IMPACT OF INDUSTRY IN RURAL ECONOMIES: AN INPUT-OUTPUT APPROACH

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Industrialization is an integral part of many rural community development programs across the country. Interest in attracting industry is often based on an *ex ante* assessment by local groups and officials of the positive benefits accruing to the community or area from industrialization. Obvious benefits to a local economy include increased output, income, and employment. Benefits occur in the form of purchases of labor and inputs by industry from endogenous sectors and the resulting local trade. A complete understanding of these benefits by local groups and officials in rural economies is essential for the planning of effective industrial development programs.

One method of determining the impacts of industry is input-output analysis. Normally, measures obtained from input-output analysis estimate how changes in industry final demands will affect the output of other sectors in the economy individually or collectively. Indirect impacts of industry also contained in the basic input-output measures are estimates of how industry contributes to the output impacts of changes in final demands of other endogenous sectors in the economy as a result of purchases from industry. Explicitly identified are estimates of output which must be provided by industry to satisfy the demands created for additional output from the other endogenous sectors. Included in the basic input-output measures but not explicitly identified is the additional output demanded from other endogenous sectors as a result of purchases from industry when changes in final demands occur. That is, because of interrelationships between industry and other endogenous sectors, purchases from industry have a distribution effect on the output generated in the economy. Knowledge of the distribution impacts associated with industry or any other sector will provide a better understanding of the impacts of that sector in an economy. We present a specification of the input-output model which will permit identification of these distributional impacts, and describe an empirical application of the model to the industrial sector of a small rural economy.

BASIC MODEL

Since Leontief's initial work in 1936, many presentations of the input-output model have been given in the literature (Chenery and Clark; Doeksen and Schreiner; Miernyk). In general, the model can be stated as

$$(1) \qquad X = (I - A)^{-1} Y$$

where

X   represents an n × 1 column vector of total commodity production for each endogenous sector (i = 1, ...n)

I   represents an n × n identity matrix

A   represents an n × n matrix of technical coefficients

$$(a_{ij} = \frac{x_{ij}}{X_j})$$

Y   represents an n × 1 column vector of final demands for each sector.

Empirical application of this model to a given economy provides measures that can be used to estimate sectoral impacts resulting from changes in sector final demands.[1] More specifically, each element of the Leontief inverse [(I − A)$^{-1}$] represents the direct and indirect output generated in a given sector by a change in final demands. The direct output demanded in Sector i from a change in Sector j's final demands results from direct purchases by Sector j from Sector i to supply the output necessary to meet the change. Indirect output requirements from Sector i result from an increase in the demands for its output by endogenous sectors in the economy due to the endogenous trade generated by an increase in Sector j's

[1]A review of the various forms of the model, assumptions, limitations, data requirements, and resulting impact measures is given by Doeksen and Schreiner.

final demands. Identification of that portion of the indirect output required from Sector i due to the interrelationships generated by some other sector in the economy will provide a better understanding of the distributional output effects of that sector in the economy. The following specification of the basic input-output model allows for the separation of these distributional impacts in an economy.

Model Specification

The model specification used to estimate the distributional impact of the industrial sector on the indirect and induced effects of other endogenous sectors is obtained through the use of partitioned matrices. Consider the matrix of technical coefficients, A. This matrix is partitioned as follows by the number of sectors (q) whose distributional impact is to be measured.

$$A = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix}$$

where

A_{11} is an $(n - q) \times (n - q)$ matrix of technical coefficients

A_{12} is an $(n - q) \times q$ matrix of technical coefficients

A_{21} is a $q \times (n - q)$ matrix of technical coefficients

A_{22} is a $q \times q$ matrix of technical coefficients.

Given this partition of the matrix of technical coefficients, A, and its inverse (Searle, p. 210), equation 1 becomes

$$(2) \quad \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} (I-A_{11}) & -A_{12} \\ -A_{21} & (I-A_{22}) \end{bmatrix}^{-1} \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix}$$

where

X_1 and Y_1 are $(n - q) \times 1$ column vectors
X_2 and Y_2 are $q \times 1$ column vectors.

Total production and final demand vectors for the sector(s) whose distributional impact is to be estimated are given by X_2 and Y_2, respectively. The inverse in equation 2 is the Leontief inverse and retains all of its properties.

