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The Construction of a 47-Region Inter-regional Input-Output Table
and Inter-regional Interdependence Analysis at Prefecture Level in Japan

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1.Introduction

The construction of several regional input-output tables in Japan has enabled us to perform an economic analysis for various regions. The most important of these tables is the nine-region inter-regional input-output table which covers the whole of Japan, which was produced by MITI(2000)¹⁰⁾ and which is the first of its kind in Japan. However, the regional divisions in this table do not correspond with those of local government. Therefore, researchers in Japan have rarely used this table. Regional input-output tables have been constructed for all prefectures. However, most other regional input-output tables are intra-regional rather than inter-regional. Therefore, analysis using these tables does not take inter-regional interdependence into consideration.

In this study, we attempted to compile a 47-region inter-regional input-output table at prefecture level, covering all of Japan. The hybrid approach of constructing regional input-output tables was adopted in this 47-region inter-regional input-output study. First, intra-regional input-output tables were prepared at the prefecture level. The second step was to estimate the inter-regional trade coefficients. In this study, we propose a method for the estimation of inter-regional trade using a distribution census and some data. In addition, the inter-regional trade coefficients were adjusted using a new iterative method to ensure that the sum of the total output of the 47 regions matched the total output of Japan. Further, this paper presents the characteristic features of a 47-region inter-regional

input-output table and a regional economic analysis using the 47-region inter-regional input-output table. We analyzed regional relations among all prefectures by measuring the inter-regional technical coefficients and the Leontief inverse matrix. In addition, we estimated the effects of an increase in demand for automobiles in the Aichi prefecture on each prefectural economy in Japan.

2. General methodology for constructing inter-regional input-output tables

(1) Outline

It is generally recognized that there are three approaches to constructing inter-regional input-output tables: survey, non-survey, and hybrid. Survey-based tables are considered more accurate. But effectively they are limited by cost and time factors, because the survey technique involves surveys of a large number of firms. The input-output tables for Washington State (1993)¹⁴⁾ are survey-based input-output tables. A survey of a stratified sample of manufacturing and service industries in Washington was undertaken for the 1987 Washington table. For each establishment surveyed, respondents were asked to estimate essentially three things: (1) the value of total output; (2) sales and purchases by sector; and (3) the proportion of each sale and purchase made within and outside Washington. Non-survey methods are based on the use of national tables to derive regional tables and can involve various approaches: the quotient approach, the iterative approach, and so on. These have been detailed and reviewed by Morrison and Smith¹¹⁾ (1974) and Round (1978,1983)¹²⁾¹³⁾ among others. Hybrid approaches use a mix of survey and non-survey elements, attempting to combine some of the advantages of both methods. They require more effort than non-survey methods because they need some additional data, which are obtained through surveys. However, most hybrid methods require far fewer surveys than

survey methods.

For Japan, we are able to obtain from MITI a nine-regional input-output table that covers the whole of Japan. However, because the table's regional divisions do not correspond with the regional divisions of local government, researchers have hardly ever used the nine-region table produced by MITI. In spite of many researchers and policy-makers' need for an inter-regional input-output table at prefecture level covering the whole of Japan, this has not been constructed.

We used statistical data already prepared to construct the 47-region inter-regional input-output table at prefecture level. And we obtained the data by combining the 47 intra-regional input-output tables for all the prefectures in Japan. We are able to use intra-regional input-output tables for all prefectures in Japan from 1990. The most important step in compiling the 47-region inter-regional input-output table is to estimate the inter-regional trade coefficients. We can adopt a non-survey method, such as a technique that uses a spatial computable general equilibrium model. Because this is a modeling method, however, the estimated result is difficult to verify. Methods such as this should be used to measure inter-regional trade coefficients only when data on inter-regional trade cannot be obtained. If some inter-regional trade data can be obtained, the inter-regional trade coefficients should be estimated using them. In this study, we can estimate the inter-regional trade coefficients using the data we have on regional trade.

(2) The relation between the intra-regional input-output table and the inter-regional input-output table

Because we are attempting to construct a 47-region inter-regional input-output table on the basis of intra-regional input-output tables for all 47 prefectures in Japan, the first point that we should discuss is the relation between the intra-regional input-output table and the inter-regional input-output table.

Table 1: Inter-regional Input-Output Accounting Framework

		<i>r</i>			<i>s</i>					
		<i>I</i>	<i>2</i>	<i>FD</i>	<i>1</i>	<i>2</i>	<i>FD</i>	<i>IEx</i>	<i>IIm</i>	<i>Output</i>
<i>r</i>	1	X_{rr}^{11}	X_{rr}^{12}	F_{rr}^1	X_{rs}^{11}	X_{rs}^{12}	F_{rs}^1	IE_r^1	$-IM_r^1$	$X_{r\bullet}^1$
	2	X_{rr}^{21}	X_{rr}^{22}	F_{rr}^2	X_{rs}^{21}	X_{rs}^{22}	F_{rs}^2	IE_r^2	$-IM_r^2$	$X_{r\bullet}^2$
<i>VA</i>		V_{rr}^1	V_{rr}^2	0	V_{rs}^1	V_{rs}^2	0	0	0	$V_{r\bullet}$
<i>s</i>	1	X_{sr}^{11}	X_{sr}^{12}	F_{sr}^1	X_{ss}^{11}	X_{ss}^{12}	F_{ss}^1	IE_s^1	$-IM_s^1$	$X_{s\bullet}^1$
	2	X_{sr}^{21}	X_{sr}^{22}	F_{sr}^2	X_{ss}^{21}	X_{ss}^{22}	F_{ss}^2	IE_s^2	$-IM_s^2$	$X_{s\bullet}^2$
<i>VA</i>		V_{sr}^1	V_{sr}^2	0	V_{ss}^1	V_{ss}^2	0	0	0	$V_{s\bullet}$
<i>r</i>	1	$X_{\bullet r}^{11}$	$X_{\bullet r}^{12}$	$F_{\bullet r}^1$	$X_{\bullet s}^{11}$	$X_{\bullet s}^{12}$	$F_{\bullet s}^1$			
+	2	$X_{\bullet r}^{21}$	$X_{\bullet r}^{22}$	$F_{\bullet r}^2$	$X_{\bullet s}^{21}$	$X_{\bullet s}^{22}$	$F_{\bullet s}^2$			
<i>s</i>	<i>VA</i>	$V_{\bullet r}^1$	$V_{\bullet r}^2$	0	$V_{\bullet s}^1$	$V_{\bullet s}^2$	0			

