IO&SAM

Input-Output and Social Accounting in Windows

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INTRODUCTION

IO&SAM for Windows projects activities and prices applying input-output and social accounting models. Social accounting multipliers can be decomposed following Pyatt & Round and Stone. Rectangular input-output data can be converted into symmetric tables under various technology assumptions. Matrix algebra routines employed in the modeling tasks are accessible separately.

SYSTEM REQUIREMENTS

The IO&SAM software is supplied to run under WINDOWS 32-bit systems with one mega-byte of memory.

FEATURES

• Easy operation with a mouse on a graphical user interface.

• Applies several input-output and social accounting models.

• Projects activities and prices, and computes real income by double deflation.

• Transforms data from commodity×industry to industry×industry or commodity×commodity space assuming either industry-based, commodity-based, or mixed technology.

• Computes several measures of productivity change.

• Updates data by Stone's RAS method.

• Reads and writes EXCEL, text and other worksheet files.

• Allows processing of very large files.

• Traps numerous errors and gives appropriate, meaningful messages.

• Prints output readable by text-processing and spreadsheet software.

• Includes sample files for immediate application.

TO INSTALL IO&SAM

For the very first installation:
Insert the original IO&SAM in a CD or DVD drive. The installation should start automatically. If not, seek and double-click on the SETUP.EXE file. Ignore *Windows* messages asking whether or not you wish to install this unrecognized software.

The installation program requests you to indicate the hard disk drive and folder on which you want to install the software, your name, and your address or institutional affiliation. The installation finishes after making IO&SAM files with an icon for the executable file installed from the original disk.
Subsequent installations:

If for any reason it became necessary to re-install the software, it must first be un-installed. The next installation proceeds like the original one but without prompting you for your name and address.

*Installation instructions may change in the future. Consult the *.DOC files on your original disk for up-to-date information*

TO OPEN IO&SAM

Double-click the IO&SAM icon in the *Program Files* folder.

HELP

Press the F1 key for context-sensitive Help.

If operating this IO&SAM under Windows 7, get from Microsoft their file WinHlp32.exe and install it to enable the help feature.

Use A5 paper to print this manual.

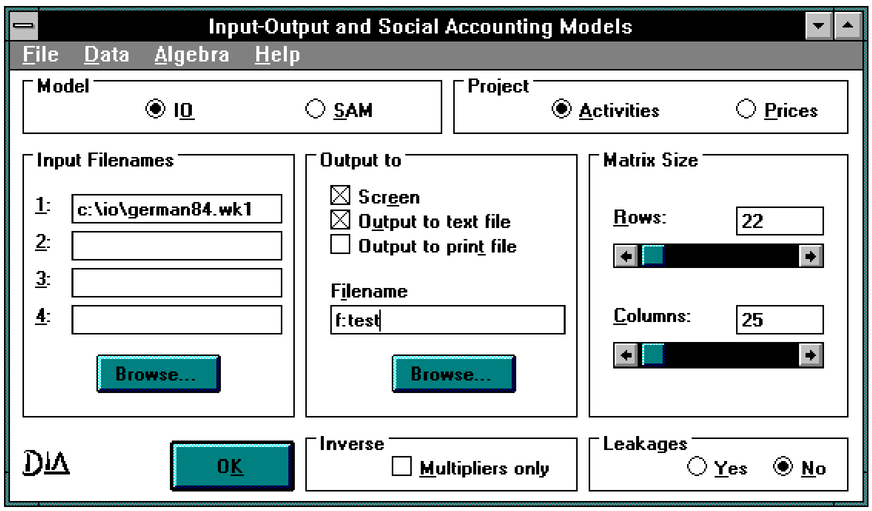
DATA

IO&SAM is supplied with sample files to make numerous practice runs. Input-output and social accounting matrices can be obtained for more computations with real-life data. DIA Agency Inc. can supply over 70 files for many countries from Argentina to Zimbabwe. Available files are listed and described in a file named IO.DOC. The same file also gives information about ordering and prices. Use *Windows Notepad* to read IO.DOC.

A PRACTICE RUN

Make a practice run with an input-output model. A sample data file is provided and will be used. The ways to create new data files will be discussed later.

Start by loading IO&SAM and view the IO&SAM screen. There are radio buttons, check boxes, text boxes, scroll bars, and command buttons. There is a menu at the top. Some menu items will also be discussed later.



Below the menu bar are frames. Each frame is associated with a different task: The choice of a model and of what the model should project, the choice of an input file, the filing and display of output, the description of the problem by the size of the data matrix, selection of alternative treatments of negative final demands, and a choice of output in the form of multipliers instead of variable values .

File names are set by typing in appropriate text boxes. The reason for the four input file text boxes will be discussed later when considering huge files. The frames around file name boxes hold browse buttons. A file name can be chosen also by browsing directories of files on disk.

The matrix size frame holds scroll bars so that the numbers of rows and columns can be indicated by scrolling with a mouse and not only by typing numbers.

The Leakages and Inverse frames will be discussed later in subsequent chapters about input-output and social accounting models. The OK button at the bottom left is clicked when all choices are made and it is time to solve the model.

The various items inside frames are referred to as control. Controls are activated with the mouse. The active control can also be picked by pressing the Tab key or the key corresponding to the letter that is underlined in the control's name. Pressing the ENTER key has the same effect as a mouse click on the OK button.

Now use the buttons and boxes on screen. Press the F1 key for help about the active control. Nearly all controls have to be used. Click OK when all radio buttons, check boxes, and text boxes are set as desired. The various settings are discussed as numbered steps followed in the practice run.

A. INPUT-OUTPUT MODEL PRACTICE
Given two alternative final demand vectors, project the required gross output and value added by factor and by sector.

1. Click the IO radio button or press the O-key to choose the application of the input-output model. This choice is already made on start-up.

2. Click the activities radio button or press the A key to choose gross output projections. This choice is also made on start-up.

3. Choose the sample file called GERMAN84.WK1. Make the choice by browsing a file folder. Click the BROWSE button in the INPUT FILENAMES frame. A files dialog box should appear that allows the choice of drive, folder, and file. Click on GERMAN84.WK1 under FILENAME(S) in the INPUT FILE(S) box. Click on OK.

A PRACTICE RUN

4. The INPUT FILE(S) box disappears and the filename appears in the text box next to the 1 in the INPUT FILENAMES frame.

5. Move the mouse to the OUTPUT TO frame. Click on Screen or press the E-key to check-mark output to the computer screen.

6. Move the mouse and click on the text box in the OUTPUT TO frame or press on the I-key. Type a file name such as TEST. It makes no difference whether upper- or lower-case letters are used.

7. Move the mouse to the MATRIX SIZE frame. The number of rows is 22. The number of columns is 25. Set these numbers by editing text boxes or by clicking on the corresponding scroll-bars.

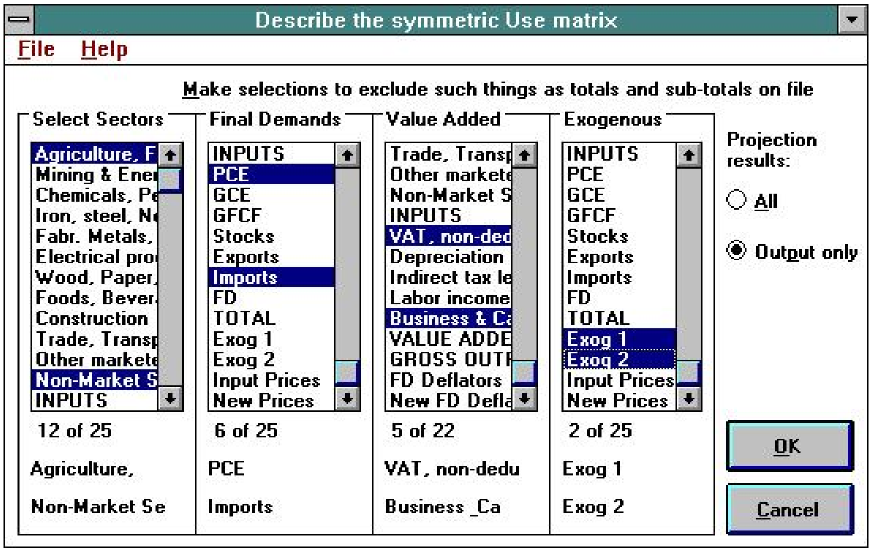
8. Click on OK or press the ENTER key.

9. A message box may appear saying that file TEST already exists. Click on YES or on NO depending on whether you do or do not want the output file to over-write the existing file. The contents of the existing file will be lost when YES is chosen. Choose NO to return to the opening screen and to revise the output file name that had been entered in step 6 above.

B. MODEL SPECIFICATION USING THE DATA ON FILE.

10. A new window such as that on the next page appears when the data have been read successfully. This new, model specification window allows the selection of industrial sectors, value added categories, final demands, and exogenous activities. The selections are made in list boxes.

11. If in doubt about the meaning of the items listed in list boxes, click the CANCEL button, activate the Spreadsheet by choosing it from the DATA menu or by pressing Shift-F1, then view the data file in the spreadsheet window. Press Shift-F1 again to resume the practice run.



12. For this practice run, select sectors in the SECTORS list box. Click first on Agriculture, then Ctrl-Click on Non-Market Services.

13. Select final demands in the FINAL DEMANDS list box with a Click on Personal Consumption Expenditure and a Ctrl-Click on Imports.

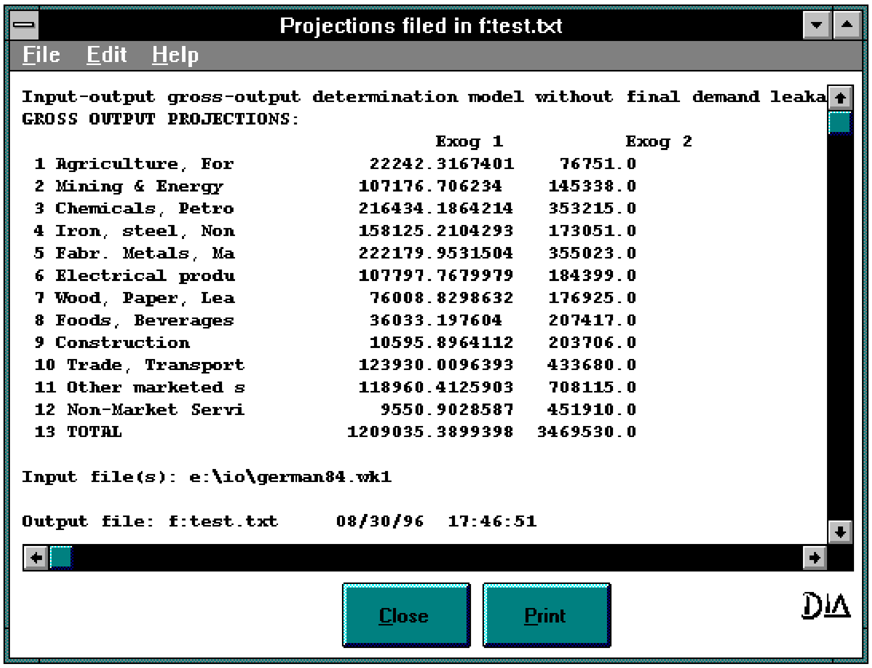
14. Select value added categories in the VALUE ADDED list box with a Click on Non-deductible VAT and a Ctrl-Click on Business and Capital Income.

