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# Keskusteluaiheita
# Discussion papers

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A REVIEW OF PC-GIVE: A STATISTICAL PACKAGE FOR ECONOMETRIC MODELLING*

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ABSTRACT: This review considers PC-GIVE which is an interactive, menu-driven econometric modelling package for IBM-compatible personal computers. PC-GIVE is found to be easy to use, powerful and stable. It opens up new possibilities in teaching econometrics and presenting research results.

KEY WORDS: Econometric research, econometrics teaching, model specification, personal computer, statistical computing.

## 1. Introduction

PC-GIVE is a menu-driven econometrics package created by David F. Hendry and available through The Institute of Economics and Statistics, Oxford, UK. The particulars of the package appear in Table 1. PC-GIVE has originated from a mainframe programme called GIVE, and the first PC version appeared in 1984. The version to be reviewed here is PC-GIVE 5.01.

According to the manual of the package, the philosophy underlying PC-GIVE is that "economic time-series data are generated by a process of immense generality and complexity." From this it follows that an econometrician can only try to model the main features of the data generation process related to prior theory. All specified models are only more or less crude approximations to the true data generation process. The principal goal of an econometrician is to find a parsimonious representation of the process still in accord with the data. To reach this goal, the econometrician must be able to check the estimated model in as many ways as possible to reveal its weaknesses. For a thorough discussion of this model building philosophy, see Pagan (1987).

PC-GIVE offers at least three kinds of tools for finding an adequate parsimonious representation for the data generation process. First, a wide variety of tests for checking the validity of any model specification are available. Second, recursive estimation techniques can be applied in order to detect periods during which the model shows signs of weakness. (For a discussion of these techniques, see Ericsson (1988).) Third, very extensive graphical output is available. For instance, the results of recursive estimation are most conveniently summarized with the aid of graphs.

## 2. Documentation and Language

A great improvement in PC-GIVE 5.01 over earlier versions is that the manual now includes a "mini"-econometrics text. It discusses the methodology of PC-GIVE and explains the available estimation and testing procedures. I am already looking forward to the day (which may not be far away) when I can purchase a "real" econometrics text complete with the user's manual of PC-GIVE or equivalent as an appendix and the appropriate diskettes inside the back cover. The present manual is a step in that direction. Purely physically, however, it is still far from this destination. The 350-or-so pages of the manual are contained in a loose-leaf binder. An informal test of letting the binder fall from the desk to the floor gave a disappointing result: the leaves were spread all over the floor. Pages may also easily disappear from the binder in heavy computer lab use. The manual includes a tutorial which is detailed, clear and very useful for a beginner. Some knowledge of DOS is necessary to understand the explanation of how to see and print graphs. The tutorial is preceded by installation instructions. PC-GIVE 5.01 is easy to install, even easier than the earlier versions of the package. The menus of PC-GIVE are largely self-explanatory and the help system sufficient to keep the user going. Reading the whole manual carefully before starting to operate the system is not necessary. On the other hand, all HELP messages of the package are also printed in the manual.

PC-GIVE is written in FORTRAN 77. The source code is not available to the user. A slightly irritating feature in operating the menu-driven system is that returning to the previous menu or to the start of the module is only possible at selected points of the programme. There are

situations in which the user may still have to complete a (long, he feels) loop after realizing that he has already made a mistake rendering all his results worthless. Breaking out of the module altogether is of course possible at almost any time using a DOS command. The system is very stable and will crash only if the user opens an output file or backtracks (respecifies the model) on a full floppy disk.

## 4. The Structure of PC-GIVE

The menu-driven PC-GIVE is started from DOS, and a good way of presenting its structure is through the first menu to appear on the screen. This is shown in Figure 1. The package consists of a set of modules whose names are listed in the picture. Modules NAIVE and DATABANK are not a part of PC-GIVE 5.01; they will be available later.