Abbreviations: FD: Domestic final demand

IEx: International Export

IIm: International Import

Output: Output

VA: Value Added

Where:

$X_{k\bullet}^i (k = r, s; i = 1, 2)$ = output of commodity *i* in the region *k*

$V_{k\bullet} (k = r, s)$ = distributed income in the region *k*

$IE_k^i, IM_k^i (k = r, s; i = 1, 2)$ = export and import of commodity *i* in the region *k*

X_{rs}^{ij} : = product *i* in region *r* consumed by production sector *j* in region *s*

F_{rs}^i : = product *i* in region *r* consumed by final demand sector in region *s*

V_{rs}^i : = distributed income in the region *s*

Table 2: Intra-regional Input-Output Accounting Framework

$$\begin{array}{c}
\begin{array}{cccccccc}
& 1 & 2 & \text{FD} & \text{Ex} & \text{Im} & \text{IEx} & \text{I Im} & \text{Output} \\
r & \begin{array}{c} 1 \\ 2 \\ \text{VA} \end{array} & \begin{array}{c} X_{\bullet r}^{11} \\ X_{\bullet r}^{21} \\ V_{\bullet r}^1 \end{array} & \begin{array}{c} X_{\bullet r}^{12} \\ X_{\bullet r}^{22} \\ V_{\bullet r}^2 \end{array} & \begin{array}{c} F_{\bullet r}^1 \\ F_{\bullet r}^2 \\ 0 \end{array} & \begin{array}{c} E_r^1 \\ E_r^2 \\ V_{rs}^1 + V_{rs}^2 \end{array} & \begin{array}{c} -M_r^1 \\ -M_r^2 \\ -(V_{sr}^1 + V_{sr}^2) \end{array} & \begin{array}{c} IE_r^1 \\ IE_r^2 \\ 0 \end{array} & \begin{array}{c} -IM_r^1 \\ -IM_r^2 \\ 0 \end{array} & \begin{array}{c} X_{r\bullet}^1 \\ X_{r\bullet}^2 \\ V_{r\bullet} \end{array} \\
s & \begin{array}{c} 1 \\ 2 \\ \text{VA} \end{array} & \begin{array}{c} X_{\bullet s}^{11} \\ X_{\bullet s}^{21} \\ V_{\bullet s}^1 \end{array} & \begin{array}{c} X_{\bullet s}^{12} \\ X_{\bullet s}^{22} \\ V_{\bullet s}^2 \end{array} & \begin{array}{c} F_{\bullet s}^1 \\ F_{\bullet s}^2 \\ 0 \end{array} & \begin{array}{c} E_s^1 \\ E_s^2 \\ V_{sr}^1 + V_{sr}^2 \end{array} & \begin{array}{c} -M_s^1 \\ -M_s^2 \\ -(V_{rs}^1 + V_{rs}^2) \end{array} & \begin{array}{c} IE_s^1 \\ IE_s^2 \\ 0 \end{array} & \begin{array}{c} -IM_s^1 \\ -IM_s^2 \\ 0 \end{array} & \begin{array}{c} X_{s\bullet}^1 \\ X_{s\bullet}^2 \\ V_{s\bullet} \end{array}
\end{array}
\end{array}$$

$E_k^i, M_k^i (k = r, s; i = 1, 2)$: regional export and regional import of commodity i in region k

In Table 1, r and s means each region, r+s means the whole country, and $\Gamma \cdot \Gamma$ means the total. Except for vectors of output, Table 1 can be divided into eight blocks as follows.

$$\begin{bmatrix}
A & B & G \\
C & D & H \\
E & F &
\end{bmatrix}$$

In this inter-regional input-output table, the region r's intra-regional input-output table is composed of E and G. Also, the region s's intra-regional input-output table is composed of F and H. When the vectors of output in region r and region s are defined as $X_r = [X_r^1, X_r^2]^T$, $X_s = [X_s^1, X_s^2]^T$, the input-output systems in region r and region s are shown in the following formula.

$$X_r = E + B - C + G = A + G + B \quad (1)$$

$$X_s = F + C - B + H = D + C + H \quad (2)$$

In region r's intra-regional input-output table, part B represents regional exports and part C represents regional imports. In region s's table, part C represents regional exports and part B represents regional imports. Thus, the correspondence of an intra-regional input-output table to an inter-regional input-output table becomes obvious.

