Environ. Sci ., Hokkaido	No. 2	59 ～ 74	March 1979

A Study on the Impact of the Regional Employment Opportunities arising from the Industrial Locations on the Large-Scale Industrial Park

Etsuo Yamamura*

大規模工業基地の産業立地に基づく地域雇用機会インパクトに関する研究

山 村 悦 夫*

Summary

We have investigated a new method of the measurement of the regional employment opportunities arising from the industrial locations on the Large-Scale Industrial Park. By using the new method, we can estimate the direct and indirect repercussive employment opportunities of Tomakomai Tōbu Industrial Park.

The main results are as follows.

(1) The total employment opportunities in 1985 increase remarkably than the ones in 1980.

(2) The sum of the regional employment opportunities in other regions is equal to the ones in Hokkaido region. The remarkable feature is the expansion of the regionl employment opportunities in Kanto region advanced industrially.

(3) The regional employment opportunities of the secondary industry in Hokkaido is 35 % of the total ones. This result influences the manufacturing with the relative lower level than the national level for good. And the regional emloyment opportunities of the tertiary industry is 60 % of total ones. This main cause is the indirect impact of the locational industries.

(4) The regional employment opportunities in Hokkaido region increase remarkably by the forward and backward linkage effects.

* 北海道大学大学院環境科学研究科地域計画学研究室 1978年11月16日受理

* Laboratory of Regional Planning, Division of Environmental Planning, Graduate School of Environmental Science, Hokkaido University, Sapporo
Received Nov. 16, 1978

1. Introduction

In recent years, the Large-Scale Industrial Park were planned out for the national planning. For the completion of the these projects, it would be necessary to measure the impact arising from the industrial locations. Especially, we must measure the fundamental data, the regional employment opportunities by the detail sectors arising from the industrial locations.

In this papers, we try to consider the method of the measurement of the regional employment opportunities and estimate the impact arising from the industrial locations in the Tomakomai-Tōbu Industrial Park by the application of the method. Furthermore, we estimate the regional employment opportunities of Kokkaido region arising from the forward and backward linkage effects.

2. The Interregional Input-Output Analysis

In this chapter, we shall represent the general statement of the interregional input-output analysis to know well the new method of the impact analysis of the regional employment opportunities.

The interregional input-output analysis attempts to treat two or more regions with equal detail, specifying a complete input-output matrix for each. In addition, the interregional flows in each direction between regions, by sector, are recorded in the interregional matrices for each pair of regions.

The basic structure of the most complete formulation has been represented in a general way by Isard.

2.1 Isard Model

We shall represent an attempt to examine in more detail the structure of Isard Model with most of the emphasis on the simplest two regions-case in Fig. 1.

inputs / outputs		intermediate demand				final demand		imports	total outputs
		region 1		region 2					
		industry 1	industry2	industry 1	industry 2	region1	region 2		
region 1	industry 1	x_{11}^{11}	x_{12}^{11}	x_{11}^{12}	x_{12}^{12}	F_1^{11}	F_1^{12}	$-M_1^1$	X_1^1
	industry 2	x_{21}^{11}	x_{22}^{11}	x_{21}^{12}	x_{22}^{12}	F_2^{11}	F_2^{12}	$-M_2^1$	X_2^1
region 2	industry 1	x_{11}^{21}	x_{12}^{21}	x_{11}^{22}	x_{12}^{22}	F_1^{21}	F_1^{22}	$-M_1^2$	X_1^2
	industry 2	x_{21}^{21}	x_{22}^{21}	x_{21}^{22}	x_{22}^{22}	F_2^{21}	F_2^{22}	$-M_2^2$	X_2^2
value added		V_1^1	V_2^1	V_1^2	V_2^2	—	—	—	V
total inputs		X_1^1	X_2^1	X_1^2	X_2^2	F^1	F^2	$-M$	

Fig. 1. The interregional input-output table by two regions -case.

