

## 2. DEVELOPMENT OF MEASURING SYSTEM FOR ECONOMIC IMPACTS : BY USING INTERREGIONAL INPUT-OUTPUT ANALYSIS

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**Abstract** : In this paper, We present the interactive system that even an ordinary person can measure economic impacts which are derived from public investment. The features of this new system are following two respects : In the first place, Everybody can measure economic impacts by interregional input-output analysis which could not analysis in any prefectures so far. And then, can measure it automatically as long as set total cost by having database of input component ratio for public works. Everybody can measure economic impacts by using this system in short time, and besides, can measure it minutely.

**Keywords** : *Public investment, Interregional Input-Output Analysis, Interactive system for measuring economic impacts, Graphical User Interface(GUI), Personal Computer*

### 1. INTRODUCTION

When public works such as the construction of an airport or a road are done, the case is increasing every year where the economic effect which the work causes is measured by input-output analysis. The main reasons are as follows. First of all, it is enumerated that the necessity for quantitatively grasping the effect which the project gives to the economy is increasing in order to prove the effectiveness of doing public works as reflation policy. Another main factor is that analysis tools have become easier to use owing to the proliferation of personal computers and application software such as spreadsheet programs.

However, there are still many problems when the economic effect is actually measured by input-output analysis. First of all, sufficient knowledge concerning input-output analysis is needed. A lot of time and efforts are needed in the measurement process such as making various coefficients that are necessary for analysis, too. In addition, when the economic effect is measured for a specific region such as administrative divisions, there is a problem that it has to be measured by intraregional input-output analysis and not by interregional input-output analysis which would be more effective as an analysis. Thus, we have developed a system that is capable of measuring the economic effect extremely easily by input-output analysis for which a lot of time and efforts were so far necessary, only by giving various conditions. The interregional input-output analysis

which had been difficult at administrative division levels can be easily done by using this system.

### 2. CHARACTERISTIC AND EFFECTIVENESS OF THIS SYSTEM

When the economic effect on a specific region such as administrative divisions is measured, the measurement is usually done by intraregional input-output analysis. The reason is that an input-output table is made using the form of the intraregional input-output table at the administrative division levels.

However, the measurement by this intraregional input-output analysis causes following problems. That is, the effect (hereafter called the "feedback effect") that production outside the region again causes production within the region owing to the relation structure between regions is not included in intraregional input-output analysis. Therefore, it is necessary to use the interregional input-output analysis in order to measure in consideration of the trade between regions. Thus, author et al. have already developed a model which enables the input-output analysis between a specific region and the other regions, even in arbitrary regions, as long as the intraregional input-output table and the national table are available. The economic effect measuring system developed in this research is capable of doing this two-region interregional input-output analysis. If this system is used, all processes from making the

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Chenery-Moses type input-output table to the measurement of the economic effect using the two-region interregional input-output model developed by us can be done. It is necessary to allot construction cost to each industrial sectors to actually measure the economic effect that a public work brings. This work process consists of two systems; a part directly distributed to the endogenous sector and a part distributed to it through the added value sector. To do these estimate work, a lot of efforts are needed in arranging the data and making various coefficients. Therefore, the system developed in this research automatically allots construction cost according to the industry, and makes the final demand vector necessary for input-output analysis. It is one of its main characteristics that the measurement of the economic effect is possible only by inputting the amount of construction cost. In addition, in the actual development of the system, it was developed as a screen-interactive system which operates on personal computers, so that even analysis who do not have enough special knowledge on computers and input-output analysis could carry out the measurement easily. We can measure the economic effects extremely easily only by answering questions on the measurement conditions displayed on the screen one by one.