15. Select exogenous final demands in the EXOGENOUS list box with a Click on Exog1 and a Ctrl-Click on Exog2. This completes the identification of data in the matrix that are relevant to the projection task at hand.

A PRACTICE RUN

16. Projections of activity levels can be used to project also the required value added by sector. Click the ALL radio-button to project both gross outputs and value added. The illustrated setting is for projection of gross output only.

17. Click the OK button when ready to continue.



C. THE RESULTS

18. Wait for the IO&SAM-SOLUTION message. Read the message saying where the results were filed. Then click on the OK button or press the ENTER key.

RESULTS

19. The RESULTS window has the output file name at the top and CLOSE and PRINT buttons at the bottom. Use the scroll bars to view the entire output. Click on PRINT after turning on the printer to obtain a printed copy of the output. Click on CLOSE to return to the opening IO&SAM screen.

The practice run is now complete. Further uses of the output in word-processors and in spreadsheet programs will be discussed later.

OTHER CASES

Input-output and social accounting projections are made in ways very similar to the practice run. Each case is discussed in a separate chapter.

Besides making projections one can (1) transform data and (2) execute several matrix algebra operations. Data transformations and matrix algebra operations fall into two classes: (a) those that require the input of only one data file and (b) those that require the input of two files. In the latter case, the IO&SAM window presents two INPUT FILENAME(S) frames and two MATRIX SIZE frames.

One file	Two files
Input-Output Price Model	Transform Make and Use tables into a symmetric IO table
SAM activity projections	Construct a mixed technology Make matrix
SAM deflator projections	Matrix addition & subtraction
Recast final demand leakages	Matrix multiplication
Simultaneous linear equations	Multiply a matrix by a diagonalized vector
Matrix inversion	RAS adjustment
Diagonalize a vector	Balance Make and Use tables
Re-scale a matrix	Productivity change estimates
Transpose a matrix	
Compute matrix row sums	
Compute matrix column sums	
Balance an input-output table	

THE IO&SAM SPREADSHEET

Choose the Spreadsheet from the IO&SAM DATA menu or by using the Shift-F1 short-cut keys. The Spreadsheet has its own FILES menu. Choose OPEN to open one of the sample files. A new dialog box appears when OPEN is chosen. Enter the file name and file size in the dialog box. The file size is indicated by the numbers of rows and columns. File input is slightly accelerated by indicating the exact matrix size but the file size is not strictly necessary.

Sample file	Rows	Columns	Used to
a.wk1	4	5	Updated by RAS
b.wk1	4	5	RAS control totals
invertme.wk1	3	3	Matrix inversion
lh.wk1	3	3	Solve by inversion
rh.wk1	3	1	constants in lh.wk1
solve_me.wk1	3	4	Solve by LU decomposition
solve_me.txt	3	4	Alternative file format
german84.wk1	22	25	IO price models, dble. deflation
kenya_76.wk1	37	39	SAM models
uk_68sam.wk1	53	53	SAM multipliers
leontief.wk1	12	12	Compute coefficients and [I-A]
make.wk1	3	3	Make symmetric IO tables
use.wk1	5	5	Make symmetric IO tables
trad_v1.wk1	4	4	Create mixed technology Make
trad_v2.wk1	4	4	Create mixed technology Make
alt_v1.wk1	3	4	Create mixed technology Make
alt_v2.wk1	3	4	Create mixed technology Make
Can_IO86.wk1	28	34	Symmetric model of Canada
Can_IO88.wk1	28	34	Symmetric model of Canada
CanSam86.wk1	87	83	Primitive SAM for Canada
CanSam88.wk1	87	83	Primitive SAM for Canada

The last four files are in a Canada sub-folder and include data required for productivity change estimation. Files are processed in the spreadsheet by editing cells. The number of rows and columns, the number formats, file open and save, and many other operations involve the use of menu items.

THE IO&SAM SPREADSHEET

Items on the Spreadsheet menu bar, their short-cut keys and uses are:

Menu	Sub-menu		Short-cut Keys	Use
FILE				
	NEW		Ctrl-N	Create a new spreadsheet.
	OPEN		Ctrl-O	Open a file for input.
	SAVE		Ctrl-S	Save the file with the same name.
	SAVE AS		Ctrl-A	Save with a new path and name.
	CLOSE			Close the Spreadsheet .
EDIT				
	COPY		Ctrl-C	Copy selected cells to *Windows Notepad.*
	CUT		Ctrl-X	Delete selected cells after copying them to *Windows Notepad*.
	PASTE		Ctrl-V	Fill selected cells with data in the Notepad.
	DELETE			Delete selected cells.
	ERASE			Erase all data.
	UNDO		Ctrl-U	Cancel cell edit.
	CALCULATOR		F9	Calculator
OPTIONS				
	FREEZE TITLES			
		Col. headings	Ctrl-H	Fix the row of headings.
		Row stubs	Ctrl-T	Fix the column of stubs
	INSERT ROWS/COLS		Ctrl-I	Increase the spreadsheet size.
	DELETE ROWS/COLS		Ctrl-D	Reduce the spreadsheet size.
	NUMBER FORMAT			Change the number format.

DELETING ROWS AND COLUMNS:

The number of rows and columns to delete can be selected by dragging the mouse. The deletion point is at the cell that took the last mouse click or where mouse dragging started.

FILES:

Files that can be opened are DIF files produced by EXCEL, ASCII text files, binary files in the LOTUS 1-2-3 WK1 format, and comma delimited ASCII files in the LOTUS 1-2-3 print file format.

Files can be saved as DIF files readable by EXCEL, as ASCII text and in the WK1 format. File formats are explained in greater detail in a separate chapter.

FIXED ROWS AND COLUMNS:

Fix column headings and row stubs so that they will be kept in view while scrolling the spreadsheet. Fixed cells cannot be edited. Only the first row and the first column can be fixed.

INSERTING ROWS AND COLUMNS:

The number of rows and columns to insert can be selected by dragging the mouse. The insertion point is at the cell that took the last mouse click or where mouse dragging started. The number of rows and columns inserted is limited by the maximum matrix dimensions.

MATRIX DIMENSIONS:

The maximum matrix size is 1024 rows by 1024 columns. The number of rows (columns) cannot be increased beyond 1024 even if the number of columns (rows) is reduced below 1024.

THE IO&SAM SPREADSHEET

NUMBER FORMATS:

Number formats apply globally to the entire spreadsheet. The possible formats, listed from least to most precise, are:

(1) fixed number of decimals and fixed number of integer digits.
(2) scientific, where, for example, 1.21E+002 means 121.
(3) free format using up to twenty spaces to represent numbers with the maximum precision possible with a PC.

Choice of the first and second formats entails a loss of precision. The loss is permanent if the altered numbers are saved with the same file name and in the same file folder.

EDITING CELLS:

Editing cells involves changing the focus to new cells, typing new numbers and headings, and copying to and from the Clipboard.

SELECTING CELLS:

Press		
	End	to go to the last column.
	Ctrl-End	to go to the last cell.
	Home	to go to the first column.
	Ctrl-Home	to go to the first cell.
	>	to increase the width of the selected columns.
	<	to decrease the width of the selected columns.
	Arrow key	to select an adjacent cell.
Click	on a cell	to type a value in the edit box that will be transferred to the current cell when a different one is selected or when the ENTER key is pressed.
	On a fixed cell	to select an entire row or column, e.g. to fill it with a constant value.
Drag	over cells	to select a range of cells for copying to Clipboard for pasting from Clipboard for filling with a constant for insertion or deletion.

CALCULATOR

The calculator can be opened by

Selection from the Edit menu;
pressing the F9 key;
clicking on the Calculator icon.

The calculator screen holds the current cell contents when it is opened.

The value on the calculator screen is copied to the Clipboard when the COPY button is clicked. Use Ctrl-V to paste the value in the Clipboard to a selected spreadsheet cell.

Click on PASTE button to insert a value saved to the Clipboard.

Calculator keys can be used by clicking on the calculator or by pressing the corresponding keys on the computer's keyboard.

Close the calculator by clicking its CLOSE button.

INPUT FILE FORMATS

All files can be thought of as cells arranged in rows and columns. There are small files and large files. Large files are those that have more than 255 columns. Such files are discussed in a separate chapter.

The arrangement of rows and columns differs between input and output files. Input or data file formats are set and differ between input-output, social accounting and matrix algebra problems.

Input files are stored in ways peculiar to IO&SAM FOR WINDOWS but can also be stored in ways compatible with other micro-computer software.

These various aspects of file formats will be discussed by example using a sample file.

SAMPLE FILES FOR INPUT TO SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS.

Table 1 shows the data for Gerald's and Wheatley's example in the way in which they appear in the IO&SAM SPREADSHEET or on an EXCEL screen.

Table 1: Data filed in SOLVE_ME.WK1

	X	Y	Z	Constants
Row 1	3.02	-1.05	2.53	-1.61
Row 2	4.33	0.56	-1.78	7.23
Row 3	-0.83	-0.54	1.47	-3.38

The rules for creating such a table are:

0. Rows and columns are counted from base 0.
1. Variables are in columns starting with column 1 (B in EXCEL).
2. The right-hand constants are in the last column.
3. Equations are in rows, starting with row 1.
4. Column headings are required and must be in row 0.
5. Row stubs are required and must be in column 0 (A in EXCEL).
6. Non-numeric values outside row 0 and column 0 are ignored.
7. Zeros need not be filed. Any cell can be blank.

INPUT FILE FORMATS

FILE COMPATIBILITY

EXCEL can be read if saved as *.DIF files. The IO&SAM SPREADSHEET writes *.DIF files readable by EXCEL and *OpenOffice*.

*.WK1 files can be created with the IO&SAM SPREADSHEET. Older versions of EXCEL and *QuattroPro* will also read and write *.WK1 files compatible with IO&SAM. Such files can be imported by most word-processing programs after reading into and saving from a spreadsheet program.

INPUT OF ASCII FILES

Data files can also be created by any ASCII editor. A Word-processor can also be used to record data and save them in DOS ASCII text format. The text data file is a comma-delimited file. The commas separate row, column, value. Table 2 shows how such a file appears in the text editor.