Thus we have the following set of 4 equations.

$$\begin{cases} x_{11}^{11}+x_{12}^{11}+x_{11}^{12}+x_{12}^{12}+F_1^{11}+F_1^{12}-M_1^1=X_1^1 \\ x_{21}^{11}+x_{22}^{11}+x_{21}^{12}+x_{22}^{12}+F_2^{11}+F_2^{12}-M_2^1=X_2^1 \\ x_{11}^{21}+x_{12}^{21}+x_{11}^{22}+x_{12}^{22}+F_1^{21}+F_1^{22}-M_1^2=X_1^2 \\ x_{21}^{21}+x_{22}^{21}+x_{21}^{22}+x_{22}^{22}+F_2^{21}+F_2^{22}-M_2^2=X_2^2 \end{cases} \tag{1}$$

Where

x_{ij}^{rs} : intermediate input from i industry in r region to j industry in s region.

F_i^{rs} : final demand from i output good in r region to final demand in s region.

M_j^s : import of j industry in s region.

X_i^r : output of i industry in r region.

And the interregional input coefficients and import coefficients are as follows.

$$a_{ij}^{rs}=\frac{x_{ij}^{rs}}{X_j^s} \tag{2}$$

$$m_i^r=\frac{M_i^r}{X_i^r} \tag{3}$$

Further, if we let the set of 4 equations represent the matrix formation.

$$\begin{pmatrix} a_{11}^{11} & a_{12}^{11} & a_{11}^{12} & a_{12}^{12} \\ a_{12}^{11} & a_{22}^{11} & a_{12}^{12} & a_{22}^{12} \\ a_{11}^{21} & a_{12}^{21} & a_{11}^{22} & a_{12}^{22} \\ a_{12}^{21} & a_{22}^{21} & a_{12}^{22} & a_{22}^{22} \end{pmatrix}\begin{pmatrix} X_1^1 \\ X_2^1 \\ X_1^2 \\ X_2^2 \end{pmatrix}-\begin{pmatrix} m_1^1 & 0 & 0 & 0 \\ 0 & m_2^1 & 0 & 0 \\ 0 & 0 & m_1^2 & 0 \\ 0 & 0 & 0 & m_2^2 \end{pmatrix}\begin{pmatrix} X_1^1 \\ X_2^1 \\ X_1^2 \\ X_2^2 \end{pmatrix}+\begin{pmatrix} F_1^{11}+F_1^{12} \\ F_2^{11}+F_2^{12} \\ F_1^{21}+F_1^{22} \\ F_2^{21}+F_2^{22} \end{pmatrix}=\begin{pmatrix} X_1^1 \\ X_2^1 \\ X_1^2 \\ X_2^2 \end{pmatrix} \tag{4}$$

The vector formation of the matrix formation is as follows.

$$A \cdot X-\hat{M} \cdot X+F=X \tag{5}$$

The derivation of total output of equation (5) is as follows.

$$X=[I-A+\hat{M}]^{-1} \cdot F \tag{6}$$

2.2 Leontief Model

This model has been represented by Leontief. The simple scheme of the model provides for simultaneous balancing of all input-output flows from the point of view of each individual region, as well as for the national economy as a whole. And the sector is divided into two parts.

One part is the local industries on which the balance between production and consumption tends to be established separately within each regions; for examples Retail trade and Auto repair services.

The other part is the national industries on which such a balance typically is achieved only for the country as a whole; for examples Iron Industry and Aircraft Manufacturing.

Next, we shall represent the mathematical formation of the model.

The multi-regional input-output system is as follows.

$$\begin{pmatrix} X_L \\ \hline X_N \end{pmatrix} = \left(\begin{array}{c|c} A_{LL} & A_{LN} \\ \hline A_{NL} & A_{NN} \end{array}\right)\begin{pmatrix} X_L \\ \hline X_N \end{pmatrix} + \begin{pmatrix} F_L \\ \hline F_N \end{pmatrix} \tag{7}$$

We define the notations of the partitioned matrices as follows.

X_N : matrix of output of the national industries.

X_L : matrix of output of the local industries.

A_{LL} : matrix of input coefficients describing flows from local to local industries.

A_{LN} : matrix of input coefficients describing flows from local industries to national industries.

A_{NL} : matrix of input coefficients describing flows from national industries to local industries.

A_{NN} : matrix of input coefficients describing flows from national to national industries.

F_L : matrix of final demands of local industries.