### 3. POLICY OF DEVELOPMENT AND COMPOSITION OF THIS SYSTEM

#### 3.1 Policy of Development

The program packages which can be used for input-output analysis include ECONOMATE-IO developed by Macroeconometrics society besides the system developed by this research. However, this aims at predictive analysis of the industrial structure that is one of the input-output analysis. Therefore, the ECONOMATE-IO cannot measure directly the economic effect which public works brings like the system developed by this research. Moreover, the type of the Leontief inverse matrix which can be calculated is usual intraregional input-output analysis model type and the calculation of the Leontief inverse matrix in the interregional input-output analysis model is impossible. In addition, its latest version does not work on the operation systems with the GUI, but only on DOS. Then, so that even analysts unfamiliar with computer or input-output analysis can measure economic effects according to their purposes,

we decided on the following development policies in this research:

- (1) The system will enables the measurement of economic effect by the interregion input-output analysis at the administrative division level which has not been realized yet,
- (2) The use of the system will aim at the measurement of economic effect of public works and the data in the input-output table for analyzing construction sector necessary for analyzing the effect of various public works such as roads, airports, and port will prepared as a data base. Moreover, the system will be used for general purposes and will allow any given business other than public works to be analyzed by the input of final demands vector.
- (3) The measurement region and the measurement model will be able to be selected according to analysis purpose.
- (4) Taking the popularization and the performance improvement of the personal computer in recent years into account, the system will work on various types of the personal computer such as DOS/V, Macintosh and PC98 .
- (5) The system will be user-friendly, allowing interactive condition setting through the Graphical User Interface (GUI).

To satisfy the above policies, we used the macro language of Microsoft EXCEL Ver.4 for programming and developed it as an add-in software of EXCEL. The macro language of EXCEL is a simple programming language and is not so versatile as the programming language. However, from the reason that it can fill the development policy in this research, the programming of the matrix calculation is easy, and most of the input-output table which are necessary for analysis are the file format of spreadsheet, we thought it will be useful for the system development.

#### 3.2 Main Function of System

This system is composed of three functions: the measurement of economic effects by input-output analysis, data update, and file management. These functions are as follows.

- (1) measurement of economic effects

Conditions necessary for measurement of economic effects by using are inputted , and according to the measurement conditions economic effects is measured. When the economic effect of

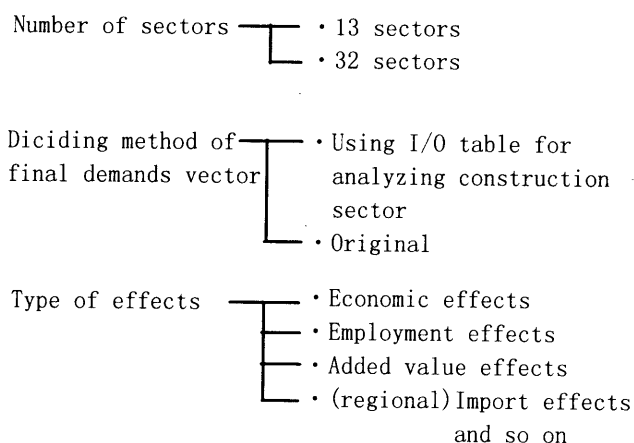


Figure-1 The Extent of Measurement

public works is measured, inputting the gross construction cost automatically creates the final demands vector for measurement. The result of the calculation can be outputted on the screen and printed.

(2) Data update

The input-output tables, the table of composition of each commodity by final demand sectors, and coefficient table for analyzing construction sector which are necessary for measuring the economic effect in this system are newly created, aggregated into 13 sectors or the 32 sectors, and registered in the database of each table.

(3) File management

The measured result can be seen and deleted. It also delete the data registered in the database or stored in the disk.

Figure-1 shows the measurement range of the economic effect measurement system developed in this research. This system can set interactively the measurement conditions such as analysis type and the number of analysis sector, and measure the economic effect, and then display or print any measured result. In the measurement of the economic effect, as the measurements according to purposes of analysis are possible, the system can make the three analysis: interregional input-output analysis at the administrative divisions level, national input-output analysis, and intraregional input-output analysis. Moreover, as for the national input-output analysis, it can make measurement in the two cases; considering the import (open economy) or not considering the import (closed economy). In addition, as well as the economic effect, the employment effect, the added value effect, the (regional)import effect,