If the user has not analysed his current data set before with PC-GIVE, the first module he will enter during a PC-GIVE session is GIVA. It is for data input, data description and data storing. TSLS offers single-equation estimation assuming white noise errors, and a wide variety of tests. FIML is for estimating and testing simultaneous-equation systems: VAR models can be handled as a special case. The user may move from one module to the next in any order he likes. The utilities consist of GIVPLOT, VIEWF, DOS and HELP. GIVPLOT allows plotting of graphs saved during a PC-GIVE session. VIEWF makes it possible to view data files. DOS offers an access to DOS without exiting PC-GIVE. HELP contains general information about the system. Some utilities like viewing files and accessing DOS are available inside the econometrics

modules as well. Most submenus have a HELP option of their own offering help on items on that menu. Next I shall discuss these modules in greater detail.

## 5. Operating PC-GIVE I: GIVA and TSLS

GIVA. The user can input his data sets using GIVA. The module allows typing in the data as well as input from ASCII files. In the latter case it is possible to choose a free-format input for data sets with data only and a fixed-format input. The latter is used if the data set also contains non-data items like comments. If the fixed format input is selected, the user has to know enough FORTRAN to write the necessary format statements. I did not encounter any difficulties when trying out the input facilities of PC-GIVE.

The data on PC-GIVE may exist in two types of files, in small files called PC-GIVE files and in usually larger files called databanks. Only the data in PC-GIVE files can be analysed in TSLS or FIML. The files may originally contain up to 40 variables; the maximum length of a time series is 240 observations. A file may grow during the analysis through transformations and other additions but only 40 variables may be stored when the file is saved. The databanks are for storing large amounts of data, up to several thousand series. This kind of work file/storage system is a satisfactory solution only if forming data files from databank series is easy. In PC-GIVE, this is the case. Time series may be selected from a databank by name or dates, but what often makes life easy is the use of a template. Assume the user denotes the logarithm of any variable X by LX and the difference of LX

by DLX. By specifying a template with D in the first and L in the second position, he can automatically select all differenced log-series from the databank into his PC-GIVE file. In fact, PC-GIVE helps the user to be systematic in naming his variables. For instance, if a new variable is formed by taking a logarithm of X, its default name is LX. The default name for differenced LX is DLX.

Transformations are an important part of GIVA. The constant and seasonal dummies may be formed with one command; constructing other dummy variables is another command. The transformation operations are menu-driven; see Figure 2 for the transformations menu. In many applications this is no doubt a convenient solution. However, when I took the tutorial data set of DATAFIT and formed the dependent variables needed to estimate consumption models of Pesaran and Evans (1984), I wished I had been able to type in the transformation equations and execute them as in DATAFIT; see Ericsson (1988). However, PC-GIVE does allow the user to see the intended transformation in equation form on the screen before he executes the command. This enables him to check once more that the transformation involves the right variable(s) and is the one he wants to perform. As indicated above, GIVA includes a possibility to review files. Time series may be graphed, and a definite plus in the graphing option is the flexibility offered in adjusting the data before actually creating the graph on the screen. Converting PC-GIVE files into ASCII files for use elsewhere can be done in GIVA as well.

Some preliminary model specification tools are contained in GIVA. The OLS estimation of an autoregressive model for a single series is available. With two series, an autoregressive-distributed lag (ADL)

model can be estimated, and the system automatically carries out the appropriate Granger Causality test. The ADL option is also very useful in carrying out the (augmented) Dickey-Fuller test.

TSLS. After modifying the data in GIVA the user may continue to either of the two model building modules, TSLS and FIML. The data input has to be from a PC-GIVE file. TSLS is designed with dynamic models in mind. The user formulates his model using a template showing the contents of the PC-GIVE file. The file need not contain lags: the user may indicate the lag length for each of his variables separately, and the system creates the corresponding lags. The redundant intermediate ones, if any, may be omitted from the model before estimation. This is all very practical and easy to use. Any model specification may be saved for later use.

