IO/EAM: AN INPUT-OUTPUT ECONOMIC ASSESSMENT MODEL

Jeffrey L. Jordan and Rusty Brooks

Abstract

This paper describes a microcomputer software package, IO/EAM: An Input-Output Economic Assessment Model, which was developed at the University of Georgia through a joint extension-research effort. The package is a menu-driven, user friendly program that is designed to be used by county extension agents, researchers, and other extension personnel to estimate the economic impact of changes in county economies. The program employs an input-output model that provides users with a locally based, easily updated source of economic intelligence. Use of input-output techniques allows users to estimate the impact of changes in county economies on an industry-by-industry basis and to account for the interdependencies among these industries in a county.

Key words: input-output, impact assessment, county applications, microcomputers, BASIC.

The Cooperative Extension Service is increasingly called upon to address questions beyond traditional areas in agricultural production. The proliferation of community and rural development specialists throughout extension programs in the United States indicates that the Extension Service will be assuming a larger role in matters of general economic development. At the same time, county agents are becoming more involved in local development efforts to attract industry and estimate the impacts of changes in a county's economy.

The purpose of this paper is to describe a new microcomputer software package, IO/EAM: An Input-Output Economic Assessment Model. The program employs an input-output model (Pratt and Conner)[1] that provides users with a locally based, easily updated source of economic intelligence. Features of the package include:

1. estimation of the impact of a change in final demand on total output, by industry;
2. estimation of the demand required to support an increase in total output;
3. estimation of income, employment and output multipliers;
4. estimation of the impact of changes in an economy on income, employment and output;
5. evaluation of the contribution of consumption, investment, export and government spending to total output, and;
6. evaluation of the impact of changes in the economy on resource use (water, petroleum, etc.).

The IO/EAM package includes the program disk with the county's base-year transactions matrix, an extensive help menu that can be accessed at any point in the program, and a sample data set. Also in the package is documentation, a step-by-step tutorial on use of each feature of the program, a hard copy of the county's base-year output and all original matrices, a survey instrument for updating the data, and a template that fits over the function keys which are used to answer most of the questions asked throughout the program (see Jordan et al. for further documentation of IO/EAM).[2]

The program is designed for use on an IBM-PC, with a MS-DOS 2.0 operating system, and is written in BASIC. Memory required for the program is 64K which will allow use of up to 20 files and can accommodate an input-output model of up to 50 industrial sectors. If the program is to be used on an IBM compatible computer, more memory may be required. Also, if the BASIC interpreter is stored in the user

Jeffrey L. Jordan and Rusty Brooks are Assistant Professors, Department of Agricultural Economics, Georgia Experiment Station and Cooperative Extension Service, University of Georgia, respectively.

IO/EAM was programmed by J. Michael Lee, Mercer University, Macon, Georgia.

Microcomputer software articles are approved by the SAEA microcomputer software committee and the *SJAE* editorial council, as per executive committee action February 5, 1984.

[1]The input-output model presented in this paper is based on a FORTRAN program developed for the IBM mainframe by Pratt and Conner. The matrix manipulations of the Pratt and Conner program were rewritten in BASIC and the input, user menus and output procedures were developed for use primarily by county extension personnel on the specified microcomputer system.

[2]The IO/EAM package is available in two forms. The documentation is contained in Georgia Experiment Station Research Report Number 468. If a copy of the documentation and a program diskette with a sample data set is desired, please send a blank diskette (5 1/4 inch, double sided and double density) to Jeffrey L. Jordan, Department of Agricultural Economics, Georgia Agricultural Experiment Station, Experiment, Georgia 30212.

memory area, more than 64K of memory is needed. The program can be used on either a one or two disk-drive system. If two disk drives are available, Disk A is the program disk and Disk B contains the county's data. The program and data are on the same disk for a one disk-drive system. The program runs on either a monochrome or color display, as well as a color board and composite monitor. If a printer is available, all of the output, as well as the input-output matrices; can be either printed directly, or off the screen. The program has been designed to run on a system likely to be available to county extension offices.

