# REFLECTION OF LOSS OF TRADE BY INPUT-OUTPUT TECHNIQUE

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Edward Nissan

D. C. Williams, Jr.

University of Southern Mississippi
Hattiesburg, Mississippi

*Presented at the Input-Output Techniques Workshop*
*Regional Science Association 1982 Conference*
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## INTRODUCTION

This paper intends to outline a non-survey methodology of estimating a regional input-output, as well as providing suggestions to alter a given model to provide an impact analysis due to loss of industry and commerce in the region.

The region chosen is the coastal counties of Mississippi-Alabama. It consists of three counties in Mississippi: Hancock, Harrison and Jackson, and two counties in Alabama: Mobile and Baldwin. As a coastal unit, it is experiencing a fast rate of increase in population, estimated currently at 750,000 people.

## THEORECTICAL DISCUSSION OF INPUT-OUTPUT MODEL

An input-output model describes the economic activities of a region in an accounting framework. It has three main features.

(1) Transactions Matrix: Each row of the table shows the sales of a particular industrial sector to all other sectors in the region. Algebraically, this may be expressed by

$$X_i = \sum_j X_{ij} + D_i \ , \qquad (1)$$

where:

$X_i$ = gross output or total sales of sector i,

$X_{ij}$ = total sales of sector i to sector j,

$D_i$ = total sales of sector i to final demand.

A tablular form of a transaction matrix is given in Table 4.

(2) Technical Coefficient Matrix: A second set of relationships which assumes fixed technical coefficients can be expressed as

$$X_{ij} = a_{ij}X_j. \qquad (2)$$

The technical coefficients $a_{ij}$ which can be obtained as:

$$a_{ij} = \frac{X_{ij}}{X_j}.$$

are usually displayed in a tabular form as shown in Table 5.

(3) Interdependence Coefficient Matrix: On substituting for $X_{ij}$ in equation 2 into equation 1, the result is

$$X_i = \sum_j a_{ij}X_j + D_i. \qquad (3)$$

In compact matrix algebra form equation 3 may be written as

$$X - AX = D.$$

Factoring X, the result is

$$X(I-A) = D.$$

Then:

$$X = (I-A)^{-1}D.$$

Here gross output given by vector X is expressed as a function of final demand. Each entry in the matrix $(I-A)^{-1}$ represents the direct and indirect requirements of sector i per unit of final demand for the output of sector j.

## NON-SURVEY METHODS OF ESTIMATING AN INPUT-OUTPUT MODEL

In recent years, the interest in use of regional intput-output models has widened. This is largely due to Federal policies regarding environmental and urban impact analysis.

Since the cost of survey input-output is prohibitive for most regional studies, heavy reliance on national coefficients has become the most prominent method for estimating regional intput-output models.

By far, the most popular method to achieve this aim has been the use of location quotient defined as

$$LQ_i = \frac{\frac{x_i}{x}}{\frac{X_i}{X}}$$

where:

$x_i$ = regional output of industry i,

$x$ = total regional output,

$X_i$ = national output of industry i,

$X$ = total national output.

The regionalization of the national model can be accomplished by multiplying the direct requirements $a_{ij}$ of industry j in the national table by the location quotient $LQ_i$. At times, when output data for each industrial sector are not available, employment figures are used instead to estimate location quotients.

A further modification of the national model is often required. This entails the aggregation of comparable industries into sectors. Such a scheme is necessary due to the fact that local economies are not identical to the national economy.

## THE MISSISSIPPI-ALABAMA MODEL

The method of constructing the input-output model of the Mississippi-Alabama Coastal Region follows a procedure that is widely employed by regional economists. It is a non-survey technique which uses the direct input coefficients of the national model, itself obtained by direct survey techniques. The national input coefficients are then adjusted to fit the region under study, using secondary data sources. Adcock and Waldman [1] and Morrison and Smith [2] reported evidence that non-survey technqiues do in fact provide a fair approximation to the economic structure of the regions observed in their studies.

The following steps summarize the techniques and approaches used.

(1) The 83 sectors of the national input-output tables for 1971 [3] were aggregated into 27 sectors. Of these, 26 are the producing sectors while the 27th represents the primary input sector, the value added, using a routine developed by Curtis [4]. Table 1 shows the aggregation of national sectors scheme corresponding to the regional sectors.