The estimation may be done by OLS, instrumental variables, recursive OLS (RLS) and recursive instrumental variables. The last option is a highly innovative feature which no other econometrics package has. The output of the estimation stage is voluminous including nonstandard items like heteroskedasticity-corrected standard errors. A large number of graphs are available to summarize the information obtained through estimation in general and recursive estimation in particular. They include graphs showing for instance how the coefficient estimates (complete with $\pm$ 2 x s.d. lines) and the residual sum of squares evolve over time. Furthermore, sequences of various Chow-tests for structural change are graphed whenever the tests can be carried out.

The test statistics appearing in Figure 2 belong to the validation stage of modelling following estimation. They are not computed

automatically. The user may select the ones he wants from a testing menu. In some cases further choices have to be made to define the test exactly. If the model contained at least one lag of income (Y), COMFAC tests would also be available and that option would appear in the menu. Note that although the screen in Figure 2 only contains "F-forms" of LM tests, the $\chi^2$ statistics are available elsewhere in the output. The output generally also includes the critical values of the test statistics on the 5 % significance level. I would prefer the cdf value of the (approximate) null distribution corresponding to the value of the statistic to the mere critical value. Anyway, the wide variety of tests available to the user by simple commands is a characteristic that together with the amount of graphing options very strikingly separates PC-GIVE from most other econometrics packages.

## 6. Operating PC-GIVE II: FIML

FIML is the module that puts PC-GIVE 5.01 one step ahead in performance of its closest rival, DATAFIT. It is designed for constructing equation systems. So far FIML can only handle rather small systems: the maximum number of stochastic equations is 12 and the maximum number of variables 40 including lags. The constraint limiting the number of parameters in a single equation to 18 in principle already allows the systems modelling of seasonal monthly data. In practice, building dynamic monthly models is still bound to be difficult as long as this restriction prevails. FIML requires 640 K RAM, whereas the other modules are designed to use no more than 512 K.

Operating FIML requires care because equation systems are more complicated to handle than single-equation relations. To specify a

system, the user has to assign a status to every variable: endogenous variables have to be separated from lagged endogenous and "non-modelled" ones. FIML automatically creates the constant and all seasonal dummies if they are needed for every equation. Creating lags is as easy as in TSLS. When each variable has obtained a status the user has in fact specified an unrestricted reduced form (URF) of his system. It can subsequently be estimated either directly or recursively using multivariate least squares. The latter option is the default. This estimation has to be carried out before moving on to structural specification; tests are offered for testing the validity of the URF. The idea is to direct (with a rather firm hand) the user to first build a statistically solid base for structural modelling. Only having done this, he may move on to the specification of a structural system. One option is accepting the URF as a structural form and estimating it with systems techniques. If 3SLS is used this amounts to SURE.

FIML aids the user in specifying the structural form by issuing warnings if the usual identification conditions are not satisfied. This may be an even greater advantage in the future when PC's have become more powerful and the present size constraints of the module can be relaxed. The programme also handles identities and checks every identity with data. If the discrepancy is too large, FIML requires respecification: either the identity or variables have to be redefined.

Estimation always begins with a 2SLS. It is thoughtfully accompanied by an automatic $\chi^2$ test for overidentifying restrictions. After that, the user may re-estimate by 3SLS, Full Information Maximum Likelihood (FIML), Limited Information Instrumental Variables and Full Information Instrumental Variables. For FIML estimation, the module FIML offers three optimization algorithms. The one called BFGS and discussed in

Hendry et al. (1987) is recommended after first obtaining a reasonable set of starting-values from 2SLS or 3SLS. (The user may also specify his own starting-values.) My experience does not contradict this recommendation. The one technique not needing derivatives is based on the conjugate directions algorithm in Powell (1964). It is slow and usually needs many more function calls than the programme default of 500. Because starting-values are usually not a problem in this module, it is unlikely that this algorithm will be applied in "serious" estimation. The user whose machine lacks a math co-processor should not even think of using it.