F_N : matrix of final demands of national industries.

The derivation of the new total output of (7) equation is as follows.

$$\begin{pmatrix} X_L \\ \hline X_N \end{pmatrix} = \left(\begin{array}{c|c} I-A_{LL} & -A_{LN} \\ \hline -A_{NL} & I-A_{NN} \end{array}\right)^{-1}\begin{pmatrix} F_L \\ \hline F_N \end{pmatrix} = \left(\begin{array}{c|c} B_{LL} & B_{LN} \\ \hline B_{NL} & B_{NN} \end{array}\right)\begin{pmatrix} F_L \\ \hline F_N \end{pmatrix} \tag{8}$$

X_N^r and X_L^r are as follows.

$$X_N^r = R_N^r \cdot X_N = R_N^r[B_{NL} \cdot F_L + B_{NN} \cdot F_N] \tag{9}$$

$$X_L^r = [I-A_{LL}]^{-1}[A_{LN} \cdot X_N^r + F_L^r] \tag{10}$$

Where,

X_N^r : matrix each column of which shows the output levels of all nationnal industries in one particular region (r).

X_L^r : matrix each column of which shows the output levels of all local industries in one particular region (r).

R_N^r : matrix each column of which shows what fractions of the total output of each of national industries are produced in one particular region (r).

2.3 Moses · Chenery Model

This model emphasizes the intimate connection between the interregional trade and the location of economic activity. The fundamental assumptions of the model is to determine the patterns of trade arising from the equilibrium of the outputs and requirements.

Then, the mathematical formation of the patterns of trade is as follows.

t_i^{rs} is the interregional trading pattern coefficients and the definition is as follows.

$$t_i^{rs} = \frac{\text{the amount of i good of r region required in s region}}{\text{the total demand of i good in s region}} \quad (11)$$

$\mathbf{T}$: matrix describing the interregional trading pattern coefficients along the main diagonal and zeros elsewhere.

$\mathbf{A}$: matrix describing the input coefficients in the intraregion and zeros elsewhere.

The equilibrium model is as follows.

$$\mathbf{T} \cdot \mathbf{A} \cdot \mathbf{X} + \mathbf{T} \cdot \mathbf{F} - \mathbf{M} = \mathbf{X} \quad (12)$$

The derivation of the new total output of (12) equation is as follows.

$$\mathbf{X} = [\mathbf{I} - \mathbf{T} \cdot \mathbf{A} + \widehat{\mathbf{M}}]^{-1} \cdot \mathbf{T} \cdot \mathbf{F} \quad (13)$$

$\widehat{\mathbf{M}}$: matrix of trade coefficients.

$\mathbf{F}$: matrix of final demand.

Then, in three models, Isard Model represents the most complete formation of the actual interregional situation.

In this paper, we shall adopt Isard Model.

In Japan, the Ministry of International Trade & Industry has drawn up the interegional input-output tables arising from Isard Model with 9 regions having 25 by 25 sectors in 1960, 1965 and 1970.

The classifications of regions and sectors are shown in tables 1 and 2. The map of 9 regions is shown in Fig. 2.

Table 1. The Classifiications of 9 Regions.

Regions	Prefectures
Hokkaido	Hokkaido
Tohoku	Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima
Kanto	Niigata, Ibaraki, Tochigi, Gumma, Saitama, Chiba Tokyo, Kanagawa, Yamanashi, Nagano, Shizuoka
Tokai	Gifu, Aichi, Mie
Hokuriku	Toyama, Ishikawa
Kinki	Fukui, Shiga, Kyoto, Osaka, Hyogo, Nara, Wakayama
Chugoku	Tottori, Shimane, Okayama, Hiroshima, Yamaguchi
Shikoku	Tokushima, Kagawa, Ehime, Kochi
Kyushu	Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima

Table 2. The Classiffication of 25 Sectors.