If the model is opened by the sector(s) whose distributional impact on other sector impacts is to be measured, equation 2 becomes[2]

$$(3) \quad \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} (I-A_{11}) & 0 \\ 0 & Iq \times q \end{bmatrix}^{-1} \begin{bmatrix} Y_1^* \\ Y_2^* \end{bmatrix}$$

The column vector of Y^*'s represents the final demands including the demands of the q sector(s) removed from the endogenous portion of the model and has the same dimensions as Y_1 and Y_2. The inverse in equation 3 is the Leontief inverse for the open model. Elements of this inverse represent the interrelationships between all endogenous sectors of the economy excluding the sector(s) whose impact is to be measured. Consequently, the difference between the interrelationships contained in equations 2 and 3 provides a measure of the interrelationships in the economy accounted for by the sector(s) removed from the endogenous portion of the model.[3]

The inverse in equation 3 is obtained by pre- and postmultiplying the A matrix by an $n \times n$ diagonal matrix of ones except for the qth element(s). The inverse in equation 3 then becomes

$$(I - J_q A J_q)^{-1}$$

where

$$J_q = \begin{bmatrix} I_{(n-q)\times(n-q)} & 0_{(n-q)\times q} \\ 0q\times(n-q) & 0q\times q \end{bmatrix}$$

$$J_q A J_q = \begin{bmatrix} A_{11} & 0 \\ 0 & 0 \end{bmatrix}$$

With the inverse from equations 2 and 3, the distributional impact of sector(s) q is given by the expression

$$(4) \quad D = (I-A)^{-1} - (I-J_q A J_q)^{-1}.$$

The elements of D represent an $n \times n$ matrix of distributional coefficients which identifies that part of the indirect output generated in Sector i by a change in final demands of Sector j as a result of the interrelationships generated by the removed sector(s), i.e., the industrial sector, including the removed sector(s)'s direct and indirect coefficients.[4] Specifically

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[2]Procedurally this operation is the same as when the model is opened by the household sector if the household sector was included in the endogenous portion of the model. However, in this presentation the procedure relates to any sector of interest.

[3]Procedurally this would be similar to determining the induced effects from a model which has been opened and closed by the household Sector.

[4]The elements of D are not additive, that is, if the model were opened by the removed sector(s) and then D recalculated for each sector in the economy separately, the sum of the derived D's would not equal the inverse given in equation 2. The reason is that double counting of the interrelationships of sectors common to the various determinations of equation 3 will occur.

20

these interrelationships represent the output effects being generated by the sector(s) removed from the endogenous portion of the model given the structural relationships present in the economy.[5]

The elements of D excluding the removed sector(s)'s direct and indirect coefficients have a close relationship to what has been referred to elsewhere (Richardson, p. 182) as the import substitution effects, particularly when the sector being removed is the industrial sector.[6] However, this interpretation of the elements of D would be appropriate only when the sector removed represents a new sector in the economy producing products which are not competitive with those produced by other endogenous sectors. Under these conditions only the import coefficients would have changed with the new sector's entrance in the economy. As developed, the elements of D represent the indirect output effects generated by the removed sector(s)'s presence in the economy as changes in the final demands of other endogenous sectors occur. Any increase or decrease in the removed sector(s)'s capacity to supply the output demanded by the other endogenous sectors will increase or decrease their output effects in the economy by the amount of the coefficients contained in D per dollar of increase or decrease in the output supplied by the removed sector. This would represent a first approximation of such an impact if, as adjustments occurred in the economy, some other endogenous sectors were to supply part or all of the output demanded.

The distributional coefficients (D) serve as an additional measure of a sector(s)'s contribution to the economic activity of an area. As is shown in the following empirical application, the model specification can be applied to a model which has been closed by the household sector and would provide an estimate of the distributional effect of a sector on the indirect and induced impacts of other endogenous sectors within the economy. The distributional effect can also be identified in the resulting output, income, and employment multipliers.

EMPIRICAL APPLICATION

The empirical application of the model to estimate the distributional impacts of industry is based on the information obtained from a study of a rural Louisiana economy (Guedry and Rosera). The results reported hereafter are from the model closed by the household sector.

The model was applied to the economy of a parish (county) whose largest town had a population of 2,012 in 1974. Between 1969 and 1972, four industrial firms, employing a total of 1246 workers, moved into the parish. Data for the model were obtained by personal interviews with a sample of households and businessmen, stratified by sector. Endogenous sectors in the economy, shown in Table 1, were identified on the basis of types of output markets served. In Table 1, the direct requirements matrix (A) for this economy indicates that only a limited number of sectors made direct purchases from the industrial sector, and its purchases were primarily for labor from the household sector.