Table 2: Data filed in SOLVE_ME.TXT

```
1,0,Row 1
2,0,Row 2
3,0,Row 3
0,1,X
1,1,3.02
2,1,4.33
3,1,-0.83
0,2,Y
1,2,-1.05
2,2,0.56
3,2,-0.54
0,3,Z
1,3,2.53
2,3,-1.78
3,3,1.47
0,4,Constants
1,4,-1.61
2,4,7.23
3,4,-3.38
```

OUTPUT FILES

Output files can be in ASCII text format with and without comma delimiters. Those without commas are suitable for insertion in word processor files. Those with commas can be inserted in spreadsheets, including the IO&SAM SPREADSHEET.

Both file types, print and text, can be check-marked before clicking the OK button. IO&SAM will then file results in two files. Input-output and SAM projection results will be displayed in the RESULTS window and will be available for immediate printing.

Text files without commas are best printed in a fixed, non-proportional font such as courier. In that way they retain the appearance shown on the IO&SAM results window with neatly spaced columns and aligned decimal points. IO&SAM uses a fixed font when the user clicks the PRINT button on the results window. See that window to view the output files.

Print files with commas should not have more than 8,192 lines, because that is the maximum number of rows allowed by spreadsheet software intended for importing and processing these files.

Excessively large projection output files cannot be viewed in the RESULTS Window. Use other software to browse through and process the output files.

RAS, data transformation, and matrix algebra results, and multiplier matrices can be viewed in the SPREADSHEET. There must be more than 16 mega-bytes of free memory to copy a matrix that is 1024-square from memory to the spreadsheet.

LARGE FILES

Large files are those too large for spreadsheet programs by having either too many rows or too many columns. There are two ways to handle large files.

1. Cut the file into sets of columns. Up to four sets can be used.

2. Translate the file to a comma-delimited ASCII format such as that shown in Table 2.

The first approach is useful when using WK1 files but it can also be used to cut large text files. Gerald's and Wheatley's data are reproduced as three files in Tables 3 and 4.

Table 3: SOLVE_ME data stored in three text files

ONE.TXT	TWO.TXT	THREE.TXT
1,0,Row 1	1,0,Row 1	1,0,Row 1
2,0,Row 2	2,0,Row 2	2,0,Row 2
3,0,Row 3	3,0,Row 3	3,0,Row 3
0,1,X	0,1,Y	0,1,Z
1,1,3.02	1,1,-1.05	1,1,2.53
2,1,4.33	2,1,0.56	2,1,-1.78
3,1,-0.83	3,1,-0.54	3,1,1.47
		0,2,Constants
		1,2,-1.61
		2,2,7.23
		3,2,-3.38

The data cells in text files are indexed by their absolute position: column 1 is in file ONE.TXT, column 2 is in file TWO.TXT, and columns 3 and 4 are in file THREE.TXT. Thus the three files can be read in sequence to fill a four-column matrix. Table 4 shows more clearly that all files meant to be merged into one IO&SAM data set must have identical numbers of rows and that the column of row stubs must be repeated in every file.

Table 4: SOLVE_ME data stored in three WK1 files

ONE.WK1		TWO.WK1		THREE.WK1		
	X		Y		Z	Constants
Row 1	3.02	Row 1	-1.05	Row 1	2.53	-1.61
Row 2	4.33	Row 2	0.56	Row 2	-1.78	7.23
Row 3	-0.83	Row 3	-0.54	Row 3	1.47	-3.38

LARGE FILES

MULTIPLE FILE INPUT

Up to four files can be read at one time. The file paths and names can be typed into the four text boxes in the INPUT FILENAME(S) frame. Alternatively, click the BROWSE button and select files from the FILES dialog box. Use Click and Shift-Click to select a range of files. Use Click and Ctrl-Click to select individual files. Click on the OK button to confirm the multiple file selection. File names are then transferred to the text boxes in INPUT FILENAME(S) frame. The filenames are inserted in alphabetical order. Their alphabetical order may be inappropriate. Any two file names can be swapped by dragging the number at the left of a text box. Drag the 2 over the 3, or drag the 3 over the 2, and the contents of text boxes 2 and 3 will be exchanged. Continue reordering file names until they are in the same order as the blocks of columns.

The order of columns will not matter in most cases. There is only one case where the order always matters. That is the case of right-hand constants that must always appear in the last column. For example, if one clicked on ONE, TWO, and THREE, Windows gathers them from disk in the order of ONE, THREE and TWO. IO&SAM then puts THREE in text box 2 although THREE contains the right-hand constants. Order is then restored by dragging the 2 over the 3.

FILE TRANSLATION

Files can be converted from ASCII to WK1 format and back using the FILE TRANSLATION option in the FILE menu. Up to 4 WK1 files can be converted to a single, large ASCII file. One large ASCII file can be converted into 9 WK1 files. Such files will all have the same 7-character name with an 8th character indicating their position in the grand file. That last character can be 1, 2, ..., 9. File output is truncated if a tenth or more files were needed.

WHICH IS THE MOST CONVENIENT FILE FORMAT?

The WK1 format is transportable to older versions of EXCEL, *QuattroPro*, and word processors. However, these spreadsheet programs allow only 255 columns. Thus a large file has to be cut into 2 to four sets of columns with at most 1016 columns of numerical data. The ASCII text format is therefore more convenient for files with more than 255 columns.

LARGE FILES

Small files of less than 1024 rows can be dealt with in the IO&SAM SPREADSHEET and saved as WK1 if they have fewer than 255 columns. Otherwise they are saved as TXT or DIF.

MAKING SMALL FILES OUT OF LARGE ONES

Any large file can be cut into two small files using the MAKE SMALL FILES option in the FILE menu.

RESULTS

Computed results appear in a window. The volume of results usually exceeds the size of the window. To view all results, scroll the text in the window using the keyboard or the scroll bars. Keyboard uses are:

End	Show the end of the line
Ctrl-End	Show the end of the text
Home	Show the beginning of the line
Ctrl-Home	Show the beginning of the text
PageUp	Show lines above
PageDown	Show lines below

The results text cannot be edited to change words and numbers but it can be cut, copied to the Windows Clipboard, and pasted with text in the Clipboard. Text cut or copied to the Clipboard can be transferred from there to other Windows applications.
The results text can be printed. To print the text, click on the PRINT button or press the Ctrl-P keys. The printed text is that in the results file, not the edited text shown in the window.

The volume of results may exceed that which can be held in the results window. The displayed results are truncated in that case. Other software must be applied to view and process all results.

INPUT-OUTPUT MODELS

INPUT-OUTPUT DATA

The data record the intermediate and final demand of goods and of primary factors. The data are arranged in a matrix that can be partitioned as in Figure 1.

Figure 1: Arrangement of Input-Output Data

	Production Activities	Final Demands	Total
Goods	U	E	x
Factors	Y		Yi
Total	x′	i′E	

The table is symmetric in the sense that the list of goods is identical to the list of production activities.[1] Total, gross output by production activities (row x') is thus equal to total demand for goods (column x). Goods can be defined either as commodities or as industrial outputs.

The table is balanced. Total final demand iEi equals total value added iYi because the production and use of goods are balanced. The table is unbalanced in the sense that $i\,'$E is not the transpose of Yi.

Commodity balance means that Ui + e = x, where e is a column vector of total final demands.

[1] The ways to obtain square and symmetric matrices from rectangular Make-Use tables are explained in the chapter on DATA TRANSFORMATIONS.

INPUT-OUTPUT MODELS

AN OUTPUT DETERMINATION MODEL

The commodity balance statement can be turned into an economic model by assuming

(1) Free entry (price = marginal cost);
(2) Constant returns to scale and zero profits (marginal cost = average cost);
(3) Fixed input proportions; or
assume cost minimization subject to linear homogeneous production functions while also assuming that primary input prices are exogenous.

Denote the diagonalization of a vector by a caret (^). The assumed constant coefficients are then expressed as a matrix

$$A = U\,\hat{x}^{-1}$$

and thus the commodity balance equation is

$$x - Ax = e \qquad \text{or} \qquad [I - A]x = e$$

Retaining final demand as a matrix, one can also write

$$[I - A]X = E$$

IO&SAM solves for X given U and E when E is appended to the right of the last column in the data file. The solution is a goods × final demands matrix that has two applications.

First, E can be a copy of the actual final demand matrix. A column of X then shows the outputs required from industries indicated in the rows to meet the final demand indicated above the column. The requirements are direct and indirect. Direct requirements are shipments from an industry to final users. Indirect requirements are demands for intermediate inputs to production of other goods in final or intermediate demand.

If the final demand matrix has an imports column, the imports column of X shows the domestic outputs displaced by imports.

Second, E can be a matrix of projected final demands or plan targets. The solution X then shows the levels of industrial activity required to meet the targets.

IO&SAM also computes primary inputs required to meet every final demand when the user chooses the ALL output option in the MODEL SPECIFICATIONS window. For example, labor requirements are a row ℓ' in a matrix of primary factor requirements $Y\hat{x}^{-1}$ and IO&SAM can compute and display $\ell'X$ in the RESULTS window. Similar primary factor requirement matrices are computed and displayed for all other primary factors on file. These last results can be used, for example, to compute the value of the factor content of imports and exports. Another application is the computation of factor requirements implied by plan targets for assessment of the feasibility of those targets given the factor supplies.

A PRICE MODEL

The price model is the dual of the output determination model. Denote a vector of unit factor costs by z and a vector of factor prices by w. When given this factor price vector, IO&SAM can compute the vector of product prices p in

$$p' [I - A] = z'$$

where $z' = i' \{ \hat{w} (Y \hat{x}^{-1}) \}$

The user must provide the assumed factor prices w in a column to the right of the final demand columns on file.

DOUBLE DEFLATION

Leontief's units convention is that quantities are measured in units that fetch a price of \$1.00. Thus, in the base case, $p_o = i$, $w_o = i$, and $z_o = (Y_o \hat{x}_o^{-1})' i$. When IO&SAM finds other prices of goods p in the price column it computes the value added deflator π by double deflation as $\pi' = \{p' [I - A]\} (\hat{z}_o^{-1})$.

INPUT-OUTPUT MODELS

The user must Click PRICES in the PROJECTIONS frame of the IO&SAM window and the ALL PRICES option on the price model's model specification window to obtain product price projections and value added deflators by double deflation.

The exogenous prices list box in the model specification window allows only one Click on one price column. This column can contain both product and factor prices. Positive factor prices are mandatory in a price model. Product prices are optional. No value added deflators are computed when all product prices are zero.