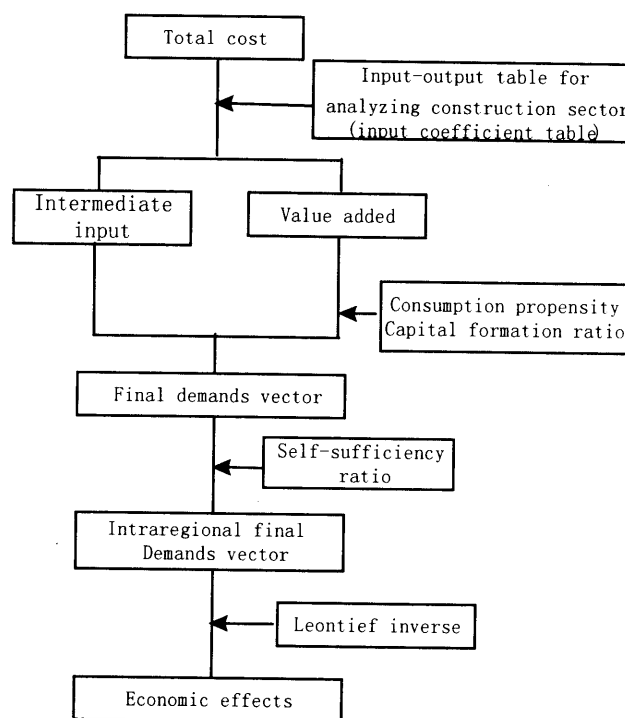


Figure-2 Outline of Measurement

import effect, the influence coefficient, and the responsiveness coefficient can be measured.

3.3 Composition of this System

The calculation order which the economic effect of public works is measured is as follows. First of all, the gross construction cost is distributed to intermediate input and value added using the input coefficients of construction sector. Among these, intermediate input is directly distributed to each industrial sectors, but value added sector must be distributed to industrial sectors after estimating the part used for consumption and capital formation. Construction cost distributed thus are added up according to industry, the final demands vector is created, and the economic effect is found by regional final demands found by multiplying it by the rate of self-sufficiency and the Leontief inverse matrix separately calculated.

The program of this system is composed by four parts such as the establishment of the measuring condition, a calculation with input-output model, the indication of the measuring result, the preservation of the measuring result. As shown in figure-3, the establishment of the measuring conditions are done: the number of sectors, the treatment for trade,

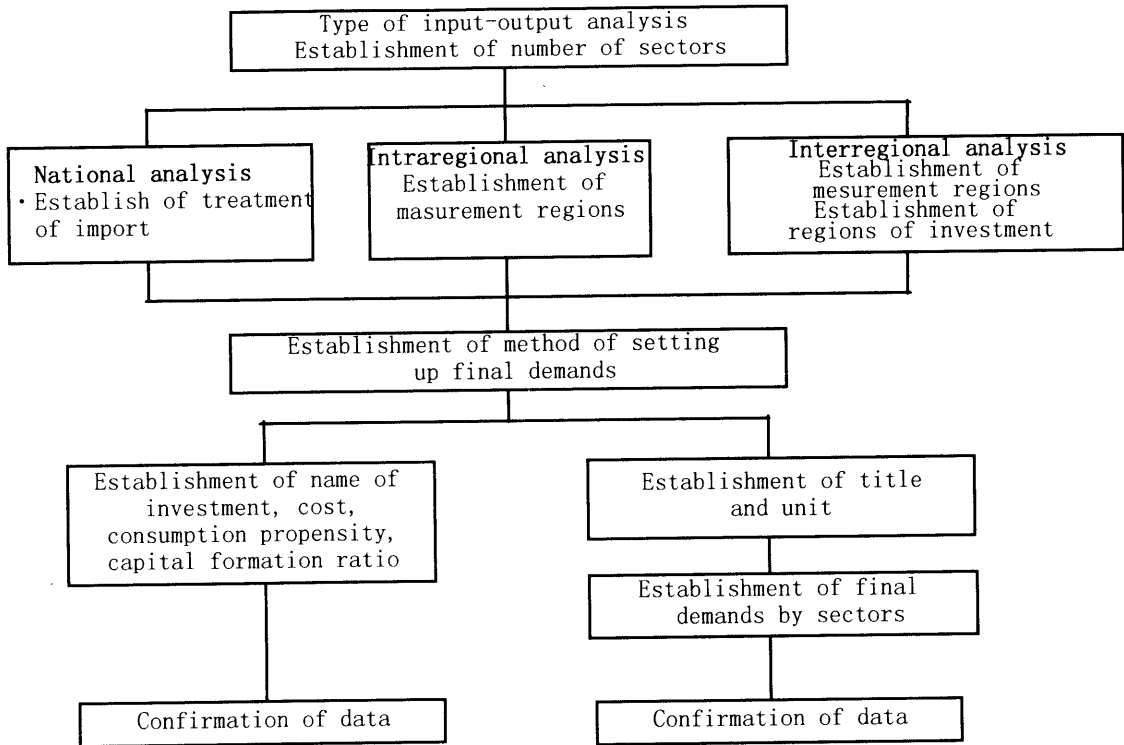
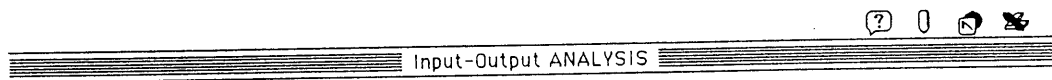