Number	Sectors
01	Agriculture Forestry & Fisheries
02	Coal & Lignite Mining
03	Mining (Except 02)
04	Food & Kindred products
05	Textile products
06	Lumber & Wood products
07	Pulp, Paper & Paper products
08	Leather, Leather products & Rubber products
09	Chemicals
10	Petroleum & Coal products
11	Ceramic, Clay & Stone Products
12	Primary Iron & Steel Manufacturing
13	Primary Nonferrous Metal Manufacturing
14	Metal products
15	Machinery (n. e. c)
16	Electric Machinery
17	Transportation Equipment
18	Precision Machinery
19	Miscellaneous Manufacturing
20	Construction
21	Electricity, Gas, Water & Sanitary Services
22	Wholesale & Retail Trade
23	Finance, Real Estates & Other Service
24	Transportation & Warehousing
25	Unallocated

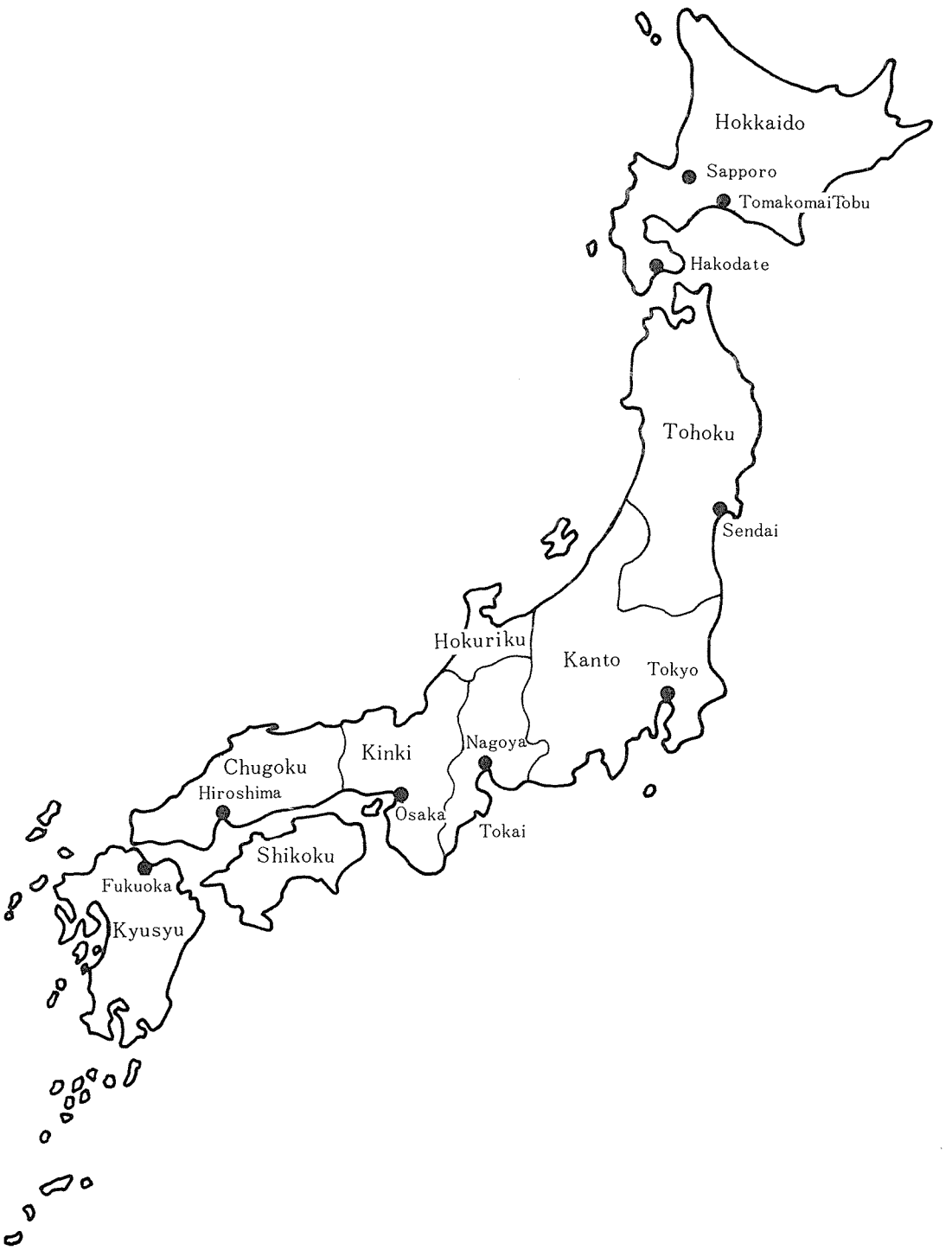

Fig. 2. The map of 9 regions

3. The Method of measurement of the Regional Employment Opportunities

The impact of the development of the Large-Scale Industrial Park consists of three effects such as the effective demand making, intermediate demand making and consumption demand making.