MORE ASSUMPTIONS

Goods and factors are homogeneous. Any good fetches the same price in all its intermediate and final uses. Any factor fetches the same price in all employments. A price is constant everywhere along an input-output matrix row. Thus it is recommended that input-output transactions be valued at *basic prices* exclusive of indirect taxes and distribution margins.[2] Failing that, it is recommended that input-output transactions be valued at *producers' prices* exclusive of transport and trade margins. Valuation at *purchasers' prices* is to be discouraged because they are apt to vary along a row depending on the margins that are included in the column.

The homogeneity assumption can be maintained by disaggregating goods and factors that do not fetch a constant price in all uses. If there is a fixed wage differential between rural and urban labor, then disaggregate the labor row into rural and urban labor rows.

MARKUP-PRICING

Product prices cannot be found unless there is at least one primary factor that has an exogenous price. However, other factors need not be priced. They can be rewarded with the proceeds of mark-up pricing. A particularly interesting case is that of indirect taxes.

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[2] United Nations System of National Accounts, 1993, paragraph 15.127.

Suppose a good is sold at cost plus 11 per cent. If the cost is 90 cents, the marked-up price is $1.00. The 10 cent mark-up can be determined by a 0.10 value added coefficient and by the $1.00 price. Thus the effect on price of an 11 per cent sales tax can be modeled by a 0.10 indirect tax coefficient and by valuation of the tax "input" at the cum-tax product price. The value of the tax input varies across activity columns depending on the change in the gross output price. The tax input does not have a homogeneous, exogenous price. The user can indicate this situation by entering a price of zero in the indirect tax row. When IO&SAM detects that zero, it solves for product prices using the formula

$$p' \, [\, I - A - \hat{t} \,] = z'$$

where t is a vector of indirect tax coefficients.

Most other primary factor inputs can be treated in the same way, interpreting the value added coefficient as a mark-up factor and setting a zero price in the corresponding row and in the price column to the right of the final demands on file.

PRICE CONTROLS

One or more of n product prices can be exogenous or controlled. If only the j-th price is controlled, IO&SAM can solve for the remaining $n - 1$ endogenous product prices if row j was moved down into the value added section of the data table and if column j was moved into the final demand section of the table. More products can be treated in this way but there should always be at least 2 endogenous product prices left.

INPUT-OUTPUT MODELS

MULTIPLIERS

The inverse of [I–A] is a matrix of output determination multipliers. Its transpose is the matrix of price model multipliers. The value of an output multiplier m_{ij} is the output of the *i*-th activity that is required, directly and indirectly, to satisfy the demand for one unit of good *j*. It is also the impact on the *i*-th activity of a one unit change in the demand for good *j*. In the price model, the multiplier m_{ij} is the impact on the price of good *i* of a one unit change in the unit factor cost of product *j*.

IO&SAM does not normally compute inverse matrices to solve simultaneous equations. Inverses are computed and saved on file by special request. The request is made by putting a check-mark in the INVERSE frame of the IO&SAM window. The inverse is then the only output produced.

LEAKAGES

Final demands are injections into a circular flow of income. Value added is the leakage from the flow. Multipliers are finite because there are leakages.

Besides leakages from the circular flow of income there can also be leakages from a final demand shock. These other leakages appear as negative final demands, most notably imports in tables where imports are carried in the final demand wing. Changes in stocks, sales by government, and sales of scrap by households and industry can result in negative cells in the final demand columns for inventory change, government consumption, personal consumption, and gross fixed capital formation. More negative final demands can appear as columns of import duties and of other indirect taxes on imports.

Negative final demands are supplies of goods and services not attributed to current production. Focus on imports to further understand their meaning. If imports need to be deducted in a final demand column, it is because imports are included in all intermediate and final uses of goods. No distinction is made between the use of imported and domestic products. Both products are regarded as perfect substitutes and have one and the same price. Imports are *competitive*.

An alternative way of presenting the assumption of competitive imports is to transpose the imports column after changing its sign. The column disappears. The numbers in the column reappear as a row of positive imports inside the value added section of the input-output table. In this way one maintains the commodity balance illustrated in Figure 1.

The two methods for presenting imports in the table have consequences for the interpretation of a final demand shock. In the first case (imports in a negative numbers column) one assumes that the final demand is a demand for domestic products only with no leakage into imports. In the second case (positive imports row) one assumes that the exogenous shock is a demand for competing products with some leakage into imports. The multipliers are smaller in this second case. IO&SAM will follow the second approach when the user selects YES in the LEAKAGES frame.

When running a model with yes to leakages, **all** negative final demands are transposed into value added rows and changed in sign. All remaining final demands are positive. In a price model, the factor price of the transposed supply is the corresponding final demand deflator. The user can file final demand deflators in a row below the gross output row. If the deflator is zero or absent then the value added by final demand is valued at the price of its product, as in mark-up pricing.

There is still another way of treating imports and other negative final demands discussed in the DATA TRANSFORMATIONS chapter.

SOCIAL ACCOUNTING MODELS

A social accounting matrix (SAM) is a matrix representation of the national accounts.[3] It differs from the national accounts by its disaggregation of households. The SAMs of many countries differ also from the countries' national accounts by their construction with data not found in the corresponding national accounts, mainly because the national accounts are incomplete. A SAM differs from an input-output table by inclusion of accounts necessary to make a completely symmetric table that shows how value added is spent in final demand.

The IO&SAM user can project SAM activities and prices. The prices computed with a SAM price model can be interpreted as deflators appropriate for the corresponding activities. In the case of production activities, the deflators are like product prices. Household expenditure deflators are like broad cost of living indices specific to households. They go beyond a consumer price index by giving weight to transfers and taxes paid by households.

The SAM data file can have a row and column of totals and it can have columns of exogenous activity levels and exogenous prices to the right of the table. The user of such a table needs to specify in a SAM specification window (1) the last account on file (last before the row and column of totals), (2) the exogenous accounts, and (3) the columns holding exogenous outlays or exogenous prices.

Exogenous accounts are selected in a list box with Click and Ctrl-Click. Any number of accounts can be selected, so long as two or more accounts remain endogenous. For a practice activity projection, use file KENYA_76.WK1. (1) Click on Rest of World to select the last account on file, (2) click on Urban Middle to select an exogenous account, and (3) Click on Urban Middle to select a column of exogenous expenditure. The projected endogenous account levels will then be equal to the corresponding totals on file.

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[3] On the matrix representation of the national accounts, see United Nations System of National Accounts, 1993, chapter 2, Annex C.

For a practice price projection, use file KENYA_76.WK1 again. (1) Click on Rest of World to select the last account, (2) click on Unskilled Worker and Shift-Click on Depreciation to select primary factors accounts as exogenous, (3) Click on Price1 and Ctrl-Click on Price2 to select the columns of exogenous factor prices. Then Click OK and inspect the account deflators in the RESULTS window.

LEAKAGES

Some SAM cells can be negative. Negative values can be a source of trouble. If found in endogenous account columns, they can make the account total negative or zero. A negative total is difficult to interpret. A zero total causes a division by zero error when computing technical coefficients. Problems can be avoided by selecting YES in the LEAKAGES frame. Any negative element in an *i*-th row, *j*-th column is then set equal to zero and balance is restored by adding its absolute value to the element in the *j*-th row and *i*-th column. The coefficient matrix will then be semipositive and likely to have an inverse.

RESIDUALS

One often encounters unbalanced tables. These are tables where the column of row sums is not identical to the transpose of the row of column sums. Small imbalances can be a cause of large projection errors. Exact projections are obtained by adding a residuals account. Check-mark RESIDUALS in the model specification window to make IO&SAM compute and use the residuals.

SOCIAL ACCOUNTING MODELS

MULTIPLIERS

Endogenous accounts can be classified as belonging to various sub-systems such as Wants, Primary Distribution, Secondary Distribution, Production, Capital, etc. Multiplier effects can be thought of as originating in a sub-system and terminating in the same or in some other sub-system and, if terminating in the same, as getting there directly or indirectly, i.e. through other sub-systems.[4]

Thus a matrix M of total multipliers can be expressed as

$$M = M_3 \times M_2 \times M_1$$

where

- M_1 a matrix of direct effects or Leontief multipliers or of effects of a circular flow within a sub-system
- M_2 a matrix of feed-back or indirect effects
- M_3 a matrix of open-loop or cross effects ending in other sub-systems.

Total multipliers can also be expressed in terms of additive effects:[5]

$$M = I + A_1 + A_2 + A_3$$

When the user checks MULTIPLIERS ONLY in the IO&SAM window then the SAM model specification requires the selection of sub-systems by clicking on the first account in each sub-system. This selection is made in a list box. If the user clicks only one account then the whole SAM is treated as one big sub-system and only total multipliers M are computed.

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[4] See Graham Pyatt and Jeffery I. Round, *Accounting and Fixed-Price Multipliers in a Social Accounting Matrix Framework*, **Social Accounting Matrices: A Basis for Planning**, The World Bank, 1985, chapter 9.

[5] See Sir Richard Stone, *The Disaggregation of the Household Sector in the National Accounts*, **Social Accounting Matrices: A Basis for Planning**, The World Bank, 1985, ch. 8.

SOCIAL ACCOUNTING MODELS

Total multipliers are saved on disk with the file name specified in the OUTPUT TO frame of the IO&SAM window. All other multiplier matrices are saved with file names M1.*, M2.*, M3.*, A1.*, A2.* and A3.*, where the * stands for the name extension corresponding to the output file format chosen in the OUTPUT TO frame (text or WK1). Moreover, all multiplier files are stored in the same folder as the total multipliers. The user should have in that folder no other files with the same names.

The computations made by IO&SAM are the following: First the coefficients in a matrix A are copied to two matrices B and C such that

B contains only the coefficients in block-diagonal partitions, one for each sub-system

C contains all other coefficients

Then $M = (I - A)^{-1}$

$$M_1 = (I - B)^{-1}$$

$$M_2 = \{ I - [(I - B)^{-1} C \; (I - B)^{-1} C \; (I - B)^{-1} C]\}^{-1}$$

$$M_3 = I + (I - B)^{-1} C + (I - B)^{-1} C \; (I - B)^{-1} C$$

$$A_1 = M_1 - I$$

$$A_2 = (M_2 - I) M_1$$

$$A_3 = (M_3 - I) M_2 M_1$$

Replicate Stone's results in a practice run. Use file UK_68SAM.WK1 for input, select Multipliers, select Unidentified Items as the last account, select exogenous accounts with a Click on Sales by final buyers and Shift-Click on Unidentified items, and use Click and Ctrl-Click to mark the beginnings of each of three sub-systems at Income from Employment, Wages & Salaries, and Food. Click OK and compare the results with Stone's tables 8.3 to 8.9.