After structural estimation the system automatically derives the restricted reduced form (RRF) coefficients. If the user has saved the end-of-sample observations for forecasting the strength of the specification can be tested outside the estimation period. Values of test statistics including the test for normality of errors are computed and graphs are provided in the customary PC-GIVE fashion. The RRF residual covariances and correlations are a part of the output, and it is possible to save the residual series in a PC-GIVE file for further analysis. All told, FIML is an impressive leap forward in specifying, estimating and testing econometric equation systems on PC's.

## 7. Output and Graphics

Output from TSLS and FIML is automatically generated on disk. However, those who like to study it with a pen in hand can always print the contents of the output files from the operating system. Those who rather prefer to view their output on the screen and only print out

the main results at the end are certainly satisfied with the facilities of PC-GIVE. There are two output files, one containing all results excluding graphs and the other the estimated equations and tests. The user has to open both files or create them when starting an econometrics module.

PC-GIVE makes use of high resolution graphics. The user may choose the screen colours: this applies to text screens as well. He cannot control the scale markings of graphs but the system chooses the markings in a more intelligent way than in previous versions. This is a welcome improvement in view of using printed graphs in reports. Monochrome monitor owners with the Hercules graphics card are able to see graphs as well. I checked that on an IBM XT with a monochrome monitor; my PC with a colour monitor was an HP Vectra.

The wealth of graphs offered by PC-GIVE makes the GIVPLOT module useful. Saving graphs is not automatic, but many users might want to retain at least some of them and print them out later. This can be done via GIVPLOT. Saving is easy: just press the Ctrl-Home key when the graph is on the screen. The problem is how to find the saved graphs. My solution was to use the DOS access mentioned earlier to check the PC-GIVE directory for new files. Later I noticed that the manual briefly explains the automatic graph file labelling system. Anyway, it could be better if, after saving a graph, the system gave the user a message about the save with the filename included. Instant printing is available as well for those who are definitely not in a hurry during their PC-GIVE session. In classroom use, students may easily obtain copies of interesting graphs afterwards via GIVPLOT.

## 8. Future Developments

As mentioned earlier, the simulation module NAIVE and the file organization one DATABANK appearing in Figure 1 are not yet available in PC-GIVE 5.01. On the other hand, I have had access to another module called RALS which has not yet been incorporated to PC-GIVE either. At present it can be run directly from DOS. In fact, all the modules can be run that way without the main menu, and it is recommended practice on PC's with no hard disk in order to minimize the number of diskette changes. RALS contains all the model formulation features of TSLS and the OLS and RLS estimation as well as autoregressive least squares (ALS). When applying ALS, it is preferable to perform an OLS estimation first, because the OLS loop enables the user to study the estimated autocorrelation function and perform tests for serial correlation in the errors. The ALS option is not recursive in the direction of observations. It includes grid estimation of the AR(1) process and the graph of the results is available. The user specifying an AR process of order one or higher may select the starting-value(s) for the Gauss-Newton optimization algorithm. If he does not exercise this option, the system provides the values. The maximum order of the autoregression is 12. It is worth mentioning that RALS does not contain the Cochrane-Orcutt procedure. This is probably a deliberate omission due to negative properties of this technique.

## 9. Conclusion

PC-GIVE 5.01 is an easy to use, powerful and stable econometrics package. Ericsson (1988) stresses the suitability of DATAFIT for "live"

use in teaching and seminars; PC-GIVE shares the same property. Thus, in addition to being a very flexible research tool, PC-GIVE opens up new possibilities in teaching econometrics and presenting research results. Furthermore, the system seems to be developing rapidly. New extensions and improvements expanding the capabilities of the package and thus enhancing its value even further can be expected in the near future.

## REFERENCES

Ericsson, N.R. (1988), 'A review of DATAFIT: An interactive econometric modeling package for IBM-compatible PCs', Journal of Applied Econometrics 3 (forthcoming).

Hendry, D.F., A.J. Neale and F. Srba (1987), 'Econometric analysis of small linear systems using PC-FIML', Journal of Econometrics (forthcoming).