Then, we must consider the following condition to measure the regional employment opportunities arising from the industrial locations.

(1) It is necessary to measure the regional employment opportunities by the industries and scales.
(2) We can make to be clear the difference of the regional economic structures.
(3) It is necessary to measure the employment opportunities not only the direct repercussive effects but also the indirect repercussive effects of the industrial locations.
(4) We must measure the indirect repurcussive employment opportunities not only the industrial locational region but also the other regions.

The basic method of the measurement of the employment opportunities has been represented by Isard and Miller.

Isard attempts an impact study wherein the direct and indirect repercussions of the location of the steel industry on the greater New York-Philadelphia industrial region.

Miller also attempts the same impact study of the location of the aluminum industry on the Pacific Northwest.

However, in these studies, only a relatively small amount of research has been made on the four conditions mentioned above.

In this chapter, we shall consider the new detailed method of the measurement of the regional employment opportunities arising from the industrial locations on the Large-Scale Industrial Park by the interregional input-output method.

We define the notations of the partitioned matrices as follows.

A : interregional input coefficients matrix by regions.
I : identity matrix.
S : matrix having the values of inputs from other industries to locational industry along the main diagonal (the diagonal running upper left to lower right) and zeros elsewhere.
D : matrix having the values of inputs of locational industry along the column and zeros elsewhere.
R : basic unit of direct employment opportunities.

$\mathbf{R}'$: basic unit of indirect employment opportunities.
$\mathbf{N}$: number of regions.
$\mathbf{M}$: number of industriess.

$\mathbf{X}$ represents the matrix of the total repercussive employment opportunities and is satisfied the following equations.

$$\begin{aligned}\mathbf{X} &= \mathbf{D}\otimes\mathbf{R}+\mathbf{A}\cdot\mathbf{S}\otimes\mathbf{R}'+\mathbf{A}^2\cdot\mathbf{S}\otimes\mathbf{R}'+\cdots\cdots\\ &= \mathbf{D}\otimes\mathbf{R}+[\mathbf{I}+\mathbf{A}+\cdots\cdots]\cdot\mathbf{A}\cdot\mathbf{S}\otimes\mathbf{R}'\\ &= \mathbf{D}\otimes\mathbf{R}+[\mathbf{I}-\mathbf{A}]^{-1}\cdot\mathbf{A}\cdot\mathbf{S}\otimes\mathbf{R}' \qquad (14)\end{aligned}$$

Where, $\mathbf{D}\otimes\mathbf{R}$ is the direct repercussive employment opportunities and $[\mathbf{I}-\mathbf{A}]^{-1}\cdot\mathbf{A}\cdot\mathbf{S}\otimes\mathbf{R}'$ is the indirect one.

Let $[\mathbf{I}-\mathbf{A}]^{-1}]\cdot\mathbf{A}$, $\mathbf{S}$, $\mathbf{D}$, $\mathbf{R}$ and $\mathbf{R}'$ be the following partitioned matrices.

$$[\mathbf{I}-\mathbf{A}]^{-1}\cdot\mathbf{A}=\begin{bmatrix} a_{11}^{11} & \cdots & a_{1N}^{11} & a_{11}^{1M} & \cdots & a_{1N}^{1M} \\ \vdots & & \vdots & \vdots & & \vdots \\ a_{N1}^{11} & \cdots & a_{NN}^{11} & a_{N1}^{1M} & \cdots & a_{NN}^{1M} \\ a_{11}^{M1} & \cdots & a_{1N}^{M1} & a_{11}^{MM} & \cdots & a_{1N}^{MM} \\ \vdots & & \vdots & \vdots & & \vdots \\ a_{N1}^{M1} & \cdots & a_{NN}^{M1} & a_{N1}^{MM} & \cdots & a_{NN}^{MM} \end{bmatrix} \qquad (15)$$

$$\mathbf{S}=\begin{bmatrix} \mathrm{S}_1^1 & & & & 0 \\ & \mathrm{S}_N^1 & & & \\ & & \ddots & & \\ & & & \mathrm{S}_1^M & \\ 0 & & & & \mathrm{S}_N^M \end{bmatrix} \qquad (16)$$