3. Estimation of inter-regional trade coefficients and the procedure for constructing a 47-region inter-regional input-output table at prefecture level

(1) Inter-regional trade coefficients

In Japan, input-output tables have been constructed for each prefecture. However, most of them, being intra-regional input-output tables like Table 2. In order to convert intra-regional input-output tables at the prefecture level into an inter-regional input-output table, we need to estimate the inter-regional trade coefficients. The supply-demand balance equations of commodity i in region r can be formed from Table 2 as follows.

$$X_r^i = \sum_j X_r^{ij} + F_r^i + E_r^i - M_r^i \quad (3)$$

Also, regional exports and imports are shown in the following formula.

$$E_r^i = \sum_{s \neq r} \sum_j X_{rs}^{ij} + \sum_{s \neq r} F_{rs}^i \quad (4)$$

$$M_r^i = \sum_{s \neq r} \sum_j X_{sr}^{ij} + \sum_{s \neq r} F_{sr}^i \quad (5)$$

In addition, the following variables are determined.

$$y_{rs}^i = \sum_j X_{rs}^{ij} + F_{rs}^i \quad (6)$$

$$Y_s^i = \sum_j X_s^{ij} + F_s^i \quad (7)$$

y_{rs}^i : Commodity i flow from region r to region s

Y_s^i : Product i consumed by region s

Next, the following Chenery-type trade coefficients are adopted.

$$t_{rs}^i = \frac{y_{rs}^i}{Y_s^i} \quad (8)$$

Using these trade coefficients, the balance formula is as follows.

$$\begin{aligned} X_r^i &= \sum_s t_{rs}^i (\sum_j X_s^{ij} + F_s^i) \\ &= \sum_s t_{rs}^i (\sum_j a_s^{ij} X_s^j + F_s^i) \end{aligned} \quad (9)$$

a_s^{ij} : technical coefficients of commodity j in region s

The balance formula is also shown as follows:

$$X = TAX + TF \quad (10)$$

where X is the vector of total outputs, F is the vector of final demand, T is the inter-regional trade coefficient matrix, and A is the technical coefficient matrix. In the case of two regions and two sectors, formula (10) is shown as follows:

$$\begin{bmatrix} X_r^1 \\ X_r^2 \\ X_s^1 \\ X_s^2 \end{bmatrix} = \begin{bmatrix} t_{rr}^1 & 0 & t_{rs}^1 & 0 \\ 0 & t_{rr}^2 & 0 & t_{rs}^2 \\ t_{sr}^1 & 0 & t_{ss}^1 & 0 \\ 0 & t_{sr}^2 & 0 & t_{ss}^2 \end{bmatrix} \begin{bmatrix} a_{rr}^{11} & a_{rr}^{12} & 0 & 0 \\ a_{rr}^{21} & a_{rr}^{22} & 0 & 0 \\ 0 & 0 & a_{ss}^{11} & a_{ss}^{12} \\ 0 & 0 & a_{ss}^{21} & a_{ss}^{22} \end{bmatrix} \begin{bmatrix} X_r^1 \\ X_r^2 \\ X_s^1 \\ X_s^2 \end{bmatrix} + \begin{bmatrix} F_r^1 \\ F_r^2 \\ F_s^1 \\ F_s^2 \end{bmatrix} \quad (11)$$

Thus, a 47-region input-output table can be compiled using trade coefficients. For instance, the transaction matrix and final demand matrix in region s are given in the next formula.

$$X_{rs}^{ij} = t_{rs}^i X_s^{ij} \quad (12)$$

$$F_{rs}^i = t_{rs}^i F_s^i \quad (13)$$

(2) The procedure for constructing a 47-region inter-regional input-output table at prefecture level

The procedure for compiling the 47-region inter-regional input-output table is shown in Figure 1.

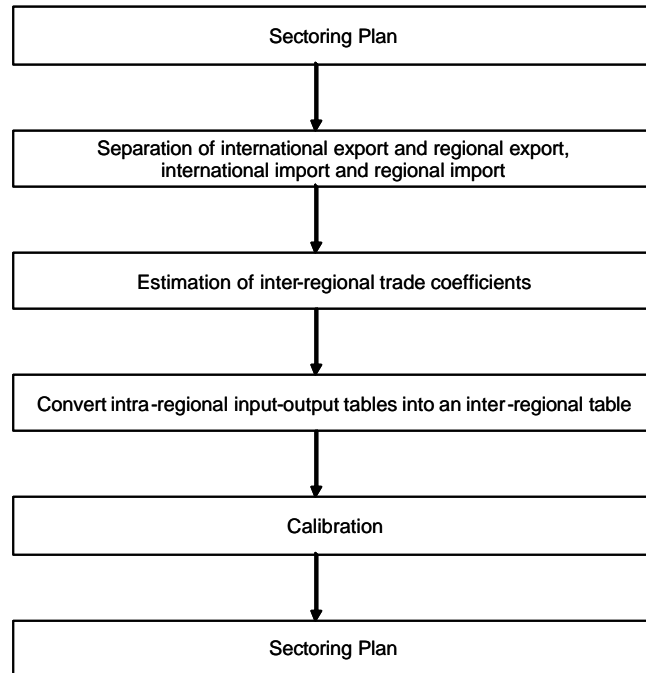


Figure 1 . The procedure for compiling the 47-region inter-regional input-output table

(a) Sector Classification

First, we prepared intraregional input-output tables for all 47 prefectures in order to construct a 47-region interregional input-output table. Each input-output table differs in

terms of sector classification. However, in all prefectures, aggregated tables classified by approximately 90 sectors were published. In this study, for all prefectures with approximately 90 sectors, 47 intraregional input-output tables were aggregated into 45 sectors. Therefore, the interregional input-output table was compiled using 2115 endogenous sectors (47 regions multiplied by 45 sectors).