Pagan, A. (1987), 'Three econometric methodologies: A critical appraisal', Journal of Economic Surveys, 1, 3-24.

Pesaran, M.H. and R.A. Evans (1984), 'Inflation, Capital Gains and U.K. Personal Savings: 1953-1981', Economic Journal, 94, 237-257.

Powell, M.J.D. (1964). 'An efficient method for finding a minimum of a function of several variables without calculating derivatives', Computer Journal, 7, 155-162.

Table 1. Summary Information for PC-GIVE 5.01

| | |
|---|---|
| Distributor | Institute of Economics and Statistics<br>St. Cross Building, Manor Road,<br>Oxford OX1 3UL, England<br>(0865) 271088 |
| Format | 3 5.25" floppy disks (1.2M)<br>or 7 5.25" floppy disks (360K), not copy-protected |
| Computer | IBM PC, XT, AT or compatible<br>MS-DOS 2.0 or higher<br>Twin-floppy disk drive or hard disk drive<br>512K RAM, 640K RAM to run FIML<br>math chip recommended<br>CGA/Hercules graphics card, runs on EGA in CGA mode |
| Storage space on hard disk | 2 MB |
| Printer (optional) | Most printers (laser printers included) |
| Language | Fortran |
| Computational accuracy | Fully acceptable[1]. System suggests re-scaling of data when the moment matrix is near-singular |
| Documentation | User's Manual with Tutorials + MiniManual for Graphics Printing, about 350 pages |
| Support | Owners registered<br>No newsletter<br>Comments & criticisms welcomed: the address provided in the manual |
| Price | |
| Individual | £220+VAT; $380 |
| Academic | £110+VAT; $190 |
| Site License | £550+VAT; $900 |

[1] This assertion is based on experiments with the Longley data.

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Figure 1.