Figure-3 Establishment of the measuring condition



産業連関分析 ステップ4

■建設部門用投入係数表利用

公共事業名	<input type="text" value="下水道"/>	↓	下水道の定義
投資額	<input type="text" value="100"/>		地方公共団体及び地方公営企業の行う 下水道事業の構築物の建設事業。
単位	<input type="text" value="億円"/>		
消費性向	<input type="text" value="0.639728534"/>		
資本形成比率	<input type="text" value="0.525670777"/>		

figure-4 Display of Establishment with Dialogue Box 1(EX: Selection of Public Works Type)

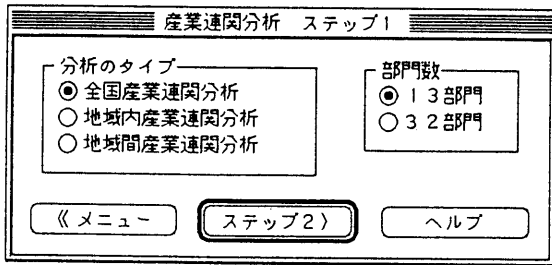


Figure-5 Display of Establishment with Dialog Box 2 (EX: Selection of Analysis Type)

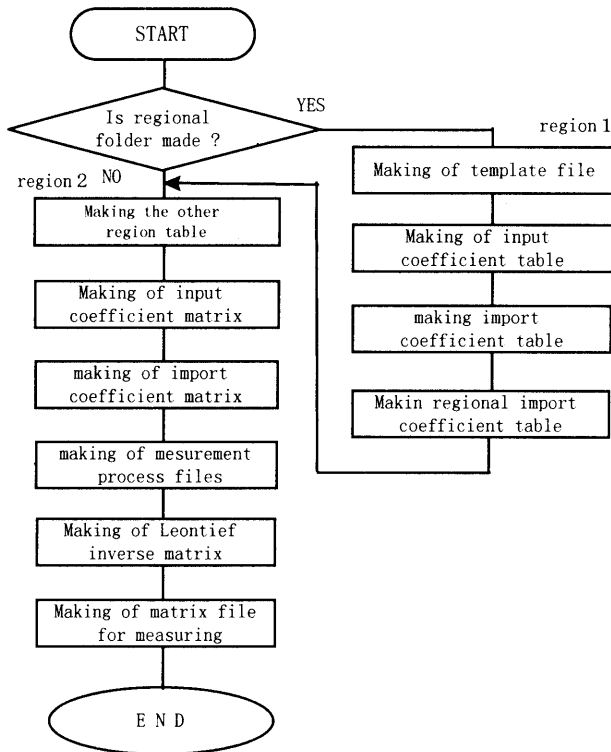


Figure-6 The Flow Chart of Calculation with Inter-regional Input-Output Analysis

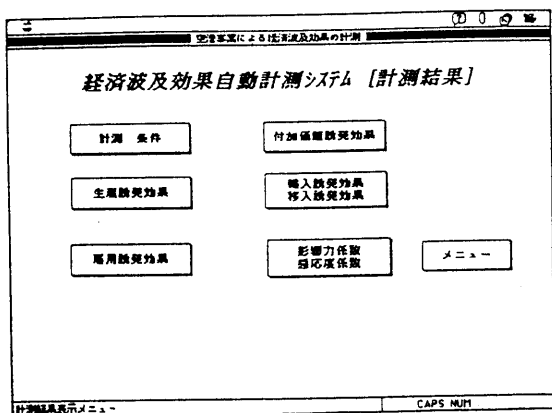


Figure-7 Menu of Measurement

region of measurement, various coefficients and find demands vector. It is possible with this system that 13 sectors or 32 sectors is chosen. Moreover, it can be chosen whether an import is taken into consideration in and the area of measuring can be chosen in intraregional input-output analysis and interregional input-output analysis. When a final demand vector is set up, the two ways of the method which an input coefficient of the construction sector is used for, and the amount of demand by the industry directly can be chosen. In this, business classification is only chosen, and a final demand vector is calculated because the input coefficients are prepared in each enterprise kind when input coefficients is used. But, because the input coefficients of the construction sector are being used, it is decided that the input coefficient prepared with this system show average injection structure in the whole country. And, this setup of conditions is done by using the dialogue box shown in the figure-4 and the figure-5. Next, the process of the calculation with input-output model is shown. The calculation of the coefficients is a different process in each of