IMPACT ASSESSMENT AND INPUT-OUTPUT MODELS

Input-output models are used in regional analysis (Richardson; Miernyk; Miernyk and Shellhammer). This method uses a system of accounts that represents the transactions among the sectors of an economy which determine their interrelationships and the relationship between these and the economic activity outside of the region (Rest of Nation, RON). This accounting shows how the value of outputs from each producing sector is distributed among other sectors in the study area and RON. The input-output table shows the source of each sector's inputs and output sales. Input-output models are consistent in that the outputs of each sector must conform with the outputs of all other sectors from which it buys inputs and to which it sells outputs, as well as with the total output of the economy. It is therefore possible to trace the interdependence in the economy and the required flow of goods needed in the input-output process (Pratt et al.)

The input-output method is particularly well-suited to the impact assessment problem. The output, income and employment multipliers that are produced by the transaction matrix provide a comprehensive set of data from which a local development group can assess the impact of changes in their economy. Questions that can be addressed using an I-O model that are important to local groups include: impact of a new firm on the entire economy; impact of a firm leaving an area; amount of demand required to support expansion of an existing facility or arrival of a new one; and amount of resources that will be used to support a new firm.

Input-output models can be used at all levels of aggregation. The U.S. Department of Commerce produces a national I-O model at approximately 4-year intervals. Input-output models have been used to evaluate economic changes at the state level (Trenchi and Flick), at the sub-state level (Stoecker et al.; Pratt et al.) and at the county level (Gamble and Raphael; Fisher; Guedry and Smith).

Although input-output models are used in regional analysis, a number of problems exist. The transactions matrix requires detailed data, particularly when building a state-level model. The large data requirement constrains updating input-output models. I-O models that are not updated become obsolete. Given the assumptions of constant production and consumption functions, an I-O model is accurate only for a short time (Richardson). Further, since the transactions matrix sets the pattern of the technological relationships among firms, it, too, can be quickly outdated. Thus, a method is required to easily update any I-O model.

Another problem with I-O models at the county level is that most are not based on primary data. Often, some sort of share-approach is used, based on a state, regional, or even a national model. This assumes that the production functions of firms at the county level are the same as similar firms in the larger area. To accurately estimate economic impacts at the county level, primary data are required.

It is recognized, however, that county extension personnel do not always have the resources or capability to conduct such surveys. In that case, the non-survey methods of regionalizing national and state input-output models offer the best potential for inexpensive and reasonably accurate analyses of local economics using the input-output technique. Yet, the experience in Georgia indicates that the sample survey is not beyond the ability of county personnel. Further, input-output models that are normally developed at a university or by a state agency are generally accessible only by a mainframe computer. Access to these models is limited, and rarely involves county agents or local officials.

The method of data collection and dissemination of the IO/EAM package addresses the above problems. Keys to providing an accurate, timely and accessible economic model include collaboration with extension service personnel and use of the microcomputer.

DATA COLLECTION AND DISSEMINATION

Resources of the county extension agent are the key to data collection and updating the I-O model. Through the county agent's office, surveys of a sample of businesses, farms, governmental units, and households are taken. The survey instrument, a relatively short and simple form, ascertains the amount of input used and the category of firm from which the input was bought. The same information is collected for total sales. The survey also determines the per-

TABLE 1. SAMPLE DATA REQUIREMENTS, IO/EAM SYSTEM

Sector	Ag. crops	Ag. processing	Construction	Wholesale and retail	Services	Household	Investment/ exports	Government
Ag. crops	36	213	0	0	0	7	214	8
Ag. processing	29	1,043	7	12	193	776	10,680	999
Construction	4	360	62	29	76	21	30	7
Wholesale and retail	18	510	12	41	165	1,231	503	202
Services	31	471	69	283	312	1,183	1,288	100
Household	219	3,110	210	812	1,896	870	1,188	929
Investment/exports	67	5,721	71	492	983	2,518	0	0
Government	74	2,311	150	1,013	712	2,036	0	0
Employment ratio	.049	.032	.028	.071	.041	.079		
Resource data	12	25	.03	.5	1	30		

centage of products bought and sold inside and outside the county.[3]