The corresponding matrix of direct, indirect, and induced requirements is given in Table 2. The total output impact of the industrial sector in the parish economy is 2.25 times the change in its final demands (column 14, row 15). Although the industrial sector traded on a limited basis with many sectors in the local economy, coefficients given in row 14 indicate that some indirect and induced output requirements are created in the industrial sector as changes occur in final demands of other endogenous sectors. The total output impacts in the economy from a change in industrial sector's final demands and the resulting multipliers can be determined from the coefficients in Table 2. In addition, the impact of changes in other sector final demands on industrial sector output can be estimated. Also contained in these coefficients, but not explicitly identified, are the distributional impacts of the industrial sector on the indirect and induced impacts of other sectors in the economy. These distributional impacts are obtained by estimating equation 4.

Distributional Impacts of the Industrial Sector

The matrix of distributional coefficients (D) provides estimates of the distributional impacts of the industrial sector. The $(I - A)^{-1}$ portion of equation 4 is presented in Table 2 and $(I - J_q A J_q)^{-1}$ is presented in Table 3. Coefficients in Table 3 represent the direct, indirect, and induced coefficients of the endogenous sectors of the economy, exclusive of the industrial sector impacts. Each cell of this matrix is interpreted as the direct, indirect, and induced output required by Sector i when Sector j's final demands increase, exclusive of the output impacts of the industrial sector.

Differences between coefficients in Tables 2 and 3 provide estimates of the distributional

[5]This differs from a with and without analysis which implies that the structural relationships in the economy could be different when the sector(s) is removed from the endogenous portion of the model.

[6]The authors are indebted to an anonymous reviewer for pointing out this interpretation.

21

TABLE 1. DIRECT TRADE REQUIREMENTS, LaSALLE PARISH, 1973

Selling Sector	1. Agricultural Production	2. Automotive	3. Construction	4. Finance	5. Gas/Oil	6. Government	7. Grocery	8. Professional Services	9. Retail Services	10. Retail/Wholesale	11. Social Services	12. Timber	13. Household	14. Industrial
1. Agricultural Production	.0006	.0000	.0000	.0000	.0000	.0000	.0019	.0000	.0001	.0000	.0000	.0000	.0046	.0001
2. Automotive	.0294	.0147	.0151	.0037	.0028	.0119	.0009	.0465	.0156	.0039	.0000	.0338	.0428	.0005
3. Construction	.0012	.0021	.0010	.0609	.0014	.0075	.0004	.0216	.0008	.0004	.0736	.0002	.0342	.0083
4. Finance	.0236	.0027	.0020	.0000	.0024	.0027	.0010	.0310	.0012	.0013	.0048	.0026	.0108	.0000
5. Gas/Oil	.0315	.0076	.0148	.0021	.0003	.0096	.0012	.1658	.0167	.0050	.0145	.0251	.0498	.0007
6. Government	.0016	.0008	.0042	.0062	.0026	.0272	.0015	.0040	.0053	.0012	.0046	.0139	.0267	.0032
7. Grocery	.0000	.0001	.0000	.0000	.0000	.0039	.0000	.0000	.0016	.0000	.0195	.0000	.1845	.0000
8. Professional Services	.0001	.0003	.0087	.0051	.0007	.0024	.0008	.0000	.0012	.0009	.0000	.0001	.0165	.0059
9. Retail Services	.0240	.0075	.0064	.0245	.0042	.0287	.0064	.0433	.0065	.0066	.0350	.0101	.1345	.0030
10. Retail/Wholesale	.1584	.0029	.1420	.0085	.1291	.0479	.0002	.0596	.0020	.0075	.0059	.0008	.1021	.1244
11. Social Services	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0442	.0000
12. Timber	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.4762	.0000	.0853
13. Household	.2790	.0523	.1134	.6870	.0700	.6216	.1080	.3485	.3703	.0622	.5106	.2274	.0637	.3676
14. Industrial	.0000	.0000	.0449	.0000	.0000	.0015	.0000	.0000	.0000	.0000	.0000	.0000	.0003	.0008
15. Total Local Purchases	.5494	.0910	.3525	.7980	.2135	.7649	.1223	.7203	.4213	.0890	.6685	.7902	.7147	.5998
16. Imports	.4506	.9090	.6475	.2020	.7865	.2351	.8777	.2797	.5787	.9110	.3315	.2098	.2853	.4002
17. Total Dollar Expenditures	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