interregional input-output analysis, national input-output analysis and intra-regional input-output analysis. A figure-6 showed the flow of making the various coefficients in inter-regional input-output analysis. As this figure, the program is the algorithm creating the input-output table, input coefficients table, trade coefficients table, inverse matrix coefficients table in turn. Measuring indication is carried out by choosing the item of the menu which shows it by the figure-7. An analysis person chooses the re-indication of the menu, the printing of the measuring result, the expansion and reduction of the indication and so on, and necessary treatment can be done after that. The preservation of the measuring result is done by dialogue box indicated after the "button" of the menu of the measuring result is pushed. There are "measuring process and measuring result is kept", "a measuring process is kept, and a measuring result is not kept", "A measuring process and a measuring result aren't kept." in the way of keeping it.

#### 4. INPUT-OUTPUT MODEL WHICH CAN BE USED WITH THIS SYSYTEM

In this system, Interregional input-output analysis, national input-output analysis, intraregional input-

産業部門	愛知県		愛知県/その他全国	
	生産誘発	係数	生産誘発	係数
全産業計	88.72000941	1.0584735	80.67549393	0.9624985
農林水産業	0.538101372	0.0064198	3.489513663	0.0416316
製造業	0.132288903	0.0015783	0.753043835	0.0089842
建設業	38.69437846	0.461643	56.05722371	0.6687904
電力・ガス・水道	3.442721673	0.0410734	0.32933719	0.0039292
商業	5.19558382	0.0619859	1.727080514	0.0206049
金融・保険	9.937528085	0.1185596	4.246408077	0.0506617
不動産	3.218031339	0.0383927	2.797065041	0.0333704
運輸・通信	3.987597355	0.047574	0.844247819	0.0100723
公務	6.858328525	0.0818232	3.186433679	0.0380157
サービス	0.208449717	0.0024869	0.046157036	0.0005507
一部	11.85022276	0.141379	3.637993452	0.0434031
分類不明	2.522289235	0.0300922	2.691030073	0.0321053
	2.134488171	0.0254655	0.869959848	0.0103791