DATA TRANSFORMATIONS

This chapter is about modules accessed from the DATA menu in the IO&SAM window.

FINAL DEMAND LEAKAGE

This section does not apply if the user does not have an input-output matrix with negative imports columns or if the user has an input-output matrix consisting of separate domestic and imported products matrices.

Imports and other negative final demand items can be viewed as perfect substitutes for current domestic production or as non-competing products. The perfect substitutes or competing products assumption is implemented by selecting the LEAKAGES option for input-output models. Application of the non-competing products assumption requires creation of a matrix of domestic product flows. Select final demand leakage to create such a matrix.

Creation of a matrix of domestic product flows requires more information than most other modeling tasks. The user has to select

The exports column
The re-exports column
The imports column
The import duty column
The column for other indirect tax on imports
The indirect tax row

and the user must enter the (non-negative) amounts of

import duty revenue
revenue from other indirect taxes on imports.

Items shown **bold** are mandatory. Other items are optional as they are not available in all input-output matrices. When all selections are made, IO&SAM transforms columns of negative final demands into alternative rows of positive sales by final demand. Sales by final demand are disaggregated from intermediate and final consumption of composite goods, i.e. of goods supplied by current domestic production and by final demand (e.g. current imports or past domestic production carried over as inventories or scrapped).

The disaggregation is made by assuming, for each good, the share of sales by final demand is the same in all uses of the good. For example, if steel imports amounted to 10 per cent of the total, domestic uses of steel, then the steel row is reduced by 10 per cent and the amount deducted is added to a new imports row in the value added section.

Domestic use is defined as all intermediate use plus all positive final demand. However, exports and re-exports are excluded from the domestic use of imports.

The results show imports and other sales by final demand in value added rows and in the final demand wing of the new input-output table. Final demands in value added rows are completely exogenous. An exogenous expenditure shock is interpreted as an expenditure on domestic products.

Use file GERMAN84.WK1 for a practice run.

PRODUCTION TECHNOLOGY

Input-output analysis assumes constant technical coefficients in square and symmetric tables. The tables can be commodity × commodity or industry × industry. The construction of such tables can be based on a rectangular, commodity × industry system of accounts. The rectangular system makes it possible to account for production of various commodities by any industry, and to account for the production of the same commodity by several industries. Production technology can then be said to be specific to the commodity (commodity based) or to the industry (industry based).

Select PRODUCTION TECHNOLOGY from the DATA menu to create symmetric accounts using rectangular accounts. The PRODUCTION TECHNOLOGY window allows the input of two files, Make and Use, the selection of the symmetric table dimensions, commodity × commodity or industry × industry, and the selection of the technology assumption, industry-based or commodity-based.

DATA TRANSFORMATIONS

The data record the use of commodities and primary factors in industrial activities and in final demand, and they record the supply of commodities by industries. There are thus two tables, a Use table that records the flow of commodities and factors to intermediate and final use, and a Make table that records the supply of commodities. The Make and Use tables can be arranged as in Figure 2.

Figure 2: The Make and Use Tables in the Input-Output System

	Commodities	Industries	F.D.	Total
Commodities	0	Intermediate Use	Final Use	q
Industries	Make	0	0	g
Final Demand	0	Value Added		Yi
Total	q′	g′	i′E	

Let
- q — a vector of m commodity outputs
- g — a vector of n industry outputs
- V — the n by m Make matrix
- U — the m by n Use matrix
- E — the final demand for commodities matrix

DATA TRANSFORMATIONS

Assume industry-based technology, or that all commodities produced by an industry are produced with the same technology; commodities produced by different industries are produced with different technologies; and define a matrix of industry shares in commodity markets, the

market shares matrix $D = V(\hat{q}^{-1})$

or assume commodity-based technology, i.e. that every commodity is produced by the same technology and the technical coefficients of an industry depend on the commodities produced by the industry. Then define a

commodity-mix matrix $C = V'(\hat{g}^{-1})$

and technical coefficients $B = U(\hat{g}^{-1})$.

Symmetric matrices computed by IO&SAM are shown in Table 5.[6]

Table 5: Symmetric Matrices Computed from Make and Use Tables		
Assumption\Dim.	Comm. × Comm.	Industry × Industry
Industry Technology	$BD\hat{q}$	$D(U + E)$
Commodity Techn.	$BC^{-1}\hat{q}$	$C^{-1}(U + E)$

The user provides the names of the Make and Use matrices, selects the assumption and dimensions, and selects commodities, industries, final demands and value added in a Use matrix specification window. The Use matrix must include all final demand columns and value added rows. Commodity technology cannot be assumed unless V and C are square.[7] For practice runs, use files MAKE.WK1 and USE.WK1 and replicate results in Miller and Blair, chapter 5, section 3.

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[6] Following Ronald E. Miller and Peter D. Blair, **Input-Output Analysis: Foundations and Extensions**, Englewood Cliffs, New Jersey: Prentice-Hall, 1985, chapter 5.

[7] A SAM with Make and Use sub-systems assumes industry technology. Figure 1 would represent a primitive version of such a SAM if there was only one value added row and only one final demand column.

DATA TRANSFORMATIONS

UNBALANCED MAKE AND USE TABLES

The data in Figure 2 may fail to balance. In such a case one should not attempt to construct symmetric tables. The best approach is to add a column of residuals between the final demand and total columns and a row of residuals between the value added and total rows. Then compute residuals that balance the table. Use control totals when available. Otherwise assume that the *j*-th control total is max(q_j , g_j). Then use the modified data for input to a standard input-output model selecting all industries and commodities as endogenous sectors.[8]

INDUSTRY BY COMMODITY AND COMMODITY BY INDUSTRY REQUIREMENTS

Industry-based industry ×commodity and commodity × industry multipliers can be obtained by using a matrix such as that in Figure 2 for input to a regular input-output model and selecting MULTIPLIERS ONLY.

MIXED TECHNOLOGY ASSUMPTIONS

It may be appropriate to represent some commodities/industries as using commodity-based technology and others as using industry-based technology. In that case, select V_1 and V_2 such that

$$V = V_1 + V_2$$

V_1 holds elements for which the commodity technology assumption is appropriate. V_2 holds the elements of V for which the industry technology assumption is valid. Even individual elements of V could be divided between V_1 and V_2. Using the two matrices as inputs, IO&SAM computes a mixed technology matrix that can be used to construct symmetric tables as if the industry-technology assumption were valid throughout. Let the output of the mixed technology routines replace the original Make data. If V is square, IO&SAM applies the traditional method for construction of the mixed technology matrix. Otherwise, the alternative method is applied.

[8] See Sylvester Damus, *On Input-Output Analyses with Incomplete Data*, **Canadian Journal of Regional Science**, XVI:1 (Spring 1993), 115-22.

Let $g_1 = V_1 i = C_1^{-1} q_1$

$g_2 = V_2 i = D_2\, q$

and $\langle D_2' i \rangle$ is a diagonal matrix formed from the vector $D_2' i$.

Then the traditional mixed technology make matrix, computable when V is square, is

$$T = \{ C_1^{-1} [I - \langle D_2' i \rangle] + D_2 \} \hat{q} .$$

Now let $q_1 = V_1' i = C_1 g$

$g_2 = V_2 i = D_2\, q_2$

then the alternative mixed technology make matrix, computable when V is not square, is

$$A = [(I + D_2 C_1 - \langle C_1' i \rangle)^{-1} D_2] \hat{q} .$$

For practice runs use files TRAD_V1.WK1 and TRAD_V2.WK1 to compute T and files ALT_V1.WK1 and ALT_V2.WK1 to compute A. The computations replicate results in Miller and Blair, Appendix 5-1.

Matrices V_1 and V_2 can be filed with or without total industry output in the last column and total commodity output in the last row. IO&SAM needs to know whether or not the totals are present in the files. They are in the sample files.

DATA TRANSFORMATIONS

RAS ADJUSTMENT

Suppose one had an out-of-date matrix A that is $n \times m$ and where the row sums are $Ai = r$ and the column sums are $i'A = s'$. Suppose also that one knows that the updated values of an unavailable matrix B would be such that

$$Bi = v \; ; \qquad i' B = w' \; ; \qquad \text{and} \qquad i' v = w' i \qquad (1).$$

Then create a WK1 or TXT file where all or most $b_{ij} = 0$ but row $n + 1$ equals w' and column $m + 1$ equals v.

IO&SAM can then be used to read A and B and to estimate the b_{ij} that satisfy (1) given the a_{ij}. The new b_{ij} are such that their deviations from the a_{ij} are minimized.[9] Non-zero elements of *B* are retained after adjustment to the constraints in (1). No new data are created. Missing data ($a_{ij} = 0$) lead to missing results ($b_{ij} = 0$). For the update to converge on a solution, one must have

files of A and B on disk, both $(n + 1)\times(m + 1)$

$a_{ij} \geq 0 \; \forall \; i, j$

$b_{ij} \geq 0 \; \forall \; i, j$

$r_i \geq 0 \; \forall \; i$

$s_j \geq 0 \; \forall \; j$

$v_i \geq 0 \; \forall \; i$

$w_j \geq 0 \; \forall \; j$

Use files A.WK1 and B.WK1 for a practice run.

The RAS method should not be used to balance a table because, contrary to assumption, control totals v and w are unknown in that case. Also, imbalances due to missing data are *not* corrected.

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[9] Michael Bacharach, **Biproportional Matrices and Input-Output Change**, Cambridge University Press, 1970.

DATA TRANSFORMATIONS

COMPUTE COEFFICIENTS

Use this menu option to convert a matrix from levels to coefficients. Input a matrix U where $g' = i'U$ to obtain as output a new matrix $A = U\hat{g}^{-1}$. The input file should hold no totals and/or sub-totals. For a practice run, use file LEONTIEF.WK1, a 12× 12 extract of transactions in intermediate inputs from GERMAN84.WK1.

[I-A]

Use this menu option to create a Leontief matrix to process models and files other than those offered or expected by IO&SAM. Input a matrix U where $g' = i'U$ to obtain as output a new matrix $L = I - U\hat{g}^{-1}$. The input file should hold no totals and/or sub-totals. For a practice run, use file LEONTIEF.WK1, a 12 × 12 extract of transactions in intermediate inputs from GERMAN84.WK1.

BALANCE INPUT-OUTPUT TABLES

An input-output table is balanced in the sense that aggregate final demand equals aggregate value added. However, it is unbalanced in the sense that no value added row sum equals any final demand column sum. The data can thus be balanced by aggregating all value added and final demand categories. The user can also choose to preserve all details on file so that data illustrated in Figure 1 are transformed to look as in Figure 3. Similarly, the Make-Use accounts of Figure 2 can be balanced as in Figure 4. One can then project either commodity and industry outputs or commodity and industry prices in one single operation that assumes industry technology.

