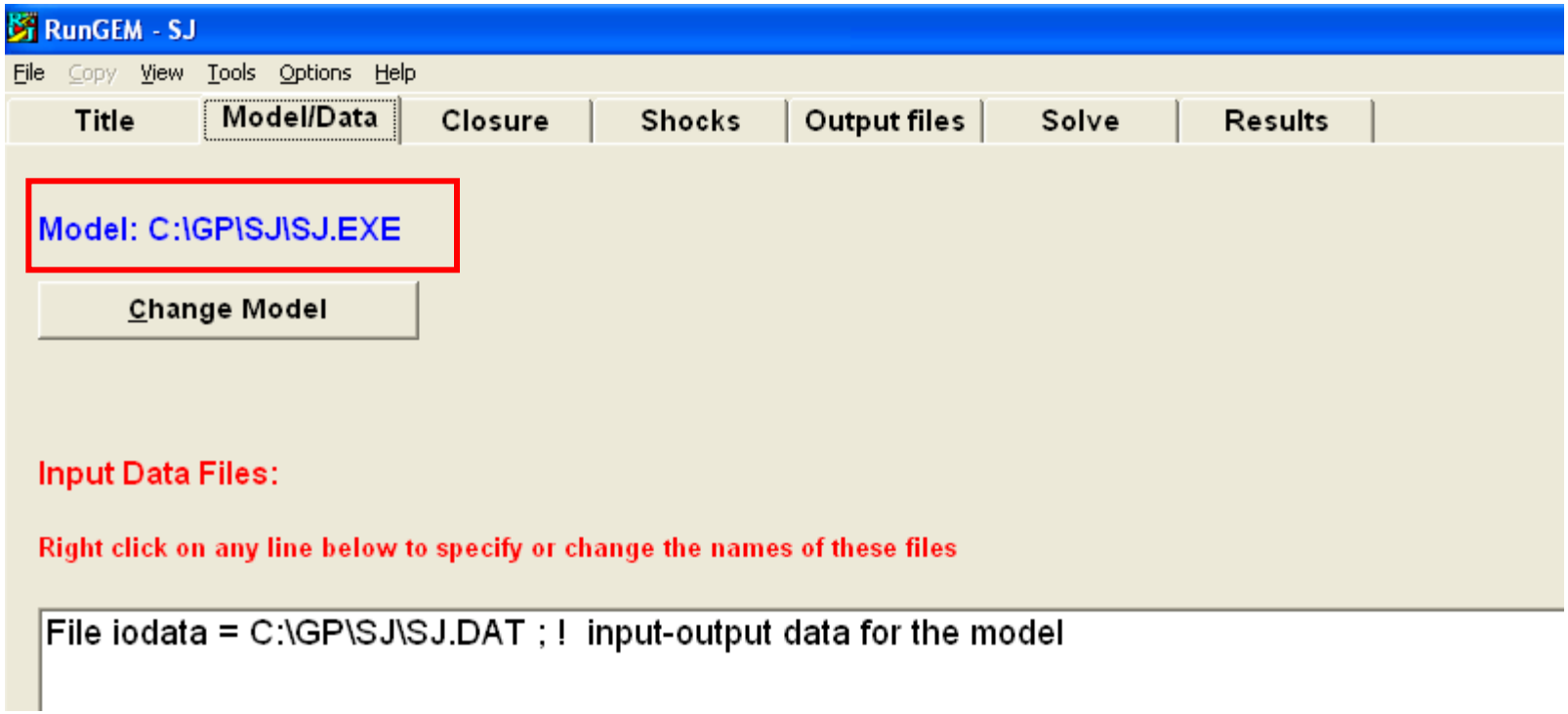
  Go to ***Model/Data*** page by clicking on its tab.

  Click on button ***Change Model*** do select your model.

  Select the file SJ.EXE.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?