(b) Separation of international and regional export, and international and regional import.

In order to convert intraregional input-output tables at the prefecture level into an inter-regional input-output table, there must be an individual separation of international and regional export and international and regional import. Since a part of the intraregional input-output tables for prefectures was not separated individually into international and regional export and international and regional import, we separated them using the nine-region interregional input-output table. It is assumed that the export and import ratios for each prefecture are equal to those of the larger region that the prefecture is a part of. The export for each prefecture was estimated as the product of the output in the prefecture and the export ratio of the larger region. The import for each prefecture was estimated as the product of domestic demand in the prefecture and the import ratio of the larger region.

(c) Estimation of interregional trade coefficients

In order to construct a 47-region interregional input-output table using input-output tables for all 47 prefectures, it is necessary to obtain some interregional trade data. The number of sectors is 75, and we have been able to use a distribution census of Japan. Sectors of the distribution census were further aggregated into 45 sectors, so that the sector classification of the distribution census would match that of the 47-region

interregional input-output table constructed in this study. First, the self-sufficiency rate was calculated using the intraregional input-output table. The formula shown below calculates self-sufficiency. In addition, other interregional trade coefficients were calculated using the distribution census data.

$$d_r^i = 1 - \sum_{s \neq r} t_{rs}^i = 1 - \frac{\sum_{s \neq r} y_{rs}^i}{Y_s^i} \quad (14)$$

(d) A strategy to convert intraregional input-output tables into an interregional input-output table.

Intraregional input-output tables for all prefectures were converted into an interregional input-output table, using interregional trade coefficients, which were estimated in the previous step.

(e) Calibration

Even if intraregional input-output tables are converted into an interregional input-output table by using the calculated inter-regional trade coefficients, the output of the sectors in the region does not correspond with those of the original intraregional input-output tables. Therefore, we have used the following trade model with balancing factors to adjust interregional trade coefficients.

$$t_{rs}^i = \mathbf{a}_r^i \mathbf{t}_{rs}^i \mathbf{b}_s^i \quad (15)$$

where,

\mathbf{t}_{rs}^i : initial estimated value of inter-regional trade coefficients

$\mathbf{a}_r^i, \mathbf{b}_s^i$: balancing factors

Interregional trade flows are given in the next formula.

$$\begin{aligned}
 y_{rs}^i &= t_{rs}^i Y_s^i \\
 &= t_{rs}^i (Z_s^i + d_s^i) \\
 &= t_{rs}^i \left(\sum_j X_s^{ij} + \sum_k F_s^{ik} \right)
 \end{aligned} \tag{16}$$

where,

Z_s^i : intermediate demand in region "s"

d_s^i : final demand in region "s"

F_s^{ik} : product "i" consumed by final demand sector "k" in region "s"

or

$$y_{rs}^i = \left(\sum_j t_{rs}^i X_s^{ij} + \sum_k t_{rs}^i F_s^{ik} \right) = \sum_j x_{rs}^{ij} + \sum_k d_{rs}^{ik} = \sum_j x_{rs}^{ij} + d_{rs}^i$$

where,

d_{rs}^{ik} : product "i" consumed by final demand sector "k" in region "s"

Interregional trade flow is shown in the next formula using input coefficients and final demand coefficients.

$$y_{rs}^i = t_{rs}^i \left(\sum_j a_s^{ij} X_s^i + \sum_k f_s^{ik} d_s^i \right) \tag{17}$$

where,

f_s^{ik} : product "i" consumed by final demand sector k in region "s"

Thus, we can obtain the following formula.

$$\begin{aligned}
 \sum_s y_{rs}^i + IE_r^i - IM_r^i &= X_r^i \\
 \sum_r y_{rs}^j + V_s^j &= \sum_r t_{rs}^i \left(\sum_j X_s^{ij} + d_s^i \right) + V_s^j = X_s^j
 \end{aligned} \tag{18}$$

Therefore, balancing factors can be calculated by means of the next formula.

$$\mathbf{a}_r^i = \frac{X_r^i - (IE_r^i - IM_r^i)}{\sum_s \mathbf{b}_s^i \mathbf{t}_{rs}^i (Z_s^i + d_s^i)} \quad (19)$$

$$\sum_i \{ \mathbf{b}_s^i \mathbf{t}_{rs}^i (Z_s^i + d_s^i) \sum_r \mathbf{a}_r^i \mathbf{t}_{rs}^i \} + V_s^j = X_s^j$$

The simultaneous equations need to be solved in order to obtain only the balancing factors.

4. The characteristic features and accuracy of a 47-region interregional input-output table.

The interregional input-output table constructed in this study is for the year 1995. The number of sectors is 45 and the regional divisions in this table are at the prefecture level. The gross value added has been classified into consumption expenditure outside households, compensation of employees, operating surplus, depreciation of fixed capital, indirect taxes and current subsidies. Final demand has been classified into consumption expenditure outside households, private consumption expenditure, consumption expenditure of general government, gross domestic fixed capital formation, and increase in stocks.