To balance a table, IO&SAM inserts a column for every factor, a row for every final demand, one column for all institutions (households, corporations, government), and one row for all institutions. Factor payments to institutions constitute the *primary distribution of income* recorded in the row vector y'. Institutional outlays on final demand constitute the *allocation of primary income* recorded in the column vector e. The new input-output table can be used like a primitive SAM. The user can develop it towards a true SAM by manually disaggregating the institutions account. And place imports and exports in a rest-of-the-world row and column.

Figure 3: Balanced Input-Output Data

	Production Activities	Factors	Institutions	Final Demands	Total
Goods	U			E	x
Factors	Y				Yi
Institutions		y'			$y'i$
Final Demands			e		ei
Total	x'	y'	$i'e$	$i'E$	

Figure 4: Balanced Make and Use Tables

	Commodities	Industries	Factors	Institutions	F.D.	Total
Commodities		Intermediate Use			Final Use	q
Industries	Make					g
Factors		Value Added				Y*i*
Institutions			y′			y*i*
Final Demand				e		e
Total	q′	g′	y′	*i*′ e	*i* ′E	

PRODUCTIVITY CHANGE

This chapter follows Wolff and, wherever possible, uses his notation.[10] The productivity module computes:

- traditional measures of multi-factor productivity change as the difference between the rate of growth of real value added and the weighted rates of growth of primary inputs. This is the *value added measure* based on gross product originating;
- *sectoral measures* of multi-factor productivity change defined as the decline in direct input requirements per unit of sectoral gross output;
- *inter-industry* rates of multi-factor productivity growth that measure the decline in total, direct and indirect factor requirements per unit of final demand on a sector.

To facilitate the interpretation of the results, the productivity module computes also the rates of growth in the productivity of each primary factor and the *price changes* associated with total factor productivity growth.

To facilitate analysis of changes in aggregate rates of productivity growth, the productivity module saves key intermediate results in worksheet files.

NOTATION AND FORMULAE

The data are found in suitably augmented input-output tables. The tables contain:

U a square and symmetric matrix of real, inter-industry, intermediate input flows;

q' a row vector of real gross output;

v' a row vector of real value added;

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[10] Edward N. Wolff, *Industrial Composition, Interindustry Effects, and the U.S. Productivity Slowdown*, **Review of Economics and Statistics**, LXVII(1985), 268-77.

Thijs ten Raa and Edward N. Wolff, *Secondary products and the measurement of productivity growth*, **Regional Science and Urban Economics**, 12(1991), 581-615.

Edward N. Wolff, *Productivity measurement within an input-output framework*, **Regional Science and Urban Economics,** 24(1994), 75-92.

y	a column vector of final demands;
N	a factors -by-activities matrix of physical primary inputs such as man-years of labor and dollars of real capital stock;
w	a column vector of nominal primary input prices.

The data have superscripts 0 and 1 to indicate an initial and a final year. A prime (′) denotes transposition, a caret (^) denotes diagonalization, and *i* is a unit vector of appropriate length.

A Tornqvist-Divisia index of total factor productivity change in sector *i* is[11]

$\pi_i^* = \mathrm{dlog} v_i - \Sigma_k \alpha_{ik}^*(\mathrm{dlog}\ n_{ik})$; i = 1,...,sectors; k = 1,...,factors

where $\alpha^* = ½[(\hat{p}^0)^{-1}(\hat{v}^0)^{-1}N^0\hat{w}^0 + (\hat{p}^1)^{-1}(\hat{v}^1)^{-1}N^1\hat{w}^1]$ is a matrix of average factor shares. Every n_{ik} is weighted by its average share in value added at current prices. The aggregate rate of productivity change is a weighted average of the sectoral rates. The weights are sectoral shares in value added at current prices evaluated at nominal factor prices on file.

The sectoral measure of total factor productivity growth is[12]

$$\pi_i = -\Sigma_j \alpha_{ji}(\mathrm{dlog}\ a_{ji}) - \Sigma_k \alpha_{ik}(\mathrm{dlog}\ \ell_{ik}) ; \quad j = 1,...,\text{sectors}$$

where $A = U\hat{q}^{-1}$ is a matrix of intermediate input coefficients;
and $L = N\hat{q}^{-1}$ is a matrix of primary input coefficients.
The weights α are relative input prices, either p_j/p_i or w/p_i times the corresponding input coefficient and averaged over periods 0 and 1.

Sectoral rates of multi-factor productivity growth are aggregated by giving each sector's productivity growth rate a weight equal to the sector's share in final demand. Thus, the aggregate rate of productivity growth is[13]

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[11] Wolff (1994), page 78, equation (2′)

[12] Wolff (1994), page 77, equation (2)

[13] Wolff (1994), page 82, equation (14)

$$\rho = \pi S \beta$$

where $\beta = \hat{p}y/(py)$; $\beta' i = 1$
and $S = \hat{p}\,(I\text{–}A)^{-1}\,\hat{p}^{-1.}$

The unweighted average of π is less than the unweighted average of π^* by a factor that depends on the ratio of value added to gross output. The value of ρ differs from the weighted average of π^* because of differences in weights. π^* is weighted by value added; π is weighted by final demands. Because of imports, withdrawals from inventory, and other sales by final demand, some final demand weights can be negative.

The evaluation of π can be tricky. Many $\log(a_{ji})$ are undefined because many a_{ji} are zero. Thus it may be easier to evaluate π as a function of the next measure of multi-factor productivity change.

The *inter-industry measure* of total factor productivity change is[14]

$$\hat{\pi}_i = -\Sigma_k\, w\, d\lambda_{jk} / p_j$$

where λ is a matrix of direct and indirect factor requirements to produce a unit vector of final demand, so that

$$(I\text{–}A')\lambda = \hat{q}^{-1}N$$

Weighting by final demand, the aggregate rate of inter-industry productivity growth is

$$\hat{\rho} = \pi\beta = \rho$$

whence the sectoral rates are $\pi = \hat{\pi}' S^{-1}$.

[14] Wolff (1994), page 86, equation (18)

PRODUCTIVITY CHANGE

PRODUCT PRICES

The measurement of productivity change requires product prices p. The initial, final, and average prices are computed by IO&SAM as the solution for the input-output price model

$$(I - A')p = \hat{q}^{-1}N\hat{w}i$$

Comparing this last equation with the formula for inter-industry productivity change, one sees that the solution for $\hat{\pi}$ is a solution for price changes when factor costs are measured not in dollars but in real primary factors per unit of output. Thus $\hat{\pi}$ is the measure of productivity change most useful in the explanation of relative price change.

DATA REQUIREMENTS

The user supplies two input-output tables in files on disk:

- the table of real flows in the initial year, and
- the table of real flows in the final year.

The latter is different from the table of nominal flows in the final year. Initial real flows are identical to initial nominal flows if the initial year is the base year for price deflation. The flow tables must be symmetric, either industry-by-industry or commodity-by-commodity.

The two tables must be augmented by

- rows of primary factor inputs such as employment (in man-years or hours) and real capital stock (adjusted for capacity utilization or not). These rows must be placed below the gross output row; and

- a column of factor prices that is zero in most rows and has positive values in the bottom primary factor rows. This column must be placed to the right of the total use column.

The data and model specification may be regarded as sound if the base year's weighted average of gross-output prices is unity, that is if $(p^0)'\beta = 1$.

PRODUCTIVITY CHANGE

MODEL SPECIFICATION

The average base year product price of 1.0 cannot be obtained unless the sum of input coefficients equals 1.0 in every sector. The column sum of input coefficients is less than 1.0 if some inputs are omitted. Therefore, indirect taxes, sales by final demand, and other non-produced inputs such as non-competing imports may have to be included in the list of primary factors besides labor and capital.

Base year prices of inputs additional to the usual list of intermediate and primary inputs are equal to unity. In other years, initial or final, their prices can be taken to be ratios of total nominal flows over total real flows.

One can treat the depreciation of capital as an intermediate input produced by an investment sector to measure change in the productivity of factors employed in production of net domestic product. All gross investment can be regarded as an intermediate input produced by the investment sector to get the productivity of factors employed for consumption and net exports. After omission of capital from the list of primary inputs, these alternatives become Wolff's *Marxian* and *Peterson-Harrod* models. In either case, the investment sector employs neither labor nor capital, but it does consume non-competing imports and pays indirect taxes. See Wolff again for a treatment of non-competing imports.

Cas and Rymes treat indirect taxes as value added by a primary factor that is supplied by government.[15] Indirect taxes can be omitted completely if both intermediate and final demands are valued at basic prices.

Cas and Rymes suggested also "the possibility of closing the model to foreign trade, government and the household sectors by treating them as input-output industries. In so doing, the model will be completely closed to the world economy in the input-output sense."[16]

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[15] Alexandra Cas and Thomas K. Rymes, **On Concepts and Measures of Multi-factor productivity in Canada, 1961-80**, Cambridge University Press, 1991, page 108.

[16] Page 119, fn. 12.

Model closure alternatives are best implemented in a social accounting framework. Use the FINAL DEMAND LEAKAGE module to create a matrix with no negative final demands. Then balance the table to create a primitive SAM.

When balancing the tables one can retain the Make and Use accounting framework. With tables such as those in Figure 4, IO&SAM will compute[17]

π^*	for all industries
$\hat{\pi}$, p^0, p^1	for all industries and all commodities.

Include residuals in the list of activities whenever they are required to balance the Make and Use tables.[18] See page 54 on why π is not computed.

FACTOR PRICES

IO&SAM assumes homogeneous, mobile factors that fetch the same price in all their uses. There is only one factor price all along a factor employment row. For this reason, $p^0 \neq i$, even in the base year. Base year prices can deviate from unity in an absolute and in a relative sense.

Absolute deviations are indicated by $(p^0)' \beta \neq 1$ and result by omission of primary factors.

Relative deviations mean $p^0 \neq i$. They indicate that the assumption of factor homogeneity may be inappropriate. The assumption can be relaxed. For example, the prices of farm products exceed 1.0 when farm labor is valued at an economy-wide average wage. The prices computed for high-wage industries are below 1.0. Such deviations from $p = i$ can be reduced by disaggregating the employment row to distinguish between farm and non-farm labor.

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[17] Assuming industry technology and accepting the biases shown by ten Raa and Wolff (1991) to follow from that assumption.

[18] Residuals are computed by the BALANCE INPUT-OUTPUT TABLES module and recorded in an additional row and column whenever the data are unbalanced in the statistical sense.

PRODUCTIVITY CHANGE

The condition $p^0 = i$ can be met by measuring primary inputs in efficiency units. For example, instead of measuring the employment of labor by an industrial census number, use the number obtained by dividing nominal value added by labor by the average wage. The average wage is the nominal value of aggregate labor income divided by census employment.