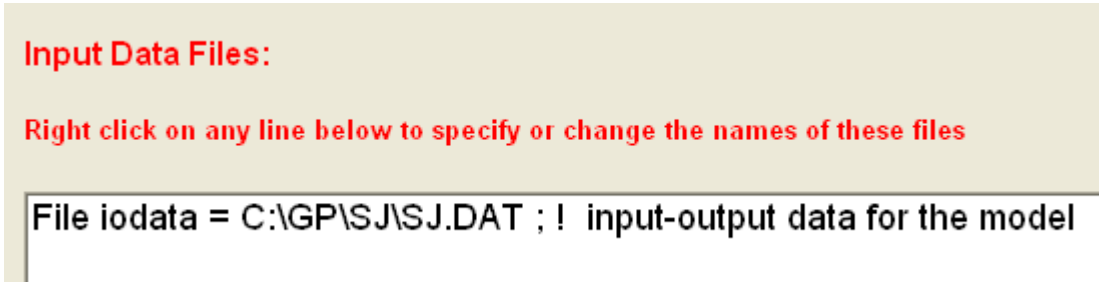
# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Starting RunGEM

  - Select the Data File

  In the white box headed ***Input Data File*** a single line of text will appear.



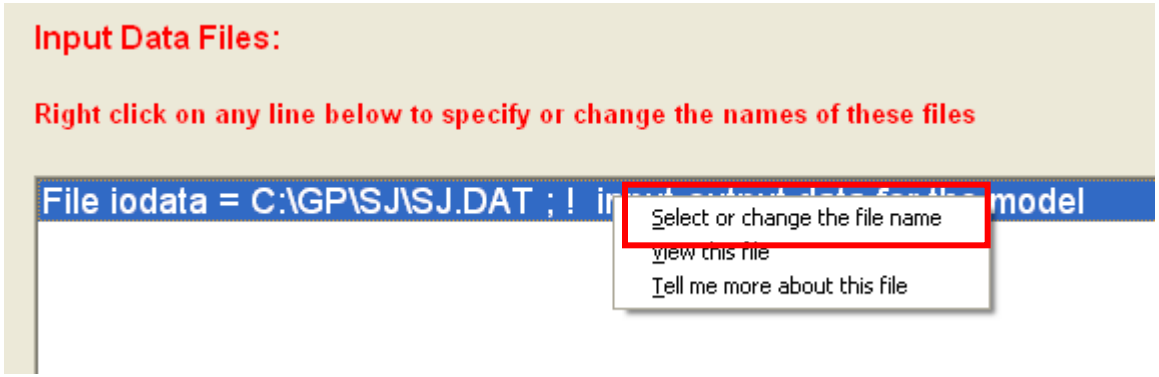
# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - Select the Data File