Main Menu of PC-GIVE 5.01

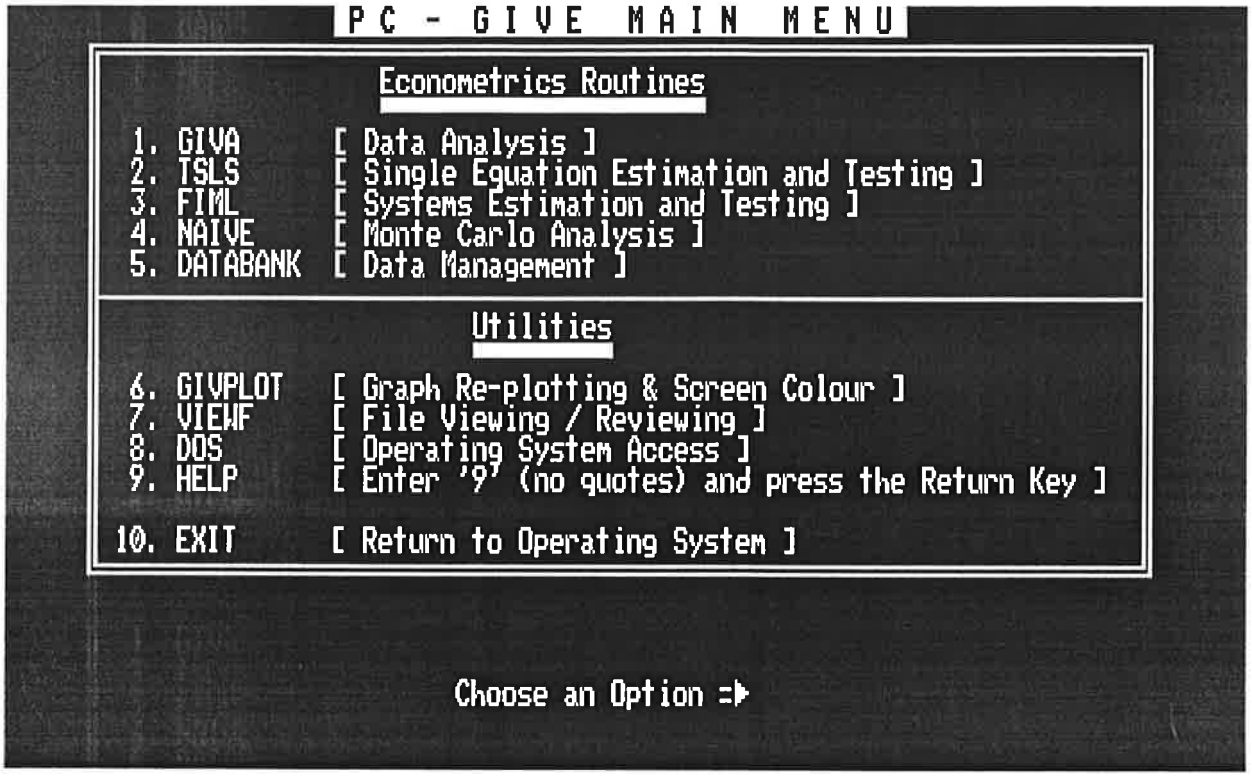


Figure 2.