DECOMPOSITION ANALYSIS

Three input-output tables can be used to compute ρ over two time periods. The change in ρ can be related to changes in S and β. The change in $\hat{\rho}$ can be related to changes in p and β.[19] The productivity change module allows a "save all details" option. When this option is chosen, IO&SAM saves on disk a file with the matrix $|S^{-1}|\beta|$. The product price vectors are displayed and saved in every case.

[19] See Wolff (1985), 272-4, and Wolff (1994), 82-4 and 87-9.

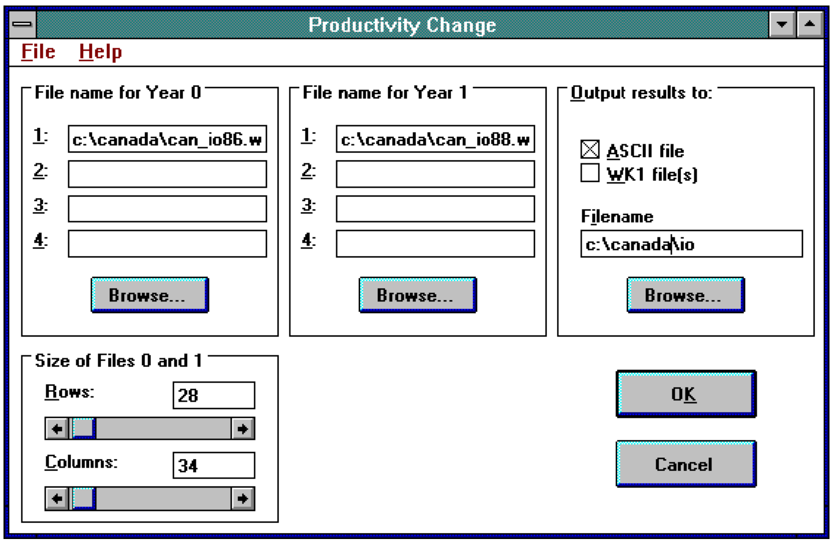
PRODUCTIVITY CHANGE

A PRACTICE RUN
A practice run can be made using the 1986 and 1988 input-output tables of Canada.[20] The sample files for such a practice run are

CAN_IO86.WK1	industry by industry, at base year prices;
CAN_IO88.WK1	industry by industry, at 1986 prices.

Both files are in the CANADA sub-folder and include labor and capital input data, as well as primary factor prices.

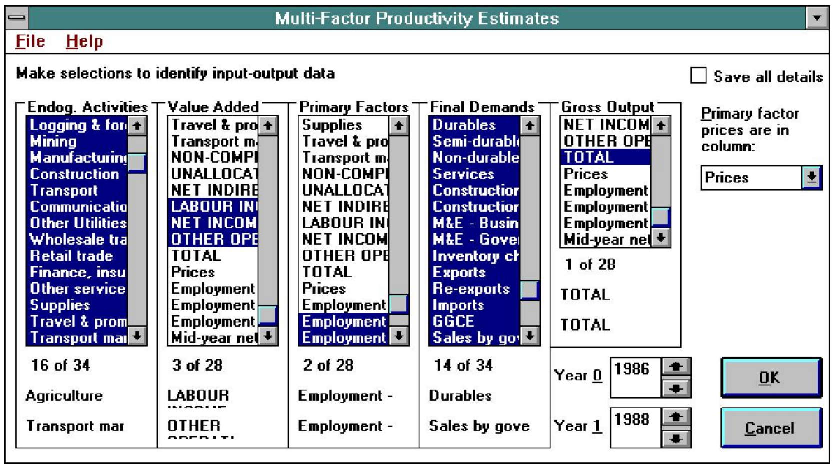
Choose PRODUCTIVITY CHANGE from the DATA menu.



[20] Statistics Canada, System of National Accounts, *The Input-Output Structure of the Canadian Economy, 1986* and *The Input-Output Structure of the Canadian Economy, 1988,* catalogue number 15–201–XPB.

PRODUCTIVITY CHANGE

Fill text boxes to read the two files, each with 28 rows and 34 columns and enter a path and filename for the output. Then click OK or press ENTER.
The next illustration shows the productivity model specification:



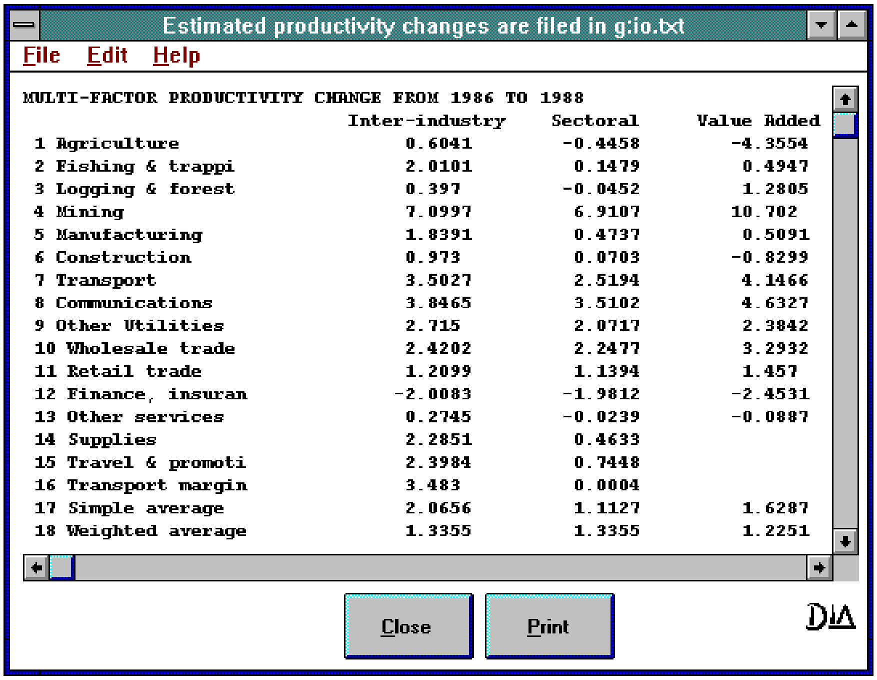
Use Click and Shift-Click to select

Endogenous activities	from Agriculture to Transport Margins
Value added	from Labour Income to Other Operating Surplus
Primary factors	Employment - Total Man-years and Mid-year Net Capital Stock
Final demands	from Durables to Sales by Government
Gross output	the TOTAL row
The primary factor price column	Prices

Set Year 0 to 1986 an Year 1 to 1988. Click SAVE ALL DETAILS if matrix S^{-1} and vector β are required for decomposition of a change in an aggregate productivity growth rate.

PRODUCTIVITY CHANGE

Then click OK or press ENTER and wait for the results:



MULTI-FACTOR PRODUCTIVITY CHANGE FROM 1986 TO 1988

		Inter-industry	Sectoral	Value Added
1	Agriculture	0.6041	-0.4458	-4.3554
2	Fishing & trappi	2.0101	0.1479	0.4947
3	Logging & forest	0.397	-0.0452	1.2805
4	Mining	7.0997	6.9107	10.702
5	Manufacturing	1.8391	0.4737	0.5091
6	Construction	0.973	0.0703	-0.8299
7	Transport	3.5027	2.5194	4.1466
8	Communications	3.8465	3.5102	4.6327
9	Other Utilities	2.715	2.0717	2.3842
10	Wholesale trade	2.4202	2.2477	3.2932
11	Retail trade	1.2099	1.1394	1.457
12	Finance, insuran	-2.0083	-1.9812	-2.4531
13	Other services	0.2745	-0.0239	-0.0887
14	Supplies	2.2851	0.4633	
15	Travel & promoti	2.3984	0.7448	
16	Transport margin	3.483	0.0004	
17	Simple average	2.0656	1.1127	1.6287
18	Weighted average	1.3355	1.3355	1.2251

The gap in the third column is there because sectors 14, 15 and 16 are *dummy industries* that do not employ primary factors. Thus they have no direct factor cost but the indirect factor cost determines a price and the estimate of $\hat{\pi}$.

Scroll down to see the changes in the productivities of labor and capital and the deflators of industrial output used in the computations.

PRODUCTIVITY CHANGE

The practice run was made with a symmetric, industry-by-industry model. The industry-by-industry data were created using Make and Use tables in the PRODUCTION TECHNOLOGY module of IO&SAM.

Make and Use tables can be employed directly in a social accounting framework to get most of the results of input-output productivity analysis. The BALANCE INPUT-OUTPUT TABLES module was used to combine the Make and Use table in files CANSAM86.WK1 and CANSAM88.WK1. These files have 87 rows and 83 columns. Select all commodities and industry products as inputs. Select the TOTALS column as the only final demand. Four additional rows hold primary input data. Select the last two. Using these files for input to the PRODUCTIVITY CHANGE module one gets simultaneous price and productivity change results for both commodity and industry outputs. Results are consistent with and identical to those of the industry-by-industry model but differ in those respects where the differences between a *rectangular* industry×commodity and a *symmetric* industry×industry (or commodity×commodity) model are significant. The differences and similarities are summarized in Table 6.

The main difference is that sectoral productivity rates π are not useful as measures of productivity change in the Make-Use social accounting framework. In fact, the aggregate, weighted average ρ is equal to zero by definition when the market shares matrix is an identity matrix.

A symmetric, commodity×commodity input-output model can be constructed for use in place of the industry×industry model. In that case, commodity prices are identical to those obtained in the rectangular, Make–Use model but industry output deflators become unavailable. Other differences between the commodity×commodity and the Make–Use models follow from the one in prices.

MEASUREMENT BIAS

Unlike π^* and π, $\hat{\pi}$ is invariant to measurement errors in output price deflators. Measurement errors in sector *i* do not affect the estimate of $\hat{\pi}_j$.[21]

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[21] See L. Wesa and H. H. Postner, **Canadian Productivity Growth, An Alternative (Input-Output) Analysis**, Economic Council of Canada: Minister of Supply and Services, 1983, p. 64.

Table 6: Differences and Similarities Between Rectangular and Symmetric Models of Productivity Change

RESULT	SYMMETRIC	RECTANGULAR
Industry gross output deflators	Same in either model	
Commodity prices	not available	available
Average product price	computed over *n* industries weighted by final demand for industry output	computed over *n* industries and *m* commodities weighted by final demand for commodity output
Factor productivity change	by industry and factor only	by factor, by industry, and by commodity
Average of factor productivity change *and* of multi-factor, inter-industry productivity changes	computed over *n* industries weighted by final demand for industry output	computed over *n* industries and *m* commodities weighted by final demand for commodity output
Inter-industry productivity change $\hat{\pi}$	by industry only	same results by industry *plus* results by commodity
Sectoral productivity change π	available	not available
Value added productivity π^*	Results by industry only	Identical results by industry

OTHER MATRIX ALGEBRA

ADD

Adds matrices or vectors after the input of two files. The data in each file must have the same dimensions. Use files LH.WK1 and INVERTME.WK1 for a practice run.