TABLE 2. DIRECT, INDIRECT, AND INDUCED TRADE REQUIREMENTS, LaSALLE PARISH, 1973

Selling Sector	1. Agricultural Production	2. Automotive	3. Construction	4. Finance	5. Gas/Oil	6. Government	7. Grocery	8. Professional Services	9. Retail Services	10. Retail/Wholesale	11. Social Services	12. Timber	13. Household	14. Industrial
1. Agricultural Production	1.0026	.0004	.0010	.0045	.0005	.0042	.0026	.0026	.0025	.0004	.0035	.0030	.0063	.0028
2. Automotive	.0510	1.0118	.0264	.0495	.0088	.0541	.0081	.0748	.0396	.0084	.0356	.0954	.0616	.0333
3. Construction	.0189	.0053	1.0096	.0968	.0059	.0410	.0062	.0447	.0200	.0039	.1014	.0247	.0499	.0298
4. Finance	.0292	.0037	.0051	1.0018	.0040	.0136	.0029	.0384	.0075	.0025	.0139	.0129	.0160	.0076
5. Gas/Oil	.0569	.0124	.0290	.0571	1.0075	.0600	.0099	.1985	.0453	.0104	.0567	.0839	.0736	.0380
6. Government	.0143	.0032	.0107	.0335	.0061	1.0530	.0058	.0207	.0198	.0039	.0258	.0452	.0373	.0217
7. Grocery	.0759	.0142	.0365	.1682	.0199	.1598	1.0267	.0977	.0914	.0161	.1483	.1112	.2359	.0999
8. Professional Services	.0076	.0017	.0126	.0215	.0027	.0173	.0033	1.0098	.0097	.0024	.0129	.0108	.0222	.0155
9. Retail Services	.0843	.0186	.0363	.1541	.0205	.1495	.0270	.1209	1.0756	.0191	.1347	.1059	.1802	.0825
10. Retail/Wholesale	.2141	.0136	.1758	.1280	.1436	.1538	.0183	.1496	.0630	1.0189	.1030	.0817	.1529	.1932
11. Social Services	.0181	.0033	.0087	.0400	.0047	.0371	.0064	.0232	.0213	.0038	1.0306	.0264	.0561	.0238
12. Timber	.0002	.0000	.0074	.0008	.0000	.0006	.0001	.0003	.0002	.0000	.0008	1.9093	.0004	.1632
13. Household	.4085	.0759	.1964	.9055	.1073	.8388	.1439	.5257	.4832	.0864	.6929	.5978	1.2701	.5381
14. Industrial	.0010	.0003	.0454	.0047	.0003	.0037	.0003	.0022	.0011	.0002	.0048	.0013	.0027	1.0023
15. Totals	1.9826	1.1714	1.6009	2.6760	1.3318	2.5865	1.2615	2.3091	1.8802	1.1764	2.3649	3.1095	2.1652	2.2517

coefficients (D) of the industrial sector. These estimates are given in Table 4.[7] Coefficients in Table 4, with the exception of those for the industrial sector (column 14), are estimates of the portion of each sector's indirect and induced output that can be attributed to purchase from the industrial sector by the other endogenous sectors in the local economy. For example, $.0002 additional output would have to be provided by the retail and wholesale sector, given a dollar increase in the final demands of the agricultural production sector as a result of purchases from the industrial sector. In addition, each dollar change in the final demands for output of the agricultural production sector (row 15, column 1, Table 4) requires an additional $.0021 in indirect and induced output demand in the economy resulting from the trade generated by purchases from the industrial sector. The greatest impact of

[7]Results obtained from this analysis are dependent on the structure of the local economy studied and the characteristics of its specific sectors. Consequently, their presentation should not be taken to imply they can be generalized to other economies.