This procedure has been implemented in Thomas County, Georgia and is beginning in both Walton and Hall counties, Georgia. The key to the successful collection of information and cooperation of local businessmen was the inclusion of business, civic, and government leaders in the process from the beginning. In Thomas and Walton counties, the work began by first meeting with a small group of people assembled by the county agent, including members of the Chamber of Commerce, city and county commissioners, and selected business leaders. A second larger meeting was organized by the county agent to enlist the help of the entire community. The experience in these cases has shown that when people in the counties understand what they will receive for their cooperation, data collection becomes a much easier task.

Data from the original survey in a county are included as base-year data on the diskette provided to the user. After this initial data collection phase, users should have the experience to periodically update the model. Further, if a change in input technology occurs between two industries, the base-year transaction matrix can be altered to reflect that change. Cooperation between researchers and county agents provides the opportunity to keep I-O models accurate and timely.

Use of microcomputers to execute the I-O model provides more accessibility at the local level than is the case with the use of mainframe computers because county extension offices throughout the U.S. are being equipped with microcomputers. Consequently, the I-O model can be accessed by local users and can answer economic questions in a timely manner. The program has been written so that only minimal computer skills are required.

SAMPLE OUTPUT AND IMPACT ASSESSMENT

The following sample of the IO/EAM program output is based on hypothetical data for a small county with firms aggregated to five industries, with three final demand categories: households, net investment/net exports and total government spending.

Sample data requirements for the IO/EAM program are shown in Table 1. Inputing the data is done by column. After creating the appropriate column label, the data from the I-O transaction matrix are entered. The data for employment ratios and resource use are also included in Table 1 and are entered under those options. The eight-by-eight data set in Table 1 is the I-O transactions matrix, the data for which are collected either from a survey or from secondary sources. The data represent sales to, and purchases from, each of the industries and final demand sectors in the sample county. Sales are read across the matrix and purchases are read down the matrix. The household, investment/exports, and government sectors represent final demands. Employment data represent labor/output ratios for each sector and the resource use data illustrate the amount of a resource (in this case gallons of water) used per $1,000 of sector output.

When the program is loaded (automatically), the first screen contains the title of the package. At this point, the user can read a short intro-

TABLE 2. SAMPLE COUNTY MULTIPLIERS - HOUSEHOLDS EXOGENOUS, IO/EAM SYSTEM

Sector	Output multiplier	Income multiplier	Employment multiplier
1. Ag. crops	1.31	0.00	1.28
2. Ag. processing	1.23	0.00	1.31
3. Construction	1.32	0.00	1.44
4. Wholesale-retail	1.17	0.00	1.10
5. Service	1.21	0.00	1.22

[3]The survey instrument employed in this study is similar to the Alabama survey developed by Trenchi and Flick.

TABLE 3. SAMPLE COUNTY MULTIPLIERS - HOUSEHOLDS ENDOGENOUS, IO/EAM SYSTEM

Sector	Output multiplier	Income multiplier	Employment multiplier
1. Ag. crops	2.41	1.66	2.85
2. Ag. processing	1.82	1.78	2.58
3. Construction	2.27	1.78	3.81
4. Wholesale-retail	1.88	1.63	1.80
5. Service	2.20	1.56	2.90
6. Households	1.93	13.28	1.71

duction or can go to the main menu. For any of the data sets shown on the main menu (transactions matrix, labels, aggregate and disaggregate final demands, labor/output ratios, resource use, and total output), the user can choose one and simply review the data.

The IO/EAM package will be most useful to users in responding to impact assessment questions. For example, if a new $1 million agricultural processing plant is considering locating in the county, the user can estimate its impact on the entire county and on water usage. An example of the output screens for a sample county are shown in tables 2-4. The first screen of output, Table 2, exhibits the economic multipliers for the county. In this case, the households are treated exogenously so there are no income multipliers produced. When households are endogenous, the output screen would look like Table 3. The output screen shown in Table 4 illustrates the impact on output, income and employment of a $1 million agricultural processing plant (projected output and final demands in Table 4 are in 1,000's). Total output in the sample county would increase $1,233,000 and income would increase $302,244 with 42 new employees. Finally, Table 5 indicates that the new plant would increase water usage in the county by 27,453 gallons per year.