  Select the line (in blue) by right clicking on it

  Select on the menu the option ***Select or change the file name***

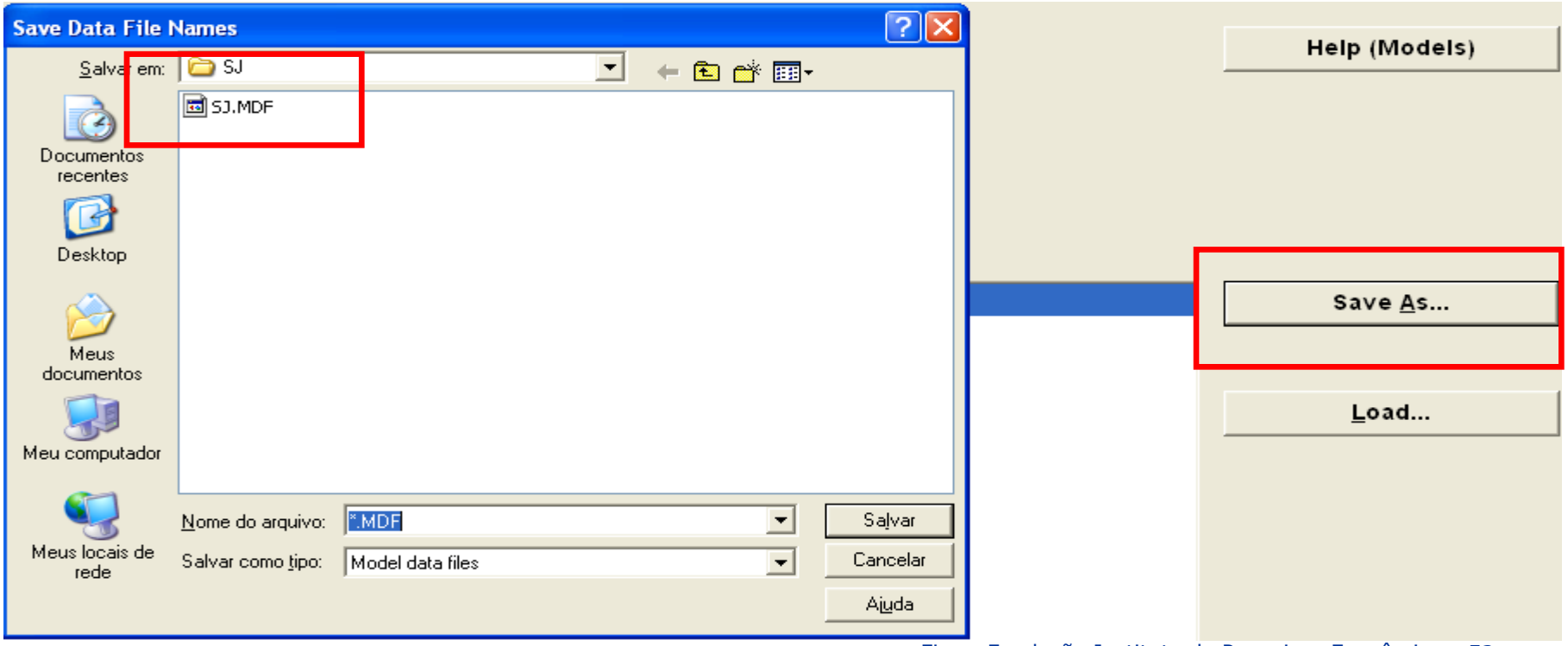


# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - Select the Data File

  Click on the ***save as*** button



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - Load Closure

  Select the ***Closure*** link

  Select the link ***Load Closure*** (as you have a closured saved in the SJ directory the GEMPACK will automatic open it).

  If you do not have the file .CLS you can type the closure and save it.