DIAGONALIZE

Creates a diagonal matrix from a row or column vector after the input of a single file. Use RH.WK1 for a practice run.

INVERT

Computes the inverse of a single, square matrix on file.
Use file INVERTME.WK1 for a practice run with an example of an ill-conditioned matrix.[22]

Inversion is done by application of the LU or Crout decomposition method with partial pivoting to solve for X in AX = I. All computations are made in double precision.

MULTIPLY

Computes C = AB after input of the two matrices A and B. Use any conformable matrices such as INVERTME.WK1 and LH.WK1 for a practice run. If A is $n \times m$ and B is $p \times q$ then C is $n \times q$ and m must be equal to p.

RESCALE

After input of any one file, changes the scale of the data on file by one of two methods chosen by clicking on radio buttons:

(1) multiplies all elements by a given constant;
(2) for every row, divides all elements in the row by the largest element in the row.

Use the first method to change units of measurement, for example to convert from £ to ¥. Use the second method to improve the solution of an ill-conditioned system of simultaneous linear equations. Use any matrix on file for a practice run.

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[22] Source: C. F. Gerald and P. O. Wheatley, **Applied Numerical Analysis**, Addison-Wesley, 3rd. ed., 1984, page 118.

OTHER MATRIX ALGEBRA

SOLVE EQUATIONS

Solves AX = B for X after input of [A|B] in a single file. The constants and unknowns can also be vectors as in Ax = b. Select the rescaling option when A is known to be ill-conditioned.

The solution is found by application of the LU or Crout decomposition method with partial pivoting to solve for X or x. All computations are made in double precision.

This method is preferable to the inversion and multiplication approach. This is illustrated with results of three test runs in Table 7.

Table 7: Alternative solutions of ill-conditioned linear systems.

	Invert and multiply	Solve equations	
		No rescaling	Rescaled
X	1.99999999999915	0.99999999999996	0.99999999999999
Y	2.00000000000252	1.99999999999987	1.99999999999997
Z	–1.00000000000015	–1.00000000000006	–1.00000000000001

The true solution is (1.0, 2.0, –1.0)

The files used in the practice runs where LH.WK1(3, 3), its inverse in TEST.TXT(3, 3), RH.WK1(3, 1) for post-multiplication of TEST.TXT, and SOLVE_ME.WK1(3, 4). The latter is identical to [LH | RH] and was shown in Table 1.

SUBTRACT

Subtracts matrices or vectors after the input of two files. The data in each file must have the same dimensions. Use files LH.WK1 and INVERTME.WK1 for a practice run.

TRANSPOSE

Transposes matrices or vectors after the input of a single file. Use file LH.WK1 for a practice run.

OTHER MATRIX ALGEBRA

ROW SUM Ai

Performs the indicated multiplication and saves the product after input of any single file with the data for matrix A. Use any matrix or vector for a practice run.

COLUMN SUM i'A

Performs the indicated multiplication and saves the product after input of any single file with the data for matrix A. Use any matrix or vector for a practice run.

Aê

Performs the indicated multiplication and saves the product after input of a file with the data for matrix A and another file with the data for vector *e*. Use files LH.WK1 and RH.WK1 for a practice run.

êA

Performs the indicated multiplication and saves the product after input of a file with the data for matrix A and another file with the data for vector *e*. Use files RH.WK1 and LH.WK1 for a practice run.

ERROR TOLERANCE

The value of the error tolerance is the convergence criterion for RAS adjustment. Convergence is declared when no row or column sum differs from the corresponding control total by an amount greater than the control amount times the error tolerance. If the error tolerance was 0.001 then all sums are within one per mil of the control amounts.

ERROR MESSAGES

Access to file *FileName* denied

The file has the *Read Only* attribute or it is a *locked* network file.
Determine the reasons for denied access before attempting to correct the problem.

Account Name cannot be both an endogenous production activity and a value added account.

Select endogenous and value added accounts again.

Account Name cannot be a production activity and a real factor input.

Select endogenous accounts and input rows again.

Account Name cannot be both an endogenous production activity and an exogenous final demand.

Select endogenous and exogenous accounts again.

A(*i,j*) is negative. Negative values cannot be RASed.

A one commodity model is not accepted.

Select commodities again.

A one sector model is not accepted.

Select sectors again.

At least one of *n* accounts must be exogenous.

Bad margins. The sum of row control totals is not equal to the sum of column control totals.

The sums differ by proportionally more than the error tolerance. Revise the control totals or the error tolerance. Attempt to RAS again.

Can not mix input files of *.WK1, *.DIF and *.TXT types

Use FILE TRANSLATION first.

Choose output file type

Check-mark an output-file type.

ERROR MESSAGES

Could not open DIACALC.EXE

Find the current location of the file and copy it to the IO&SAM folder, or decompress DIACALC.EX_ on the release disk.

Data are inconsistent with the indicated number of rows (or columns).

Ensure that the correct number appears in the corresponding text box. Click on the OK button or press ENTER again.

Did not converge in *number* of iterations.

Increase the allowed number and try to RAS again.

Enter a column vector.

Cannot multiply a matrix by a vector or by a diagonalized vector unless the vector has a single column.

Enter a row vector.

Cannot multiply a matrix by a vector or by a diagonalized vector unless the vector has a single row.

Enter a vector.

Indicated matrix dimensions instead of vector dimensions.

Enter an output-file name

Enter input-file name(s)

File *FileName* is not a Lotus v. 1.0 or 2.2 file

Switch to LOTUS or other spreadsheet program, open the file and save it again as a WK1 file. Switch back to IO&SAM and try again.

File *FileName* does not exist

ERROR MESSAGES

Gross output cannot be an endogenous activity.
Review your selections. Avoid overlapping.

Gross output cannot be a value added category.
Review your selections. Avoid overlapping.

Gross output cannot be a physical measure of primary input.
Review your selections. Avoid overlapping.

Import tax and duty revenue seem inconsistent with final demand data in the *row stub* row.
Review the data. Select indirect tax rows again. Edit the revenue amounts in the text boxes provided.

Incompatible matrix dimensions.
Matrices to add or subtract must have the same dimensions.

Matrix size error
The matrix is too large for the Spreadsheet program.
The maximum numbers of rows and columns are 1024.

Negative import duty revenue.
Enter at least zero.

Negative revenue from other taxes on imports.
Enter at least zero.

Non-conforming matrices.
If A is $m \times n$ and B is $p \times q$ then C = AB is $m \times q$ and p must be equal to n.

Not enough memory to do the multiplier decomposition.
Will not compute and file M_1, M_2, and M_3 but will compute and file the total multiplier matrix $M = M_3 \times M_2 \times M_1$. Unload unnecessary software and try again.

ERROR MESSAGES

Not enough memory to compute additive multipliers.

Will not compute and file A_1,A_2, and A_3 but will compute and file the total multiplier matrix $M = I+A_1+A_2+A_3$. Unload unnecessary software and try again.

Overlapping, inconsistent selection of primary and produced inputs.

Selected ranges overlap. Select again.

Overlapping, inconsistent selection of industries and final demand columns.

Selected ranges overlap. Select again.

Overlapping, inconsistent selection of sectors and exogenous expenditures.

Selected ranges overlap. Select again.

Overlapping, inconsistent selection of sectors and final demands.

Selected ranges overlap. Select again.

Overlapping, inconsistent selection of sectors and value added rows.

Selected ranges overlap. Select again.

Select a column of exogenous prices.

Select an exogenous expenditure column.

Select commodity rows.

Select final demand columns.

Select industries.

Select industry columns.

Select primary input rows.

Select the column that holds exogenous prices.

Select the exports column.

ERROR MESSAGES

Select the gross output row.

Select the imports column.

Select the primary factor rows.

Select produced input rows.

Select the row where total import duty is recorded.

Select the value added rows.

Set dimensions of a vector.
    There can be only one row or one column, depending on the case.

Singular matrix.

Singular matrix in *year*.
    Input-output measures of productivity change in the selected activities do not exist.

The column that holds input prices must be to the right of the final demand columns.

The duty column cannot be outside the final demand wing.
    Select final demand columns again.

The exports column cannot be outside the final demand wing.
    Select final demand columns again.

The final year must be after the base year
    or after the initial year in a productivity change computation.

The imports column cannot be outside the final demand wing.
    Select final demand columns again.

The import tax column cannot be outside the final demand wing.
    Select final demand columns again.

ERROR MESSAGES

The indirect tax row must be a commodity input or a factor input row.

Select commodities and value added rows again.

The Make matrix is not square. Go ahead under the industry technology assumption?

Cannot apply the commodity technology assumption unless the Make matrix is square because that matrix has to be inverted. Reply with *Yes* or *No*.

The name of *FileName* is invalid

Valid characters are A to Z; 0, 1, ..., 9; ! # $ ^ % ( ) - _ { }~`
Invalid name extensions are: BAT COM DLL EXE SYS

The number of produced inputs is less than the number of producing industries.

The input-output table cannot be balanced.

The path *folder pathname* is invalid

Valid characters are A to Z; 0, 1, ..., 9; ! # $ ^ % ( ) - _ { }~ : /

The problem is too large

There is no room for accounts needed to balance the input-output table. The 1024 column constraint is binding.

The problem is too large for the available memory

Close unnecessary spreadsheets and applications; install more memory. IO&SAM can access up to 64 mega-bytes.

There are no final demand leakages.

The option to recast negative final demands as positive leakages will not be implemented.

There are no primary factor prices on file. There is no price model solution.

The imports column cannot be outside the final demand wing.

Select final demand columns again.

ERROR MESSAGES

There are no industries that produce value added and employ factors in both *year 0* and *year 1*.

Productivity change π^* cannot be estimated.

The re-exports column cannot be outside the final demand wing.

Select final demand columns again.

There is no factor price for *factor name* in *year*.

Select primary factors for which factor prices are on file.

There is no final demand in *year*.

The file for the year has no data in the selected final demand columns.

There is no gross output in *year*.

The file for the indicated year holds no gross-output data.

There are no final demand leakages.

The option to recast negative final demands as positive leakages will not be implemented.

You have not chosen an input-file.

You have not chosen an output-file.

You have not chosen how to re-scale.

Use radio buttons to re-scale the entire matrix by a constant or to rescale each row by the largest element in the row.

You have not selected a factor price column.

You have not selected a gross output row.

You have not selected a total demand column.

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