(2) The aggregated national technical coefficients were scaled by the combined location quotient of each sector of the Mississippi-Alabama Coastal Region as follows:

Let: $LQ_j$ = Location quotient of sector j

$N_j^{R_1}$ = Employment in sector j in Mississippi Coastal Region

$N_j^{R_2}$ = Employment in sector j in Alabama Coastal Region

$N^{R_1}$ = Total Mississippi regional employment

$N^{R_2}$ = Total Alabama regional employment

$N_j$ = National employment in sector j

$N$ = Total National employment

then:

$$LQ_j = \frac{\dfrac{N_j^{R_1}}{N^{R_1}}}{\dfrac{N_j}{N}} \cdot \frac{N_j^{R_1}}{N_j^{R_1} + N_j^{R_2}} + \frac{\dfrac{N_j^{R_2}}{N^{R_2}}}{\dfrac{N_j}{N}} \cdot \frac{N_j^{R_2}}{N_j^{R_1} + N_j^{R_2}}$$

$$= \frac{\dfrac{(N_j^{R_1})^2}{N^{R_1}} + \dfrac{(N_j^{R_2})^2}{N^{R_2}}}{\dfrac{N_j}{N}\,(N_j^{R_1} + N_j^{R_2})} \quad . \qquad (4)$$

When employment data were not available, the corresponding output data were used:

If:

| | |
|---|---|
| $LQ_j = 1$ | implies that the region is self sufficient in sector j. |
| $LQ_j < 1$ | implies that the region is less than self sufficient in sector j, and it is an indication that inputs from other regions are necessary. |
| $LQ_j > 1$ | implies that the region is more than self sufficient. |

For the purpose of this study, when $LQ_j > 1$, the assumption is made that regional requirements of sector j are satisfied and location quotient is set equal to 1.00. Table 2 shows the values of the location quotients on an individual and combined basis.

Applying the location quotients to the national technical coefficients yields an adjusted direct requirements table, the adjustments being the scaling of the national technical coefficients to reflect more accurately the regional industrial structure.

(3) Monetary gross outputs of the 26 producing sectors of the Mississippi-Alabama coastal region are obtained from the individual input-output studies, respectively, [5], [6] as shown in Table 3. These totals are then multiplied by the regionalized technical coefficients to produce the estimated entries of the transaction table.

## ANALYSIS OF IMPACTS TO LOSS IN INDUSTRY AND COMMERCE

This section presents a method of analysis whereby impacts of loss to industry and commerce due to unforeseen events can be calculated by altering a current regional I-O model. For the Mississippi-Alabama coastal counties, such events occur largely in the form of hurricanes.

This method may also be used to evaluate the effects of closing of some industries in a region as the result of an economic downturn.

Within a decade, two major hurricanes, Camille in August of 1969, and Frederic in September of 1979, hit the shores of these counties, causing substantial damage. Williams [7,8] has estimated the damages to the area to be $1 billion and $1.25 billion, in current dollars, respectively.

Such damage, in general, has a short-term effect on the productive capacity of a region. Affected industries could, within a reasonable time (one year), regain their former economic positions.

The proposed method for modifying a current I-O model is based in part on work by Cartwright [9] on the impacts of nuclear reactor accidents. It is an intraregional I-O technique.

For the purpose of illustration, the Mississippi-Alabama coastal counties I-O models are aggregated into 8 major producing sectors as follows:

$X_1$ = Natural Resources, Sectors 1-6.

$X_2$ = Construction, Sector 7.

$X_3$ = Manufacturing, Sectors 8-17.

$X_4$ = Transportation Communication, Sectors 18-20.

$X_5$ = Wholesale-Retail, Sector 21.

$X_6$ = Finance-Real Estate, Sector 22.

$X_7$ = Public Service, Sectors 23-25.

$X_8$ = State and Local Government, Sector 26.

The aggregations are presented in Tables 4 and 5. Table 4 is the aggregated Transactions Matrix and Table 5 is the aggregated Direct Requirements Matrix.

Assume that the Construction and Manufacturing sectors incur damages due to a hurricane in the amounts of $100 million and $500 million, respectively. These are strictly hypothetical sums since in actuality, all sectors would be affected, although to different degrees.