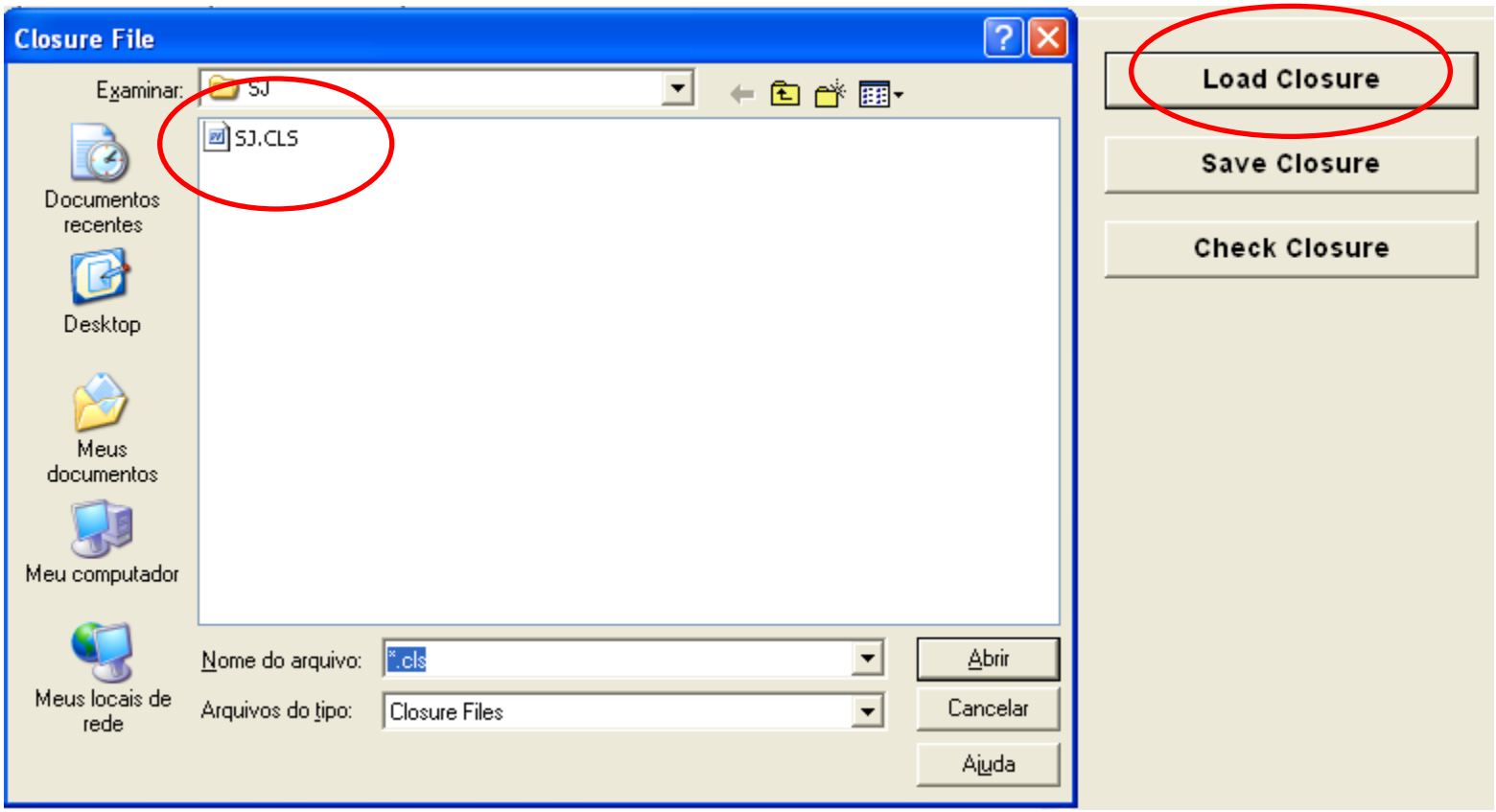
  *exogenous p_FAC;*

  *rest endogenous:*

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - Load Closure



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - Load Closure

  You also have the opportunity to check the closure. Thus click on the button ***Check Closure*** and RunGEM will check if this is a valid closure for the SJ model

  - Select the Shocks

  Click on ***Shocks*** tab, and in the box labelled ***Variable to shock***, click on