Where, $s_j^k=0$ $(k=k_0,\ j=j_0)$

$$\mathbf{D}=\begin{bmatrix} d_{11}^{11} & \cdots & d_{N1}^{11} & d_{11}^{1M} & \cdots & d_{N1}^{1M} \\ \vdots & & \vdots & \vdots & & \vdots \\ d_{N1}^{11} & \cdots & d_{NN}^{11} & d_{N1}^{1M} & \cdots & d_{NN}^{1M} \\ d_{11}^{M1} & \cdots & d_{N1}^{M1} & d_{11}^{MM} & \cdots & d_{N1}^{MM} \\ \vdots & & \vdots & \vdots & & \vdots \\ d_{N1}^{M1} & \cdots & d_{NN}^{M1} & d_{N1}^{MM} & \cdots & d_{NN}^{MM} \end{bmatrix} \qquad (17)$$

Where, the relation of matrices S and D is as follows.

$$d^{k'k}_{j\,i}=s^{k'}_{j} \quad (k=k_o,\ j=j_o)$$
$$d^{k'k}_{i\,j}=0 \quad \text{other} \qquad \begin{pmatrix} i=1,\ 2,\ \cdots\cdots\ N \\ j=1,\ 2,\ \cdots\cdots\ M \end{pmatrix} \tag{18}$$

The small k_o is the locational industry and j_o is the locational region.

$$R=\begin{bmatrix} r^{1}_{1} \\ \vdots \\ r^{1}_{N} \\ \vdots \\ r^{M}_{1} \\ \vdots \\ r^{M}_{N} \end{bmatrix} \qquad R'=\begin{bmatrix} r'^{1}_{1} \\ \vdots \\ r'^{1}_{N} \\ \vdots \\ r'^{M}_{1} \\ \vdots \\ r'^{M}_{1} \end{bmatrix} \qquad X=\begin{bmatrix} x^{1}_{1} \\ \vdots \\ x^{1}_{N} \\ \vdots \\ x^{M}_{1} \\ \vdots \\ x^{M}_{N} \end{bmatrix} \tag{19}$$

Where, $\otimes$ multiplication represents the next operation.

$$x^{k'}_{i}=\sum_{k=1}^{N} d^{k'k}_{i\,j}\cdot r^{k'}_{i}+\sum_{k=1}^{N} s^{k'}_{i}\cdot a^{k'k}_{i\,j}\cdot r'^{k'}_{i} \tag{20}$$

(i, j =1, 2,·····M, k'=1, 2,·····N)

To apply the new method, it is necessary to estimate the future target values of interregional input coefficients and the basic unit of employment opportunities.

Then, we represent the Improvement RAS method to estimate the future target values.

For example, Fig. 3 represents the flow to estimate the future target values by the interregional input coefficients in 1965 and 1970.

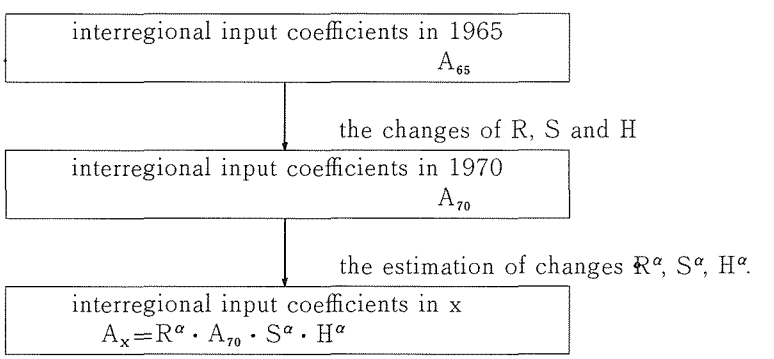

Fig. 3. The Improvement RAS Method.