The following symbols and notation will be used to explain the procedures:

r: study region,

u: unaffected economic sectors,

v: affected economic sectors,

then from equation (1), the intraregional economic transactions between the two sectors are:

$$X_i^r = \sum_j X_{ij}^r + D_i^r$$

$$X_i^u = \sum_j X_{ij}^{uu} + \sum_j X_{ij}^{uv} + D_i^u$$

$$X_i^v = \sum_j X_{ij}^{uv} + \sum_j X_{ij}^{vv} + D_i^v \,.$$

In matrix notation,

$$\begin{bmatrix} X^r \end{bmatrix} = \begin{bmatrix} X_i^u \\ X_i^v \end{bmatrix} = \begin{bmatrix} X_{ij}^{uu} & X_{ij}^{uv} \\ X_{ij}^{vu} & X_{ij}^{vv} \end{bmatrix} + \begin{bmatrix} D_i^u \\ D_i^v \end{bmatrix}, \qquad (5)$$

and

$$D_i^r = D_i^u + D_i^v \,.$$

In order to modify the Transaction Matrix in Table 4 to the form given in (5), it will be necessary to alter the direct requirements $a_{ij}^r$ by a new location quotient defined as follows:

$$LQ_i^u = \frac{\dfrac{X_i^u}{\sum_i X_i^u}}{\dfrac{X_i^r}{\sum_i X_i^r}} \,,$$

$$LQ_i^v = \frac{\dfrac{X_i^v}{\sum_i X_i^v}}{\dfrac{X_i^r}{\sum_i X_i^r}} ,$$

where

$$LQ_i = \begin{bmatrix} 1 & LQ_i > 1 \\ & \\ LQ_i & LQ_i < 1 \end{bmatrix} .$$

The sequence for obtaining the values in (5) is as follows:

(1) $$X_{ij}^{uu} = a_{ij}^{uu} \quad X_j^u$$

$$a_{ij}^{uu} = (LQ_i^u)(a_{ij}^r)$$

(2) $$X_{ij}^{uv} = a_{ij}^{uv} \quad X_j^v$$

$$a_{ij}^{uv} = a_{ij}^r - a_{ij}^{vv}$$

$$a_{ij}^{vv} = (LQ_i^v)(a_{ij}^r)$$

(3) $$X_{ij}^{vu} = a_{ij}^{vu} \quad X_j^u$$

$$a_{ij}^{vu} = a_{ij}^r - a_{ij}^{vu}$$

$$a_{ij}^{uu} = (LQ_i^u)(a_{ij}^r)$$

(4) $$X_{ij}^{vv} = a_{ij}^{vv} \quad X_j^v$$

$$a_{ij}^{vv} = (LQ_i^v)(a_{ij}^r)$$

The new final demands, $D_i^u$, and $D_i^v$, and final purchases, $V_j^u$ and $V_j^v$, can be found from the following relations:

$$D_i^u = X_i^u - \sum_j X_{ij}^{uu} - \sum_j X_{ij}^{uv} ,$$

$$D_i^v = X_i^v - \sum_j X^{vv} - \sum_j X_{ij}^{vu} ,$$

$$V_j^u = X_j^u - \sum_i X_{ij}^{uu} - \sum_i X_{ij}^{vu} ,$$

$$V_j^v = X_j^v - \sum_i X_{ij}^{vv} - \sum_i X_{ij}^{uv} .$$

Results of calculation by section for these equations are given in Tables 6 and 7.

Table 6 shows current total output, the hypothetical unaffected area's total output, the affected area's total output, and the appropriate location quotients by sector. The values of $LQ_i^u$ for the unaffected sectors are greater than 1, while those for the affected sectors are less than 1. The values of the unaffected sectors' location quotients, $LQ_i^v$, are greater than 1.

Table 7 is the modified transactions matrix. The four parts of the table may be explained as follows:

(1) $X^{uu}$: The elements in this portion represent the sales and purchases of the unaffected industries. In a sense, these entries comprise the new transaction matrix of the region.

