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Interregional Freight Flow Analysis Based on Rectangular Input-Output Tables

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1. Introduction

One way to analyze interregional freight flows is through the multiregional rectangular input-output (MRRIO) table. To obtain this table, the non-survey technique is preferred over the survey-based technique because it is more economical.

The rectangular model is superior to the Leontief model in that it is more exhaustive and because it handles the secondary-product problem more effectively (Louis,1989). Moreover, according to the various single-region applications, the rectangular system is useful in constructing the multiregional model.

The iterative technique was applied to the 1985 multiregional input-output table (Leontief form) and 1985 national rectangular output (V) table of Japan, to construct the MRRIO model. The nation was divided into three regions, i.e., north-eastern (r), center (s) and others (o). Commodity and industry were classified into three sectors.

The refined proceeding with the MRRIO table was required before iteration is processed. Some assumptions were made the initial table.

2. Methodology

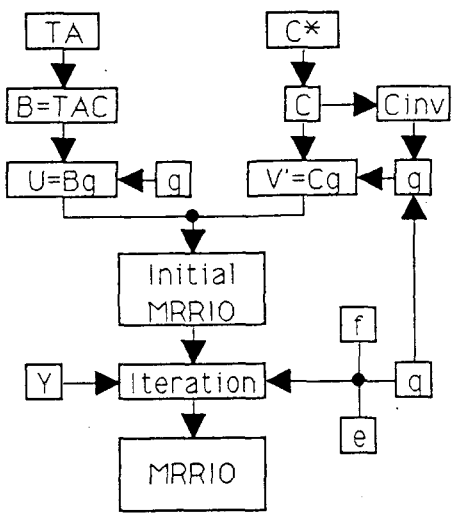
The MRRIO table is shown in table 1.

Table 1 MRRIO Model

	com	ind	com	ind			
com		U_{ij}^{rs}		U_{ij}^{ro}	f_i^r	e_i^r	q_i^r
ind	V_{ij}^{sr}		V_{ij}^{so}				g_i^s
com		U_{ij}^{or}		U_{ij}^{oo}	f_i^o	e_i^o	q_i^o
ind	V_{ij}^{or}		V_{ij}^{oo}				g_i^o
		y_j^r		y_j^o			
	q_j^r	g_j^s	q_j^o	g_j^o			

where;
U : input matrix V : output matrix
q : domestic input vector
g : industry output vector
f : final demand
e : net national export
y : value added
r, s : region
i, j : commodity or industry sector
com : commodity
ind : industry

Estimation procedure of MRRIO model is shown as below



2.1 The Initial MRRIO Table

Form national rectangular input-output table, the analysis which follows rests on five relationships given below, three of these are arithmetic identities and the other two are assumptions relating to the technical condition of production.

$$q = Ui + f + e \quad ---(1)$$

$$q = V'i \quad ---(2)$$

$$g = Vi \quad ---(3)$$

$$U = B\hat{g} \quad \text{---(4)}$$

$$V = C\hat{g} \quad \text{---(5) (commodity technology assumption)}$$

where;

B, C : matrix of coefficients of dimensions commodity x industry

From eq.1,2,4 and 5, we obtain

$$q = (I - BC^{-1})^{-1} (f + e) \quad \text{---(6)}$$

where;

I : the unit matrix

Interregional input-output analysis (Leontief form) is based on

$$q = TAq + Tf + e$$
$$= (I - TA)^{-1} (Tf + e) \quad \text{---(7)}$$

where;

T : trade coefficient

TA : matrix of coefficients of dimensions commodity x commodity

From eq.6 and eq.7, we obtain

$$TA = BC^{-1} \quad \text{---(8)}$$

With eight equations and the assumption that each regional C coefficient structures and each interregional C coefficient structures are same as national C* coefficient structure, the initial MRRIO table can be constructed.

2.2 Iterative algorithms

The advantage of the MRRIO model has the advantage of taking into account the interregional trade-flow data in terms of commodity and industry.

The trade-flow in terms of commodity rests on two relationships.

$$\sum_i V_{ik}^{rs} = \sum_j U_{kj}^{rs} + f_k^{rs} \quad \text{---(9)}$$

The commodity k exported by the various industries in region r to region s equals that commodity k imported by various industries and final demand in region s from region r.

$$\sum_m \sum_i V_{ik}^{rm} = \sum_m \sum_j U_{kj}^{rm} + \sum_m f_k^{rm} + e_k^r \quad \text{---(10)}$$

The supply of commodity k from various industries in region r equals the demand of that commodity k by the various industries and final demand in other regions including net national export.

From eq.9 and eq.10, we obtain

$$\sum_i V_{ik}^{rr} = \sum_j U_{kj}^{rr} + f_k^{rr} + e_k^r \quad \text{---(11)}$$

The supply of commodity k from various industries in region r and consumed in region r equals the demand of commodity k by the various industries, final demand and net national export in region r.

The trade-flow in terms of industry rests on the relationship given below.

$$\sum_m \sum_j V_{kj}^{rm} = \sum_m \sum_i U_{ik}^{mr} + y_k^r \quad \text{---(12)}$$

The supply of industry k in region r equals the demand of industry k in region r.

The iterative algorithms employ eq.9, eq.11 and eq.12 to construct the MRRIO model.

3. Results and Discussion

Using the initial MRRIO table, prepared from two 1985 Japan tables, the MRRIO table was constructed by iterative algorithms. Convergence was obtained with 8 iterations on U and 166 iterations on V.

For three regions and three classifications of each commodity and each industry, the number of variables equal 162 while the number of constraints equal 72. Since the number of variables exceed the number of constraints, a number of solutions can be obtained. It should be emphasized that care must be taken in constructing the initial MRRIO table since the coefficients of the constraints are based on it.

4. Further Study

After constructing the MRRIO table, it would then be necessary to convert the entries to amount of goods for use in the field of transportation planning.

5. References

United Nations, 1968. "A System of National Accounts", United Nations Publication, 48-49.

Louis, L.V.St, 1989. "Empirical Tests of Some Semi-Survey Update Procedures Applied to Rectangular Input-Output Tables", Journal of Regional Science, 29, 273-385.