TABLE 3. DIRECT, INDIRECT, AND INDUCED TRADE REQUIREMENTS, EXCLUSIVE OF INDUSTRIAL SECTOR IMPACTS, LaSALLE PARISH, 1973

Selling Sector	1. Agricultural Production	2. Automotive	3. Construction	4. Finance	5. Gas/Oil	6. Government	7. Grocery	8. Professional Services	9. Retail Services	10. Retail/Wholesale	11. Social Services	12. Timber	13. Household	14. Industrial
1. Agricultural Production	1.0026	.0004	.0009	.0045	.0005	.0042	.0026	.0026	.0025	.0004	.0035	.0030	.0063	.0000
2. Automotive	.0510	1.0188	.0249	.0493	.0087	.0540	.0081	.0747	.0395	.0084	.0354	.0953	.0615	.0000
3. Construction	.0189	.0053	1.0083	.0967	.0059	.0409	.0061	.0446	.0200	.0039	.1202	.0246	.0498	.0000
4. Finance	.0292	.0037	.0047	1.0118	.0040	.0136	.0029	.0384	.0074	.0025	.0138	.0129	.0160	.0000
5. Gas/Oil	.0569	.0124	.0273	.0569	1.0075	.0598	.0099	.1984	.0452	.0104	.0565	.0838	.0735	.0000
6. Government	.0143	.0032	.0097	.0334	.0060	1.0529	.0058	.0207	.0197	.0039	.0257	.0452	.0373	.0000
7. Grocery	.0758	.0142	.0320	.1677	.0199	.1595	1.0267	.0975	.0913	.0160	.1478	.1110	.2356	.0000
8. Professional Services	.0076	.0017	.0119	.0215	.0027	.0173	.0033	1.0098	.0097	.0024	.0128	.0108	.0221	.0000
9. Retail Services	.0842	.0186	.0326	.1538	.0205	.1492	.0270	.1207	1.0755	.0191	.1343	.1058	.1799	.0000
10. Retail/Wholesale	.2139	.0135	.1671	.1271	.1436	.1531	.0182	.1492	.0628	1.0189	.1021	.0815	.1524	.0000
11. Social Services	.0180	.0033	.0076	.0399	.0047	.0370	.0063	.0232	.0213	.0038	1.0305	.0264	.0561	.0000
12. Timber	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.9091	.0000	.0000
13. Household	.4080	.0758	.1720	.9030	.1072	.8368	.1437	.5245	.4826	.0863	.6904	.5971	1.2687	.0000
14. Industrial	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.0000
15. Total	1.9804	1.1709	1.4990	2.6656	1.3312	2.5783	1.2606	2.3043	1.8775	1.1760	2.3540	3.1065	2.1592	1.0000

TABLE 4. TRADE REQUIREMENTS GENERATED BY THE INDUSTRIAL SECTOR IN THE LaSALLE PARISH ECONOMY, 1973

Selling Sector	1. Agricultural Production	2. Automotive	3. Construction	4. Finance	5. Gas/Oil	6. Government	7. Grocery	8. Professional Services	9. Retail Services	10. Retail/Wholesale	11. Social Services	12. Timber	13. Household	14. Industrial
1. Agricultural Production	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0028
2. Automotive	.0000	.0000	.0015	.0002	.0000	.0001	.0000	.0001	.0000	.0000	.0002	.0000	.0001	.0333
3. Construction	.0000	.0000	.0014	.0001	.0000	.0001	.0000	.0001	.0000	.0000	.0001	.0000	.0001	.0298
4. Finance	.0000	.0000	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0076
5. Gas/Oil	.0000	.0000	.0017	.0002	.0000	.0001	.0000	.0001	.0000	.0000	.0002	.0001	.0001	.0380
6. Government	.0000	.0000	.0010	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0001	.0000	.0001	.0217
7. Grocery	.0001	.0000	.0045	.0005	.0000	.0004	.0000	.0002	.0001	.0000	.0005	.0001	.0003	.1000
8. Professional Services	.0000	.0000	.0007	.0001	.0000	.0001	.0000	.0000	.0000	.0000	.0001	.0000	.0000	.0155
9. Retail Services	.0001	.0000	.0037	.0004	.0000	.0003	.0000	.0002	.0001	.0000	.0004	.0001	.0002	.0825
10. Retail/Wholesale	.0002	.0001	.0088	.0009	.0001	.0007	.0001	.0004	.0002	.0000	.0009	.0003	.0005	.1932
11. Social Services	.0000	.0000	.0011	.0001	.0000	.0001	.0000	.0001	.0000	.0000	.0001	.0000	.0001	.0238
12. Timber	.0002	.0000	.0074	.0008	.0000	.0006	.0000	.0004	.0002	.0000	.0008	.0002	.0004	.1632
13. Household	.0005	.0001	.0244	.0025	.0002	.0020	.0002	.0012	.0006	.0001	.0026	.0007	.0014	.5381
14. Industrial	.0010	.0003	.0454	.0047	.0003	.0037	.0003	.0022	.0011	.0002	.0048	.0014	.0027	.0023
15. Total	.0021	.0005	.1020	.0106	.0006	.0083	.0006	.0050	.0023	.0003	.0108	.0029	.0060	1.2518

the industrial sector on the output of other sectors occurs in the construction sector (column 3, Table 4). Because of trade generated by purchases from the industrial sector, a dollar increase in the final demands of the construction sector would require a $.10 increase in output in the economy (row 15, column 3, Table 4).