In matrix notation, the Interdependence Coefficient matrix is obtained by using equation (3):

$$X^{uu} - A^{uu} X^{uu} = D^{uu} ,$$

and

$$X^{uu} = (I - A^{uu})^{-1} D^{uu},$$

where

$D^{uu}$ = final demand, assumed to be unchanged except for the affected sectors,

$A^{uu}$ = new direct requirements matrix obtained from total inputs $X^{u'}$ as follows:

$$X^{u'} = X_i^u - \Delta X_i^u$$
$$\Delta X_i^u = (I-A^{uu})^{-1}(\Delta D_i^u + D_i^u)$$
$$\Delta D_i^u = \sum_j X_{ij}^u \ .$$

(2) $X^{uv}$: The elements in this section represent the decreased sales of the unaffected industries to the affected sectors. For instance, the loss to sector $X_1$ is \$536,000 from $X_2$ and \$23,000,000 from sector $X_3$. That is, the total decrease in the demand for the products of sector $X_1$ is \$23,536,000.

(3) $X^{vu}$: The elements in this matrix represent the loss in supply of the affected sectors to the unaffected sectors. For instance, sector $X_1$ has its supplies decreased by \$219,000 from sector $X_2$ and \$2,372,000 from sector $X_3$.

(4) $X^{vv}$: The elements in this matrix represent the direct losses within the affected sectors. For instance, the loss of sales of sector $X_3$ to sector $X_2$ in the affected industries is \$18,267,000. In order to compute the Interdependence Coefficient Matrix, the following equations given in matrix notation are used:

$$X^{vv} - A^{vv} X^{vv} = D^{vv}$$
$$X^{vv} = (I-A^{vv})^{-1} D^{vv} \ .$$

Here the final demand $D^{vv}$ is obtained by adding the values in the final demand column to the corresponding row values $X_{ij}^{vu}$ . For instance,

$$D_2^{vv} = 75{,}579 + (219 + 16 + 1602 + 2292 + 342 + 3343 + 825 + 12265) = 96{,}483.$$

Hence, the transaction matrix will be given by:

| | $X_1$ | $X_2$ | Final Demand | Total |
|---|---|---|---|---|
| $X_1$ | 35 | 3,482 | 96,483 | 100,000 |
| $X_2$ | 18,267 | 153,445 | 328,288 | 500,000 |
| Final Purchases | 81,698 | 343,073 | | |
| Total | 100,000 | 500,000 | | 600,000 |

Computation of the Interdependence Coefficient Matrix in both Cases 1 and 4 is for the purpose of estimating employment and output multipliers. These are useful when impact analysis is desired.

TABLE 1

AGGREGATION OF 83 SECTORS
NATIONAL INPUT-OUTPUT MODEL
INTO 27 REGIONAL SECTORS -
MISSISSIPPI-ALABAMA COASTAL COUNTIES

| Regional Sector No. | Description | Corresponding National Sectors |
|---|---|---|
| 1 | Fishery ) | 3 |
| 2 | Forestry ) | |
| 3 | Livestock | 1 |
| 4 | Crops | 2 |
| 5 | Ag., For., Fish. Services | 4 |
| 6 | Mining | 5, 6, 7, 8, 9, 10 |
| 7 | Construction | 11, 12 |
| 8 | Food Processing | 14 |
| 9 | Apparel & Textiles | 18, 19 |
| 10 | Lumber & Wood | 20, 21 |
| 11 | Paper & Allied | 24, 25 |
| 12 | Printing & Publishing | 26 |
| 13 | Chemicals & Allied | 27, 28, 29, 30, 31 |
| 14 | Stone, Clay & Glass | 35, 36 |
| 15 | Primary & Fabric. Metals | 37, 38, 39, 40, 41, 42 |
| 16 | Transportation Equipment | 59, 60, 61 |
| 17 | Other Manufacturing | 13, 15, 16, 17, 22, 23, 32, 33, 33, 34, 43, 44, 45, 46, 47, 48 |
| 18 | Water Transportation) | 65 |
| 19 | Other Transportation) | |
| 20 | Communication & Util. | 66, 67, 68 |
| 21 | Whlsl. & Retail Trade | 69 |
| 22 | Finance, Ins., & Real Estate | 70, 71 |
| 23 | Hotel, Pers. & Repair Service | 72 |
| 24 | Medical, Educ. & Non Prof. | 76 |
| 25 | Other Services | 73, 74, 75 |
| 26 | State & Local Government | 78 |
| 27 | Final Purchases | 77, 79, 80, 81, 82, 83 |