TABLE 5. RESOURCE USE BY SECTOR WITH TOTALS, IO/EAM SYSTEM[a]

Sector	1
1. Ag. crops	218.58
2. Ag. processing	27,160.85
3. Construction	1.01
4. Wholesale-retail	22.15
5. Service	50.67
6. Total	27,453.26

[a]"1" refers to the amount of a resource - in this case water - used in each sector. Up to three columns, or three resources, can be included.

Results shown in this example are obtained by answering questions as the user moves through the program. Anticipated questions are explained both in the documentation and within the program by using a single key (F7).

CONCLUSION

The IO/EAM program was designed to give county extension agents and other users the ability to answer questions about changes in their community. As the role of county extension offices broadens to include economic development concerns, the existence of such an assessment package will aid in their efforts.

The package and method are easily adaptable to any state or county. As part of the effort in Georgia, a joint extension-research team is conducting initial surveys on a pilot county basis. The materials in the publications which accompany the program provide the information required by any state to duplicate the results.

TABLE 4. AGGREGATED FINAL DEMAND, IO/EAM SYSTEM

Sector	Projected change in final demand	Projected change in output	Percent change in output	Projected change in income	Projected change in employment
1. Ag. crops	0.0	18.2	3.81	8,345.4	0.9
2. Ag. processing	1,000.0	1,086.4	7.91	245,928.4	34.8
3. Construction	0.0	33.5	5.69	12,404.5	0.9
4. Wholesale-retail	0.0	44.3	1.65	13,413.1	3.1
5. Service	0.0	50.7	1.36	22,152.5	2.1
Total change		1,233.0		302,244.0	41.8

REFERENCES

Fisher, D. U. *Understand the County's Economy.* Staff paper 80-19, Dept. of Agr. Econ., Cornell University, Ithaca, New York; July, 1980.

Gamble, H. B. and D. L. Raphael. *A Microregional Analysis of Clinton County Pennsylvania,* University Park, Pennsylvania: The Pennsylvania State University, February, 1965.

Guedry, L. J. and D. W. Smith. "Impact of Industry in Rural Economies: An Input-Output Approach." *So. J. Agr. Econ.,* 12(2) 1980:19-24.

Jordan, Jeffrey L., Rusty Brooks and J. Michael Lee. *A User's Guide to IO/EAM: An Input-Output Economic Assessment Model,* Georgia Experiment Station Research Report 468, University of Georgia, Experiment, Georgia; February, 1985.

Miernyk, W. H. *Elements of Input-Output Economics,* New York, Random House, 1965.

Miernyk, W. H. and K. L. Shellhammer. *Simulating Regional Economic Development with an Input-Output Model,* West Virginia: Regional Research Institute, July, 1968.

Pratt, James E. and M. C. Conner. *A General Computer Program for Input-Output Analysis.* Staff Paper SP-76-6, Dept. of Agr. Econ., VPI & SU, Blacksburg, Virginia; September, 1976.

Pratt, J. E., D. K. Smith and M. C. Conner. *Input-Output Analysis: An Introductory Self-Learning Package.* Staff Paper SP-76-14, Dept. of Agr. Econ., Virginia Polytechnic Institute and State University, Blacksburg, Virginia; October, 1976.

Richardson, H. W. *Input-Output and Regional Economics,* New York, John Wiley and Sons, 1972.

Stoecker, A. L., M. L. Wright and D. A. Pyles. *An Input-Output Model of the Texas High Plains Economy in 1977,* Col. of Agr. Sci. Pub. No. T-1-199, Texas A&M University and Texas Tech University, August, 1981.

Trenchi, P. and W. A. Flick. *An Input-Output Model of Alabama's Economy: Understanding Forestry's Role,* Ala. Agr. Exp. Sta. Bull. 534, Auburn University, Auburn, Alabama; July, 1982.