The impact of the industrial sector on income generated in the household sector is determined by identifying that portion of each sector's income multiplier (type II) due to the distributional impacts generated by the in-

dustrial sector. Estimates of these impacts, given in Table 5, were computed by dividing the indirect and induced income effects (row 13, Table 4) by their corresponding direct income effects (row 13, Table 1). These estimates are interpreted as the additional income generated in the household sector by a dollar payment to it by a given sector resulting from the distributional impacts of the industrial sector. For the construction sector, approximately $.22 of the $1.73 in household income generated as a result of a dollar payment to the household sector is due to the trade generated by purchases from the industrial sector.

23

TABLE 5. INCOME MULTIPLIERS FOR LASALLE PARISH ECONOMIC SECTORS, 1973

Sector	Type II Income Multiplier	Due to Industrial Sector
Agricultural Production	1.4642	.0018
Automotive	1.4512	.0019
Construction	1.7319	.2152
Finance	1.3181	.0036
Gas/Oil	1.5329	.0029
Government	1.3494	.0032
Grocery	1.3324	.0019
Professional Services	1.5085	.0034
Retail Services	1.3049	.0016
Retail/Wholesale	1.3891	.0016
Social Services	1.3570	.0051
Timber	2.6288	.0031
Industrial	1.4638	–

IMPLICATIONS

Application of the model specification to a local economy provides additional information concerning the impact of local industrial activity. Traditional input-output measures show that the primary impact of the industrial sector occurred in its purchases of labor from the household sector, which is not surprising because the industrial firms in the sector were importers of inputs, except for labor. Even so, the industrial sector is estimated to have some influence on the indirect and induced output effects as well as the income-generation potential of the other endogenous sectors in the economy. The significance of the industrial sector in the output and income impacts of the construction sector suggests a meaningful link which should be considered in policy or program decisions directed at either of these two sectors. For example, if local officials were considering the generation of additional household income in the economy by stimulating increased activity in the construction sector, the importance of the industrial sector in the income-generation potential of the construction sector should not be overlooked. Though the distributional impacts of the industrial sector on other endogenous sector output and income effects are not as great as in the construction sector, a recognition of their significance can improve local decisions. That is, concern for the effect of the industrial sector on decisions affecting other sectors would be less warranted in the case of this economy.

Though our empirical application analyzes the role of the industrial sector, the suggested model specification could also be used to identify the distributional impacts of any sector in an economy. Such analysis could be used to evaluate policies and programs which would affect a given sector's ability to provide the needed output arising from increases in final demands due to market developments or government programs. In addition, the significance of a sector's linkage with the projected output, income, and employment effects of other sectors in the economy can be further quantified. In some sectors and economies, these linkages may be substantial, although actual linkages can be determined only through further applications of the specified model to other economies and sectors.

REFERENCES

Chenery, Hollis B. and Paul G. Clark. *Interindustry Analysis.* New York: John Wiley & Sons, Inc., 1959.

Doeksen, Gerald A. and Dean F. Schreiner. *Interindustry Models for Rural Development Research.* Tech. Bull. T-129, Agricultural Experiment Station, Oklahoma State University, Sept. 1974.

Guedry, Leo and Eugene Rosera. *Economic Impact of Industrialization on a Rural Louisiana Economy: LaSalle Parish.* D.A.E. Res. Rep. No. 558, Department of Agricultural Economics and Agribusiness, Agricultural Experiment Station, Louisiana State University, Aug. 1979.

Leontief, Wassily. "Quantitative Input-Output Relationships in the Economic System of the United States." *Rev. Econ. and Statist.* Vol. 18, Aug. 1936.

Miernyk, William H. *The Elements of Input-Output Analysis.* New York: Random House, 1965.

Richardson, Harry W. *Input-Output and Regional Economics.* New York: John Wiley & Sons, Inc., 1972.

Searle, S. R. *Matrix Algebra for the Biological Sciences.* New York: John Wiley & Sons, Inc., 1966, p. 210.