the small arrow on the right hand side to get a drop-down list of exogenous variables.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - Select the Shocks

  For the closure chosen in the SJ model we have only one exogenous variable (p_XFAC).

  Click on this line to select p_XFAC and in the ***Elements to Shock*** box click on the arrow and select "labor".

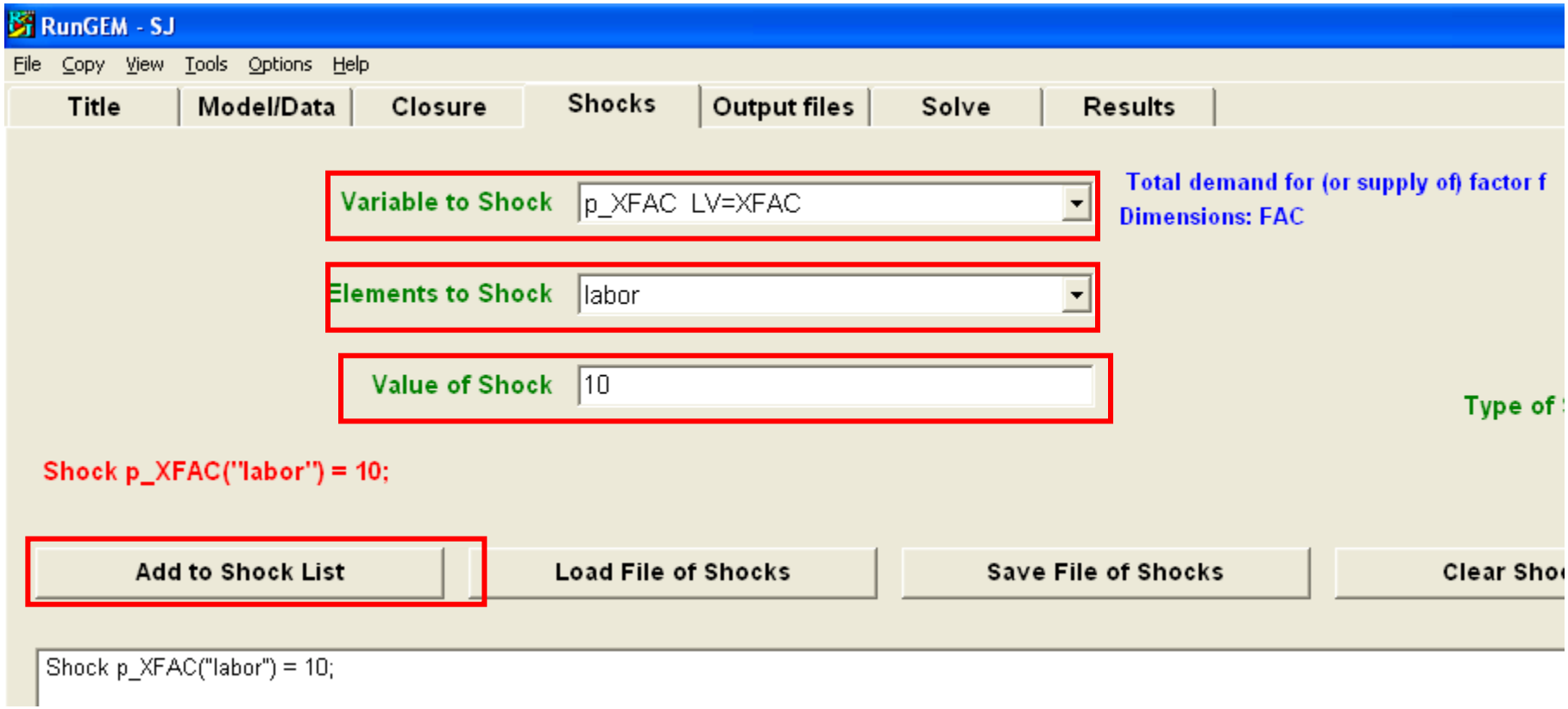
  Thus in this simulations you are shocking just one component of p_XFAC, the labor supply.