TABLE 2

LOCATION QUOTIENTS

| Sector | Mississippi Location Quotient* | Alabama Location Quotient** | Combined Mississippi-Alabama Location Quotient *** |
|---|---|---|---|
| Forestry and Fishery | 21.44 | 13.80 | 17.37 |
| Livestock | .31 | .48 | .44 |
| Crops | .13 | 1.30 | 1.24 |
| Agriculture, For., Fish. Services | 1.49 | .75 | 1.01 |
| Mining | .24 | 1.92 | 1.07 |
| Construction | 1.15 | 1.29 | 1.23 |
| Food Processing | .97 | .88 | .93 |
| Apparel and Textiles | .45 | .90 | .77 |
| Lumber and Wood | .75 | 2.31 | 1.98 |
| Paper and Allied | 2.00 | 7.49 | 6.51 |
| Printing and Publishing | .26 | .57 | .49 |
| Chemicals and Allied | 1.17 | 1.83 | 1.60 |
| Stone, Clay and Glass | .67 | .62 | .64 |
| Primary and Fabric Materials | .42 | .32 | .39 |
| Transportation Equipment | 8.62 | 1.06 | 7.63 |
| Other Manufacturing | .12 | .21 | .18 |
| Water and Other Transportation | 1.77 | 1.62 | 1.65 |
| Communications and Util. | 1.10 | 1.16 | 1.13 |
| Wholesale and Retail Trade | .83 | 1.13 | 1.02 |
| Finance, Ins., Real Estate | .66 | .89 | .80 |
| Hotel, Pers. and Repr. Service | 2.43 | 1.20 | 1.73 |
| Medical, Education and Nonprof. | .37 | .99 | .86 |
| Other Services | 1.02 | 1.01 | 1.02 |
| State and Local Government | 1.35 | .88 | 1.11 |

* Source 5
** Source 6
*** Source Equation (4)

TABLE 3

GROSS OUTPUT TOTALS OF 26
PRODUCING SECTORS OF THE
MISSISSIPPI-ALABAMA COASTAL REGION
1972 Data

| Producing Sector | Gross Output Mississippi Coastal Region* (Thousand Dollars) | Gross Output Alabama Coastal Region** (Thousand Dollars) | Total Output Mississippi-Alabama Coastal Region (Thousand Dollars) |
|---|---|---|---|
| 1. Fisheries | 11,900 | 17,728 | 29,628 |
| 2. Forestry | 7,900 | 4,837 | 12,737 |
| 3. Livestock | 4,160 | 15,912 | 20,072 |
| 4. Crops | 1,582 | 29,749 | 31,331 |
| 5. Ag., For., Fish Services | 1,667 | 3,030 | 4.697 |
| 6. Mining | 9,458 | 36,516 | 45,974 |
| 7. Construction | 119,400 | 304,386 | 423,786 |
| 8. Food Processing | 99,838 | 68,300 | 168,138 |
| 9. Apparel and Textiles | 9,915 | 46,327 | 56,242 |
| 10. Lumber and Wood | 15,659 | 58,800 | 74,459 |
| 11. Paper and Allied | 81,038 | 356,374 | 437,412 |
| 12. Printing and Publishing | 6,003 | 19,400 | 25,403 |
| 13. Chemicals and Allied | 211,228 | 281,100 | 492,328 |
| 14. Stone, Clay and Glass | 17,392 | 31,300 | 48,692 |
| 15. Primary and Fab. Metals | 55,284 | 11,000 | 66,284 |
| 16. Transportation Equipment | 523,622 | 85,900 | 609,522 |
| 17. Other Manufacturing | 28,622 | 141,500 | 170,122 |
| 18. Water Transportation | 25,070 | 118,439 | 143,509 |
| 19. Other Transportation | 32,850 | 106,298 | 139,148 |
| 20. Communication and Utilities | 121,867 | 154,701 | 276,568 |
| 21. Whlsl. and Retail Trade | 239,006 | 419,738 | 658,744 |
| 22. Finance, Ins., Real Estate | 110,900 | 357,722 | 468,622 |
| 23. Hotel, Pers. and Repr. Serv. | 29,067 | 47.010 | 76,077 |
| 24. Medical, Educ. and Nonprof. | 73,676 | 129,255 | 202,901 |
| 25. Other Services | 93,499 | 148,255 | 241,724 |
| 26. State and Local Government | 141,417 | 267,243 | 408,660 |
| TOTAL | 2,072,020 | 3,260,760 | 5,332,780 |