Figure-8 Display of Measurement

output analysis is prepared. In this, the interregional input-output model at administrative divisions level is shown in Eq.(1). You must prepare the input-output table of "the measuring area" and "the whole country excepted for the area" to measure economic effect of the public works by using this model-type. Moreover, two intraregional input-output table requires to separate the regional imports and regional exports. Though the "table of the whole country excepted for the area" isn't usually prepared, it is possible for this that it is made by deducting "the intraregional input-output analysis" from the "national table". And, there are many cases that an import and regional import, export and regional export are being separated in intraregional input-output table at administrative division level. After table of the other region is made, a variety coefficient such as the input coefficients which is necessary for measuring of the economic effect is made, and it is coming to measure economic effects with this system. Various coefficients are set up, and  $X_1$  and  $X_2$  which contains feedback effects are calculated by substituting the final demands " $F_{D1}$ " of the area 1 into Eq.(1)

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} = \begin{bmatrix} [I - (I - \bar{N}_1 - \bar{M}_1)A_1] & -\bar{N}_2A_2 \\ -\bar{N}_1A_1 & [I - (I - \bar{N}_2 - \bar{M}_2)A_2] \end{bmatrix}^{-1} \begin{bmatrix} F_{D1} \\ F_{D2} \end{bmatrix} \quad (1)$$

where  $X_r$  is a vector of the total outputs in region  $r(1,2)$ ,  $A_r$  is the input coefficients matrix in region  $r$ ,  $\bar{N}_r$  is regional import coefficients matrix in region  $r$ ,  $\bar{M}_r$  is import coefficients matrix in region  $r$ ,  $F_{Dr}$  is a vector of the regional final demands in region  $r$ . Though the other model-type are Eq.(2)(3)(4), the effect on the economic which these models were used for can be measured corresponding to the purpose of the analysis, too.

$$X = [I - (I - \bar{M})A]^{-1} (I - \bar{M})F \quad (2)$$

$$X = (I - A)^{-1} F \quad (3)$$

$$X_1 = [I - (I - \bar{N}_1 - \bar{M}_1)A_1]^{-1} (I - \bar{N}_1 - \bar{M}_1)F_{D1} \quad (4)$$

where  $X$  is a vector of the total outputs,  $A$  is the input coefficients matrix,  $\bar{M}$  is import coefficients matrix,  $F$  is a vector of the final demands.

## 5. THE MEASUREMENT OF THE APPLICABLE CASE BY THE ECONOMIC EFFECT MEASURING SYSTEM

Measuring of the economic effect which the public works derive is done by using the economic effect measuring system developed by this research. The presumed public works is the drain business carried out in Aichi Prefecture, and the construction cost is

10 billions yen. The number of the analysis sectors is 13 sectors, the final demands vector is made by input-output table for analyzing construction sector. and the economic effect is measured by using with 1990 input-output table. The result of measuring is shown by the figure-8. Economic effect on Aichi Prefecture of only the indirect effect was 8872 millions yen , it on other region was 8068 millions yen. And, the import effect, the regional import effect, the employment effect, the value added effect become results like a table-1 in the total of all the industry.

Table-1 The Result of Measuring

Effect	Region	Result
Import	Aichi	600 millions yen
	Other	500 millions yen
Regional import	Aichi	3900 millions yen
	Other	200 millions yen
Employment	Aichi	639 people
	Other	601 people
Added value	Aichi	4100 millions yen
	Other	3200 millions yen

## 6. CONCLUSIONS

The development of the system which can do measuring of the effect without sufficient technical knowledge based on the tendency that the measuring of economic effect by the public works was on the increase year by year in the business side. The system which had following characteristics could be developed as a result of the research.

- (1)It became possible that the interregional input-output analysis in administrative divisions which could not do it so far was done easily.
- (2)Measuring effect of the public works is possible only the total construction cost was given to it by having the input composition of the public works classification as a data base .
- (3)It is possible that economic effect is measured easily because it can go through all the formalities of measuring with the dialog form.

A future subject is to make it the system which a consumption endogenous model and a price analysis are made in.

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