  Type in the next box the value of shock – 10.

  Click on the button ***Add to shock list***

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

  - Output Files

  Click on ***Output files*** tab

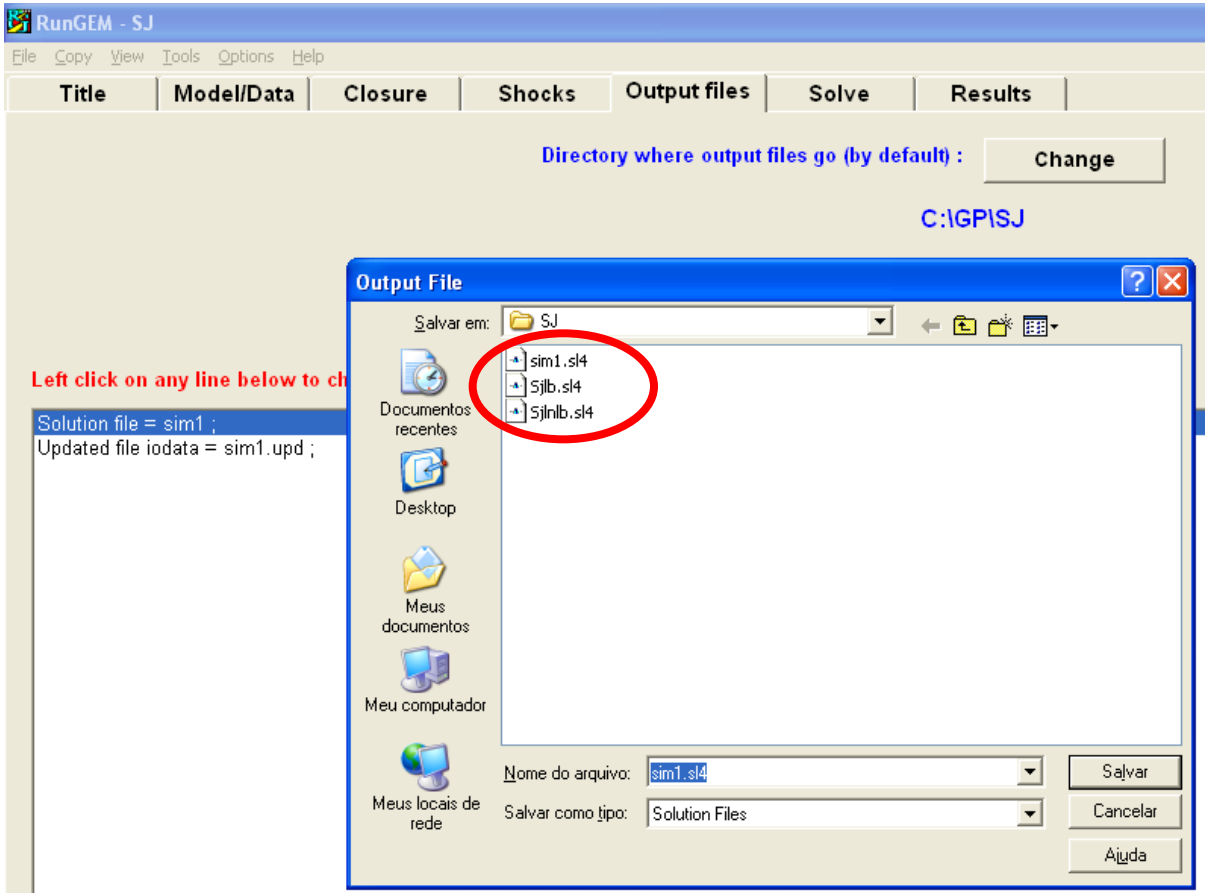
  To change the names of the output files, click (left click on this time) on the first line in the lower box:

  Solution file = sim1.

  Change the name of the Solution file to SJLB,SL4

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?



# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Carry out a simulation

  Select the next page ***Solve*** and type in some verbal description to say

  ***SJ. Standard closure – 10 percent increase in the labor supply***

  You need to select the solution method and steps.

  Click on the ***Change*** button to the right of the text "Solution method".

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

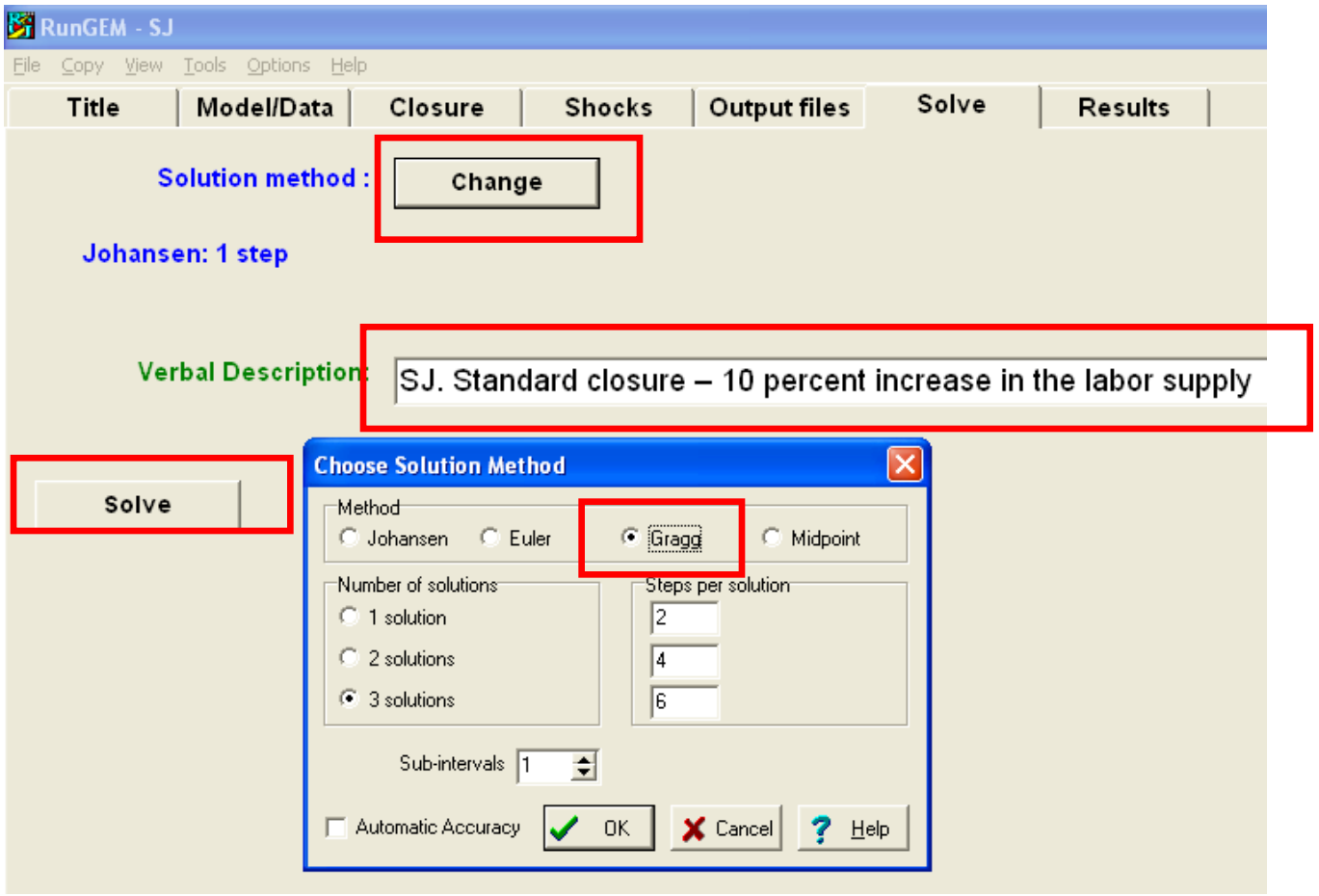
- Carry out a simulation

  Select "Gragg's method with 2,4,6 steps calculations [One subinterval, not automatic accuracy]

  Click on the ***Solve*** button and the RunGEM will calculate a solution.

# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

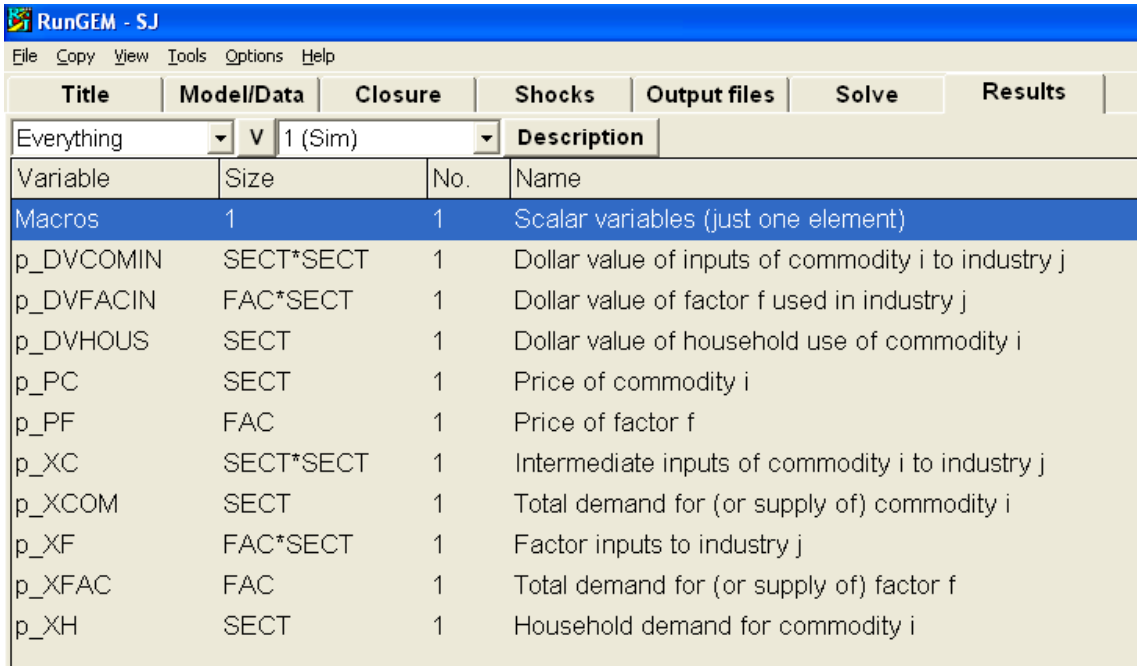


# Overview of GEMPACK Software

- How to implement the SJ model in GEMPACK?

- Look at the results:

  Click on ***Results*** tab




| Variable | Size | No. | Name |
|---|---|---|---|
| Macros | 1 | 1 | Scalar variables (just one element) |
| p_DVCOMIN | SECT*SECT | 1 | Dollar value of inputs of commodity i to industry j |
| p_DVFACIN | FAC*SECT | 1 | Dollar value of factor f used in industry j |
| p_DVHOUS | SECT | 1 | Dollar value of household use of commodity i |
| p_PC | SECT | 1 | Price of commodity i |
| p_PF | FAC | 1 | Price of factor f |
| p_XC | SECT*SECT | 1 | Intermediate inputs of commodity i to industry j |
| p_XCOM | SECT | 1 | Total demand for (or supply of) commodity i |
| p_XF | FAC*SECT | 1 | Factor inputs to industry j |
| p_XFAC | FAC | 1 | Total demand for (or supply of) factor f |
| p_XH | SECT | 1 | Household demand for commodity i |