*Source: 5
**Source: 6

TABLE 4

TRANSACTION MATRIX
MISSISSIPPI-ALABAMA COASTAL COUNTIES
VALUES IN $ THOUSANDS

| | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | Intermediate Demand | Final Demand | Total Output |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $X_1$ | 13,410 | 2,270 | 98,836 | 6,507 | 1,260 | 4,410 | 785 | 1,531 | 129,000 | 15,439 | 144,439 |
| $X_2$ | 1,565 | 148 | 14,968 | 16,420 | 2,451 | 23,932 | 5,910 | 87,856 | 153,250 | 270,536 | 423,786 |
| $X_3$ | 17,513 | 77,416 | 659,388 | 16,731 | 22,754 | 7,633 | 37,568 | 11,399 | 850,402 | 1,298,200 | 2,148,602 |
| $X_4$ | 4,869 | 10,404 | 99,551 | 72,245 | 20,452 | 8,686 | 27,370 | 52,062 | 295,639 | 263,586 | 559,225 |
| $X_5$ | 4,653 | 38,469 | 72,980 | 10,331 | 13,735 | 6,631 | 15,934 | 4,524 | 167,257 | 491,487 | 658,744 |
| $X_6$ | 10,644 | 5,179 | 41,495 | 14,182 | 37,978 | 47,131 | 27,770 | 12,568 | 196,947 | 271,675 | 468,622 |
| $X_7$ | 2,560 | 19,290 | 71,844 | 15,588 | 35,507 | 19,412 | 30,168 | 13,085 | 207,454 | 313,248 | 520,702 |
| $X_8$ | 6 | 215 | 647 | 29,446 | 2,526 | 2,868 | 1,029 | 495 | 37,232 | 371,428 | 408,660 |
| Endogenous Totals | 55,220 | 153,391 | 1,059,709 | 181,450 | 136,663 | 120,694 | 146,534 | 183,520 | | | |
| Final Purchases | 89,219 | 270,395 | 1,088,893 | 377,775 | 522,081 | 347,928 | 374,168 | 225,140 | | | |
| TOTAL | 144,439 | 423,786 | 2,148,602 | 559,225 | 658,744 | 468,622 | 520,702 | 408,660 | | | 5,332,780 |

Table 5

DIRECT REQUIREMENTS MATRIX
MISSISSIPPI - ALABAMA COASTAL COUNTIES

| | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ |
|---|---|---|---|---|---|---|---|---|
| $X_1$ | .092842 | .005356 | .046000 | .011636 | .001913 | .009391 | .001508 | .003746 |
| $X_2$ | .010835 | .000349 | .006966 | .029362 | .003721 | .051069 | .011350 | .214986 |
| $X_3$ | .121248 | .182677 | .306892 | .029918 | .034541 | .016288 | .072149 | .027894 |
| $X_4$ | .033710 | .024550 | .046333 | .129188 | .031047 | .018535 | .052564 | .127397 |
| $X_5$ | .032214 | .090775 | .033966 | .018474 | .020850 | .014150 | .030601 | .011070 |
| $X_6$ | .073692 | .012221 | .019313 | .025360 | .057652 | .100574 | .053332 | .030754 |
| $X_7$ | .017724 | 045518 | .033438 | .027874 | .053901 | .041424 | .057937 | .032019 |
| $X_8$ | .000042 | .000507 | .000301 | .052655 | .003835 | .006120 | .001976 | .001211 |
| Endogenous Totals | .382307 | .361954 | .493209 | .324467 | .207460 | .257551 | .281416 | .449077 |
| Final Purchases | .617693 | .638046 | .506791 | .675533 | .792540 | .742449 | .718584 | .550923 |
| Total | 1.000000 | 1.00000 | 1.00000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 |