Transformations Menu of PC-GIVE 5.01

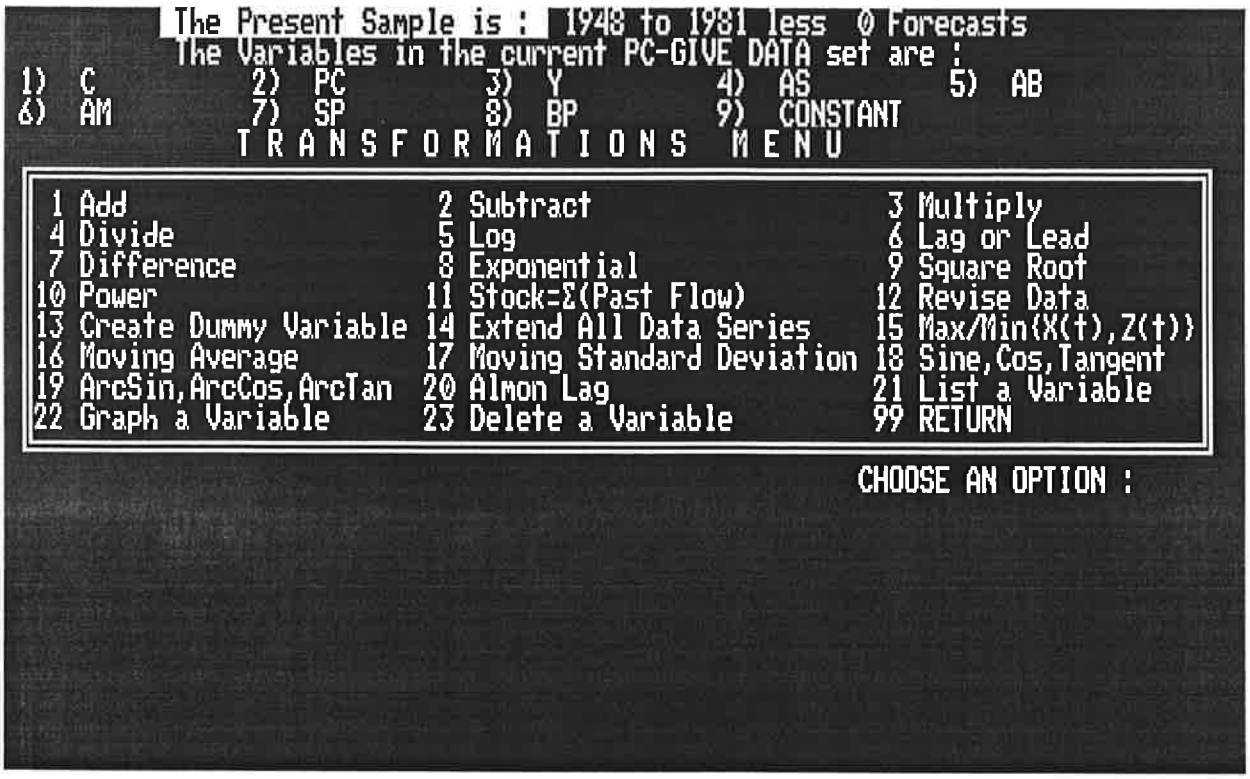
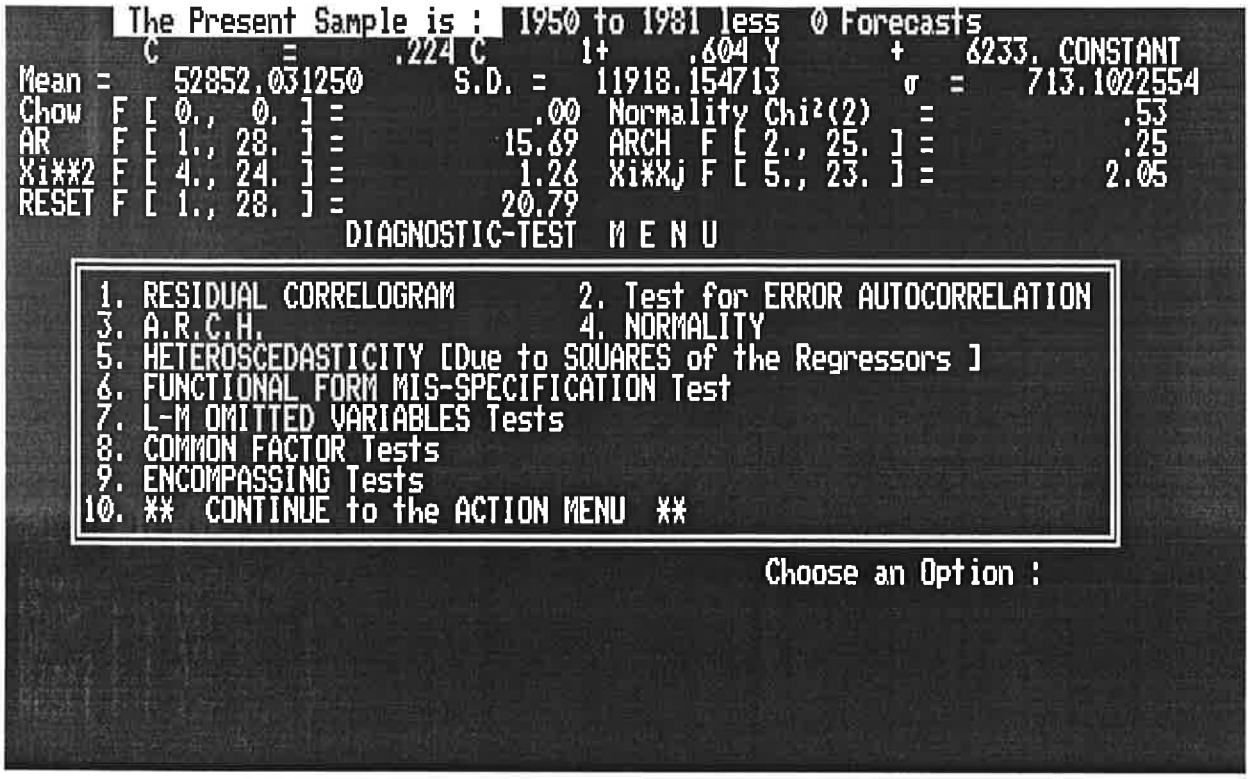


Figure 3.

Test Output after OLS Estimation of a Simple Keynesian Consumption Function




Notes: (a) The data are the DATAFIT tutorial data, see Ericsson (1988); the equation to be estimated is $C_t = \alpha C_{t-1} + \beta Y_t + \gamma + u_t$; $C_t$ = consumption, $Y_t$ = income. (b) The Chow parameter constancy test cannot be performed, because no observations are saved for forecasting. (c) The Ramsey RESET test uses the squares of the fitted values, but the package allows the use of third, fourth and fifth orders as well.

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