The outputs of the input-output table calculated in this study are almost equal to those of the original intraregional tables. Almost all outputs (97.4%) have an error of less than 5%; of these, more than half have an error of less than 1%. Only a small number of outputs have an error of more than 5%. However, since the values of these outputs are extremely small, the errors do not influence the whole input-output table.

5. Structure of inter-industry relations at the prefecture level in Japan as inferred from the 47-region interregional input-output table

(1) Outputs

In the analysis of the regional industrial relations structure to be conducted using the 47-region interregional input-output table constructed in this study, the first step is to take a broad view of the scale of production in each prefecture in our country. The production in our country, based on the 1995 interregional input-output table, amounts to approximately 937 trillion yen. Of this, Tokyo accounts for approximately 16%, and other Kanto prefectures such as Kanagawa, Saitama, and Chiba are ranked among the top 10. The Tokyo Metropolitan prefecture in conjunction with these prefectures alone accounts for 30% of the production in the country, and what seems to have brought considerable relief is the fact that a higher concentration of industries has been observed in the Tokyo Metropolitan prefecture and the surrounding prefectures. Since the period of high economic growth, our country has concentrated on local development by adopting national land development; yet, the disparity among regions with respect to economic power has been increasing significantly.

Table 3: Outputs by prefecture: Japan, 1995

	Output (billion yen)	Regional share(%)
Tokyo	154,423	16.0
Osaka	72,154	7.5
Aichi	71,172	7.4
Kanagawa	61,067	6.3
Saitama	38,273	4.0
Hyogo	38,248	4.0
Chiba	37,812	3.9
Hokkaido	34,974	3.6
Shizuoka	32,877	3.4
Fukuoka	32,636	3.4

Base year :1995

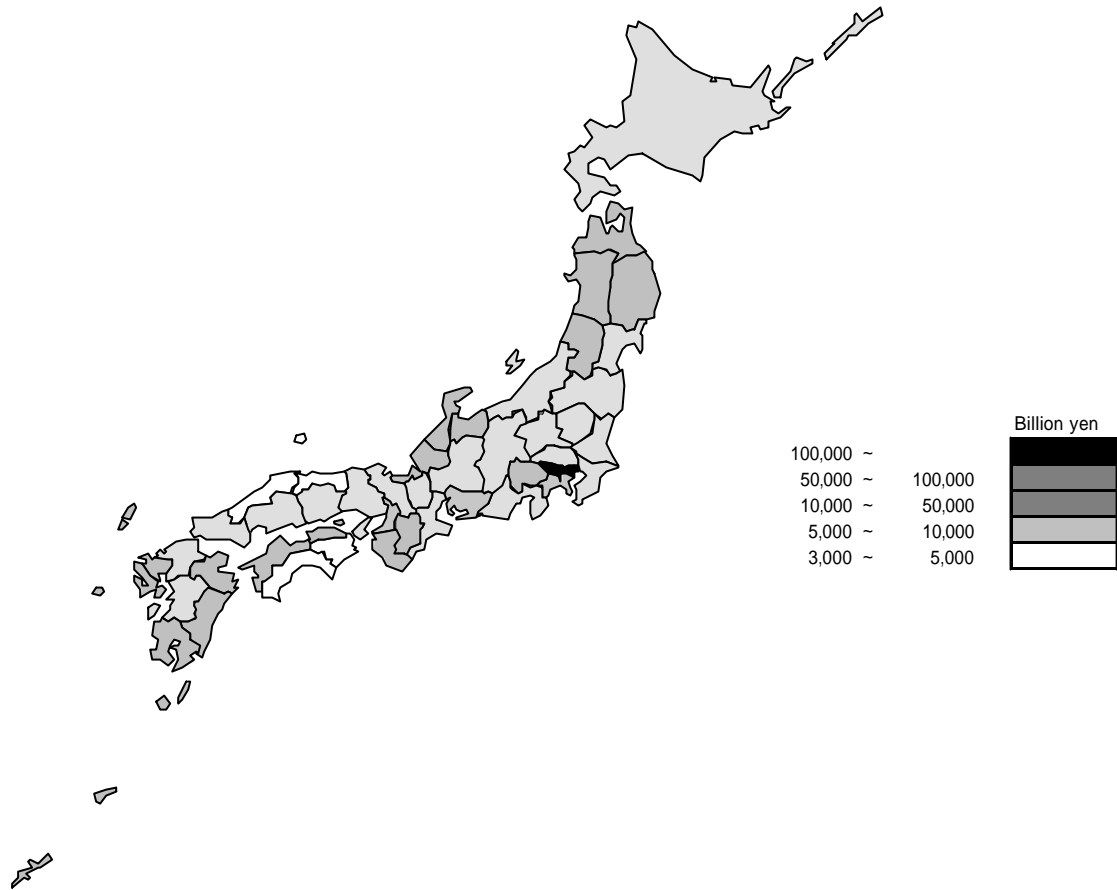


Figure 2. Outputs by prefecture: Japan, 1995

(2) Intermediate inputs

Table 4, constructed from an estimated regional input-output table, shows the top five ranking of the input coefficients from prefectures for an endogenous sector for each prefecture. This table is organized in accordance with the regional division by the Ministry of International Trade and Industry (MITI), and the names of the prefectures enclosed by bold lines within the table correspond to those prefectures that are outside the concerned region. As is evident from this, the input ratio, which places a high premium on the amount of production, shows a very strong link with other blocks in the regions with the exception of the Kanto region. Even for prefectures outside the Kanto region, the input from Tokyo in production has been quite large in comparison with the input from any other prefecture throughout the country. Further, in all 47 prefectures (excluding Osaka, Okayama, and

Hiroshima), the input from Tokyo ranks in the top five. Osaka, Okayama and Hiroshima, instead, have a strong relationship with Osaka, which is positioned in second place in terms of the scale of production in the country. Such an inter-prefectural input structure gives us highly relevant information on the extent of impact that various regional policies have had on the prefectures.