TABLE 6

LOCATION QUOTIENTS
(Thousands of Dollars)

| Sector | Current Total Output | Unaffected Total Output $u_i$ | $LQ_i^u$ | Affected Total Output $v_i$ | $LQ_i^v$ |
|---|---|---|---|---|---|
| $X_1$ | 144,439 | 144,439 | $\frac{.0305}{.0271} = 1.1255$ | 0 | 0 |
| $X_2$ | 423,786 | 323,786 | $\frac{.0684}{.0795} = .8604$ | 100,000 | $\frac{.1667}{.0795} = 2.0969$ |
| $X_3$ | 2,148,602 | 1,648,602 | $\frac{.3483}{.4029} = .8645$ | 500,000 | $\frac{.8333}{.4029} = 2.0683$ |
| $X_4$ | 559,225 | 559,225 | $\frac{.1182}{.1049} = 1.1268$ | 0 | 0 |
| $X_5$ | 658,744 | 658,744 | $\frac{.1392}{.1235} = 1.1271$ | 0 | 0 |
| $X_6$ | 468,622 | 468,622 | $\frac{.0990}{.0979} = 1.1263$ | 0 | 0 |
| $X_7$ | 520,702 | 520,702 | $\frac{.1100}{.1576} = 1.1270$ | 0 | 0 |
| $X_8$ | 408,660 | 408,660 | $\frac{.0863}{.0766} = 1.1266$ | 0 | 0 |
| TOTAL | 5,332,780 | 4,732,780 | | 600,000 | |

TABLE 7

MODIFIED TRANSACTIONS MATRIX
(Thousands of Dollars)

| | | U | | | | | | | | V | | | | | | | | Final Demand | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | | |
| U | $X_1$ | 13,410 | 1,734 | 75,836 | 6,507 | 1,260 | 4,401 | 785 | 1,531 | 0 | 536 | 23,000 | 0 | 0 | 0 | 0 | 0 | 15,439 | 144,439 |
| | $X_2$ | 1,346 | 97 | 9,882 | 14,128 | 2,109 | 20,591 | 5,085 | 75,591 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 194,957 | 323,786 |
| | $X_3$ | 15,140 | 51,134 | 437,387 | 14,464 | 19,678 | 6,599 | 32,478 | 9,854 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,061,868 | 1,648,602 |
| | $X_4$ | 4,869 | 7,949 | 76,384 | 72,245 | 20,452 | 8,686 | 27,370 | 52,062 | 0 | 2,455 | 23,167 | 0 | 0 | 0 | 0 | 0 | 263,586 | 559,225 |
| | $X_5$ | 4,653 | 29,392 | 55,996 | 10,331 | 13,735 | 6,631 | 15,394 | 4,524 | 0 | 9,078 | 16,983 | 0 | 0 | 0 | 0 | 0 | 491,487 | 658,744 |
| | $X_6$ | 10,644 | 3,957 | 31,839 | 14,182 | 37,978 | 47,131 | 27,770 | 12,568 | 0 | 1,222 | 9,656 | 0 | 0 | 0 | 0 | 0 | 271,675 | 468,622 |
| | $X_7$ | 2,560 | 14,738 | 55,126 | 15,588 | 35,507 | 19,412 | 30,168 | 13,085 | 0 | 4,552 | 16,718 | 0 | 0 | 0 | 0 | 0 | 313,248 | 520,702 |
| | $X_8$ | 6 | 164 | 496 | 29,446 | 2,526 | 2,868 | 1,029 | 495 | 0 | 51 | 150 | 0 | 0 | 0 | 0 | 0 | 371,429 | 408,660 |
| V | $X_1$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | $X_2$ | 219 | 16 | 1,602 | 2,292 | 342 | 3,343 | 825 | 12,265 | 0 | 35 | 3,482 | 0 | 0 | 0 | 0 | 0 | 75,579 | 100,000 |
| | $X_3$ | 2,372 | 8,014 | 68,554 | 2,267 | 3,081 | 1,034 | 5,090 | 1,544 | 0 | 18,267 | 153,445 | 0 | 0 | 0 | 0 | 0 | 236,332 | 500,000 |
| | $X_4$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | $X_5$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | $X_6$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | $X_7$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | $X_8$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 83,219 | 206,591 | 835,500 | 377,775 | 522,081 | 347,928 | 374,168 | 225,140 | | 63,804 | 253,393 | | | | | | | |
| | | 144,439 | 323,786 | 1,648,602 | 559,225 | 658,744 | 468,622 | 520,702 | 408,660 | 0 | 100,000 | 500,000 | 0 | 0 | 0 | 0 | 0 | | |

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