Table 4: The top five rankings of input coefficients of prefectures

Hokkaido and Tohoku													
Hokkaido	Aomori		Iwate		Miyagi		Akita		Yamagata		Fukushima		
Hokkaido	74.7%	Aomori	51.5%	Iwate	56.4%	Miyagi	57.6%	Akita	59.9%	Yamagata	53.5%	Fukushima	51.1%
Tokyo	5.0%	Tokyo	9.4%	Miyagi	9.3%	Tokyo	5.3%	Miyagi	5.8%	Miyagi	10.0%	Tokyo	9.1%
Kanagawa	3.3%	Hokkaido	5.6%	Tokyo	6.5%	Fukushima	4.5%	Hokkaido	4.9%	Tokyo	7.4%	Miyagi	5.7%
Osaka	1.5%	Miyagi	4.8%	Fukushima	4.2%	Kanagawa	3.5%	Tokyo	4.6%	Akita	4.2%	Kanagawa	5.0%
Shizuoka	1.2%	Iwate	4.6%	Aomori	3.6%	Saitama	2.5%	Iwate	3.1%	Fukushima	3.8%	Saitama	4.0%
Aichi	1.2%	Fukushima	4.2%	Chiba	3.2%	Ibaraki	2.4%	Aomori	2.6%	Kanagawa	2.9%	Ibaraki	3.8%

Kanto											
Ibaraki	Tochigi		Gunma		Saitama		Chiba		Tokyo		
Ibaraki	50.7%	Tochigi	39.2%	Gunma	50.8%	Saitama	40.9%	Chiba	52.2%	Tokyo	76.6%
Tokyo	11.9%	Tokyo	11.8%	Tokyo	9.9%	Tokyo	23.7%	Tokyo	15.5%	Kanagawa	3.9%
Chiba	7.4%	Kanagawa	8.7%	Saitama	9.7%	Kanagawa	4.8%	Kanagawa	4.9%	Saitama	3.7%
Kanagawa	5.1%	Saitama	6.4%	Kanagawa	4.5%	Chiba	4.5%	Ibaraki	4.5%	Chiba	2.8%
Saitama	4.2%	Ibaraki	5.9%	Tochigi	4.1%	Ibaraki	3.2%	Saitama	3.5%	Ibaraki	1.2%
Tochigi	2.3%	Chiba	4.9%	Chiba	3.7%	10	3.0%	Tochigi	1.9%	Shizuoka	1.1%

Chubu											
Kanagawa	Niigata		Yamanashi		Nagano		Shizuoka				
Kanagawa	51.0%	Niigata	63.4%	Yamanashi	41.0%	Nagano	49.8%	Shizuoka	49.8%		
Tokyo	13.6%	Tokyo	5.6%	Tokyo	16.1%	Tokyo	7.9%	Aichi	12.8%		
Chiba	5.3%	Gunma	2.5%	Kanagawa	9.0%	Aichi	6.3%	Tokyo	7.8%		
Shizuoka	3.8%	Ibaraki	2.5%	Shizuoka	7.7%	Niigata	5.2%	Kanagawa	6.4%		
Saitama	3.6%	Fukushima	2.3%	Aichi	4.0%	Kanagawa	3.9%	Osaka	2.3%		
Ibaraki	3.0%	Saitama	2.2%	Nagano	4.0%	Shizuoka	3.5%	Chiba	2.0%		

Chubu											
Toyama	Ishikawa		Gifu		Aichi		Mie				
Toyama	59.0%	Ishikawa	61.3%	Gifu	46.5%	Aichi	66.9%	Mie	45.1%		
Aichi	5.2%	Osaka	4.5%	Aichi	26.5%	Shizuoka	4.5%	Aichi	18.2%		
Ishikawa	4.6%	Aichi	4.3%	Tokyo	4.6%	Mie	4.1%	Osaka	5.5%		
Shizuoka	4.2%	Toyama	4.2%	Osaka	3.1%	Tokyo	3.3%	Tokyo	3.8%		
Tokyo	3.9%	Hvogo	3.9%	Mie	2.4%	Gifu	2.7%	Shizuoka	3.7%		
Osaka	3.0%	Tokyo	3.0%	Nagano	2.2%	Osaka	2.2%	Chiba	2.7%		

Kinki													
Fukui	Shiga		Kyoto		Osaka		Hyogo		Nara		Wakayama		
Fukui	57.1%	Shiga	39.2%	Kyoto	55.1%	Osaka	65.6%	Hyogo	54.0%	Nara	51.9%	Wakayama	62.2%
Osaka	5.5%	Osaka	15.6%	Osaka	13.7%	Hyogo	5.1%	Osaka	15.9%	Osaka	21.5%	Osaka	12.8%
Aichi	5.1%	Kyoto	5.7%	Tokyo	4.3%	Kanagawa	2.3%	Okayama	2.9%	Kyoto	4.0%	Hyogo	4.9%
Tokyo	5.0%	Aichi	5.4%	Aichi	3.4%	Kyoto	2.1%	Tokyo	2.8%	Hyogo	3.2%	Tokyo	3.0%
Shiga	3.2%	Hyogo	4.3%	Shiga	3.3%	Hiroshima	1.9%	Kyoto	2.2%	Tokyo	2.9%	Mie	2.7%
Ishikawa	3.2%	Tokyo	3.0%	Hvogo	3.0%	Aichi	1.9%	Aichi	2.2%	Aichi	2.5%	Aichi	1.7%

Chugoku											
Tottori	Shimane		Okayama		Hiroshima		Yamauchi				
Tottori	61.9%	Shimane	55.9%	Okayama	58.6%	Hiroshima	66.7%	Yamauchi	55.0%		
Osaka	5.3%	Hiroshima	8.2%	Osaka	5.5%	Okayama	4.9%	Fukuoka	8.2%		
Okayama	5.1%	Osaka	4.6%	Hiroshima	4.8%	Yamauchi	4.4%	Hiroshima	8.1%		
Hyogo	4.2%	Yamauchi	4.5%	Aichi	4.8%	Osaka	3.5%	Osaka	4.2%		
Shimane	3.5%	Okayama	4.1%	Hyogo	3.7%	Hyogo	2.4%	Oita	3.1%		
Tokyo	2.8%	Tokyo	3.8%	Shizuoka	2.1%	Fukuoka	2.2%	Tokyo	3.0%		

Shikoku											
Tokushima	Kagawa		Ehime		Kochi						
Tokushima	57.8%	Kagawa	55.7%	Ehime	61.4%	Kochi	60.2%				
Osaka	6.9%	Osaka	7.2%	Osaka	4.8%	Ehime	6.5%				
Kagawa	5.8%	Ehime	5.4%	Tokyo	4.6%	Kagawa	6.1%				
Ehime	5.2%	Hyogo	4.2%	Kagawa	3.6%	Osaka	5.7%				
Hyogo	4.5%	Tokyo	3.8%	Hyogo	2.8%	Hyogo	4.4%				
Tokyo	3.0%	Okayama	3.7%	Aichi	2.6%	Tokyo	3.8%				

Kyuusyuu and Okinawa															
Fukuoka	Saga		Nagasaki		Kumamoto		Oita		Miyazaki		Kagoshima	Okinawa			
Fukuoka	64.7%	Saga	57.3%	Nagasaki	61.2%	Kumamoto	61.2%	Oita	61.6%	Miyazaki	63.5%	Kagoshima	68.0%	Okinawa	72.4%
Kumamoto	3.1%	Fukuoka	20.2%	Fukuoka	12.8%	Fukuoka	10.7%	Fukuoka	12.3%	Fukuoka	7.7%	Fukuoka	7.9%	Aichi	5.1%
Tokyo	2.5%	Nagasaki	2.2%	Saga	3.4%	Osaka	2.9%	Tokyo	4.0%	Kagoshima	6.1%	Miyazaki	3.4%	Tokyo	4.9%
Osaka	2.5%	Tokyo	2.1%	Tokyo	3.1%	Tokyo	2.0%	Osaka	3.7%	Yamauchi	3.2%	Osaka	3.1%	Fukuoka	3.3%
Saga	2.5%	Osaka	1.6%	Oita	2.6%	Yamauchi	2.0%	Okayama	2.3%	Osaka	2.7%	Tokyo	2.4%	Osaka	2.2%
Yamauchi	2.4%	Yamauchi	1.5%	Kumamoto	2.4%	Oita	1.9%	Yamauchi	1.6%	Tokyo	2.6%	Oita	2.2%	agoshim	1.9%

(3) Interregional Interdependence

On the basis of the interregional input-output table constructed in this study, an inverse matrix was calculated to analyze interdependence among the regions (including direct and indirect influences). Table 5 presents the top ten row sums of the inverse matrix coefficients calculated by aggregating industries into any one of the primary, the secondary and the tertiary sectors. These coefficients will show the total effect to all domestic industries by representing demand for one unit in industry section "j" in region "s." Enormous differences have been noted in the spread structure among regional industries. The averaged coefficients for the primary, secondary, and the tertiary industries, concerning prefectures, have been calculated as 1.793, 2.175, and 1.593 respectively. This shows that the production inducement coefficient of the secondary industry is the highest regardless of the prefecture. The highest production inducement coefficient in the primary industry has been observed in prefectures in Kyushu, such as Kagoshima, Miyazaki, Saga, and Oita. Similarly, the highest production inducement coefficient in the secondary industry has been observed in Shizuoka, Hiroshima, Aichi, and other prefectures in addition to the prefectures in the Kanto district. As for the tertiary sector, the prefectures in the Kanto region such as Tokyo, Chiba, and others, have had a large impact in Japan.

Table 5: The top 10 production inducement coefficients

primary industry		secondary industry		tertiary industry	
Kagoshima	2.004	Gunma	2.347	Tokyo	1.795
Miyazaki	1.971	Shizuoka	2.318	Chiba	1.689
Ishikawa	1.966	Chiba	2.282	Fukushima	1.646
Kagawa	1.949	Hiroshima	2.279	Hyogo	1.634
Gunma	1.928	Saitama	2.279	Fukui	1.630
Gifu	1.909	Aichi	2.273	Gifu	1.627
Tokushima	1.883	Kanagawa	2.237	Wakayama	1.625
Tokyo	1.878	Yamanashi	2.236	Gunma	1.624
Saga	1.875	Ishikawa	2.230	Kagawa	1.621
Oita	1.848	Tochigi	2.228	Aichi	1.617
Average	1.793	Average	2.175	Average	1.593
Minimum (Wakayama)	1.618	Minimum (Okinawa)	2.024	Minimum (Iwate)	1.513

6. Analysis of the impact of an increase in the demand for automobiles in the Aichi prefecture on each prefectural economy in Japan

The interregional input-output table at the prefecture level constructed in this study has made it possible to analyze the effects of an increase in demand in a specific prefecture on each prefectural economy in Japan. For a case study, assuming that the demand increases to the value of 100 billion yen in the auto industry in Aichi Prefecture, the production inducement effect was calculated in order to estimate its impact on each prefecture and industrial sector based on the relational structure among the regions. Table 6 and Figure 3 show a summary of the result of the production inducement effect. First, the demand increase in Aichi Prefecture brings about the production inducement effect, which is approximately valued at 290 billion yen, and which affects not only the Aichi prefecture (the one to contribute the most to the increase in production valued at 206.7 billion yen), but also Shizuoka, Tokyo, Mie, Kanagawa, and other prefectures. The prefectures that were affected by a large amount are located in the Pacific belt zone as shown in Figure 3.

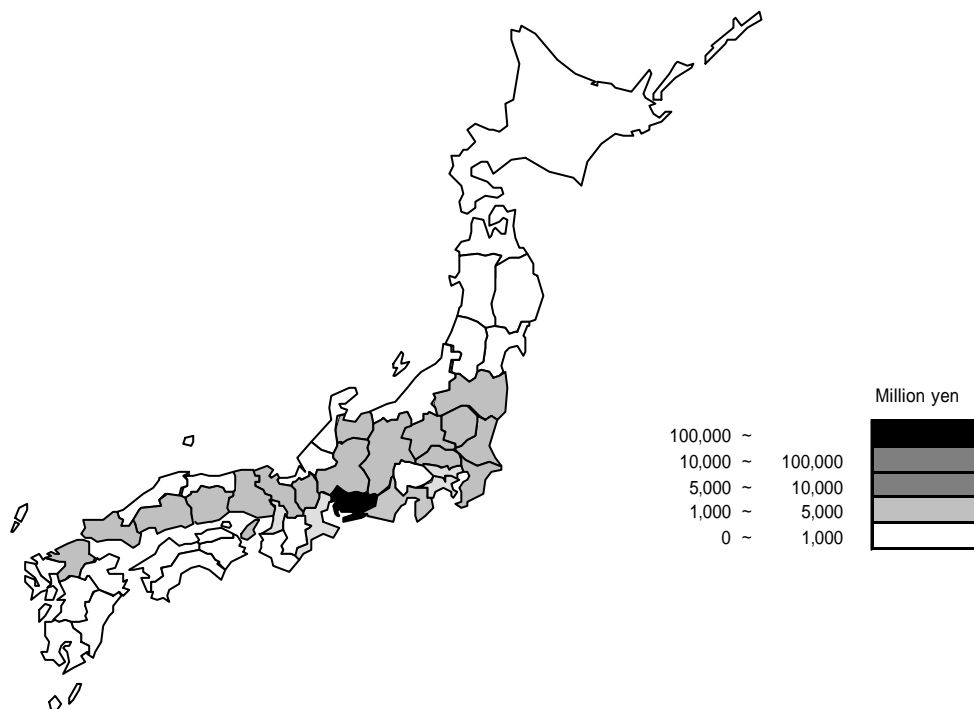


Figure 3: Production inducement effect in each prefecture

Table 6: Production inducement effect in each prefecture

Million yen	
Prefecture	Induced Output
Aichi	206,730
Shizuoka	16,638
Tokyo	9,033
Mie	8,624
Kanagawa	8,177
Osaka	5,882
Gifu	4,643
Hiroshima	4,086
Saitama	3,750
Okayama	3,624

7. Conclusions

In this study, we attempted to compile a 47-region inter-regional input-output table at prefecture level, covering all of Japan and analyzed regional relations among all prefectures by measuring interregional input coefficients using the Leontief inverse matrix. The results indicated that most industries in local prefectures have economic linkages with services in Tokyo. In addition to this, we also estimated the effects of an increase in the demand for automobiles in the Aichi prefecture on each prefectural economy in Japan. We can observe the relations between the Pacific belt zone with the large transportation networks as well as interregional economic linkages at the prefectural level.

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Appendix Prefectures in Japan

1 Hokkaido	13 Tokyo	25 Shiga	37 Kagawa
2 Aomori	14 Kanagawa	26 Kyoto	38 Ehime
3 Iwate	15 Niigata	27 Osaka	39 Kochi
4 Miyagi	16 Yamanashi	28 Hyogo	40 Fukuoka
5 Akita	17 Nagano	29 Nara	41 Saga
6 Yamagata	18 Shizuoka	30 Wakayama	42 Nagasaki
7 Fukushima	19 Toyama	31 Tottori	43 Kumamoto
8 Ibaraki	20 Ishikawa	32 Shimane	44 Oita
9 Tochigi	21 Gifu	33 Okayama	45 Miyazaki
10 Gunma	22 Aichi	34 Hiroshima	46 Kagoshima
11 Saitama	23 Mie	35 Yamaguchi	47 Okinawa
12 Chiba	24 Fukui	36 Tokushima	