Where,

R : substitute change coefficients.
S : processing change coefficients.
H : relative change coefficients.

$\alpha = (x-1970)/5$

The basic unit of employment opportunities' is estimated by the similar method.

4. The estimate of the Employment Opportunities arising from the Industrial Locations in the Tomakomai-Tōbu Industrial Park.

Hokkaido is an island developed almost entirely after the middle of the 19th century, in other words, the Meiji Restroration in 1868. It consequently displays many strong occidental as well as marked frontier characteristics. In the second year of Meiji (1869), Hokkaido development agency of the Central Government was opened at Hakodate. This was later moved to Sapporo.

In 1872, the Hokkaido Reclamation Board was established also at Sapporo, and this took over the entire responsibility for land development as well as for the administration of the island. In 1874, the government adopted even more positive measures to achieve the two-fold objectives of military defence and agricultural settlement.

In the first, the concentration was placed on the Ishikari Plain, the central region of Hokkaido. This was obviously aimed at the defence of the capital city, Sapporo. And with the establishment of the Reclamation Board at Sapporo in 1872, a ten-year plan was adopted and at the exploitation of mineral resources, land reclamation and the processing of primary materials.

The government also emphasized the introduction of modern methods of production along several lines. Technical advisors for education and industry were invited to Hokkaido from Europe and the United States. Model plants were built for the processing of such materials as flax, sugar beets and dairy products.

Facilities were established for education of leaders for this new land. Chief among these was the Sapporo Agricultural College, the predecessor of today's Hokkaido University. At this college, one of its early teachers, the American William S. Clark, through his strong and dynamic personality, had a profound effect upon the minds of the younger generation.

By the beginning of this century, the value of agricultural production had grown as the backbone of the islands economy. The introduction of paddy rice culture to Hokkaido gave a vital impetus to the agricultural development.

After World War Ⅱ, the loss of Japans colonial empire and the great influx of repatriates compelled a new view of Hokkaido.

A great opportunity as well as a great responsibility was imposed on this island for the solution of the national population pressure and economic problems.

New development projects were planned and promptly activated. In 1950, Hokkaido Development Agency was organized and was directly attached to the Prime-Ministers Office. The responsibility of the Agency is not only that of agrarian development but also that of mining, lumbering, fishing, manufacturing industry and welfare of inhabitants.

The over-all development plan in Hokkaido consists of three terms plans. The initial plan was implemented from 1952 to 1962. One of the major projects is to promote the development of Konsen Pilot Farm.

The 2nd was implemented from 1963 to 1970. One of the projects is the completion of traffic and communication facilities.

The 3rd plan is going to implement from 1971 to 1985. One of the projects is the development of Tomakomai-Tōbu Large-Scale Industrial Park.

Hokkaido economy depended primarily on the major natural industries, and tertiary industries arising from the national public disbursement. Then, the economy of region lacked diversification; its foundations lacked both breadth and depth.

The larger cities such as Sapporo, Asahikawa, Kushiro and Hakkodate contained some relatively local industries. The relative low density of Hokkaido population induced manufactures to supply the regional market from plants located closer to major consuming areas.

Therefore, the Tomakomai Tōbu Large-Industrial Park is not merely the growth of an existing industrial situation but rather a fundamental change in the economic complex of region.

The exploitation project design of this industrial park has the both functions of high level industries and living environment in Tomakomai region.

From the facts presented in Fig. 4, Tomakomai region has the main terminal functions of port, rail way, highway and air port.

The main locational industries are the international competitive industries such as steel manufacturing, petroleum, petrochemicals, non-ferrous metal manufacturing, trasportation manufacturing and relative industries.

The outputs and employees of main locational industries in 1980 and 1985 are estimated in Table 3.

The total employment opportunities of the locational level in 1980 and 1985 are measured by the project plans.

The main results are as follows.

(1) From the facts presented in the project plans, the total employment

opportunities in which the total repercussive employment opportunities plus the employees of locational industries in 1985 increase remarkably than the ones in 1980.

(2) The regional total employment opportunities in 1985 are shown in Fig. 5. From the facts presented in Fig. 5, the sum of the regional

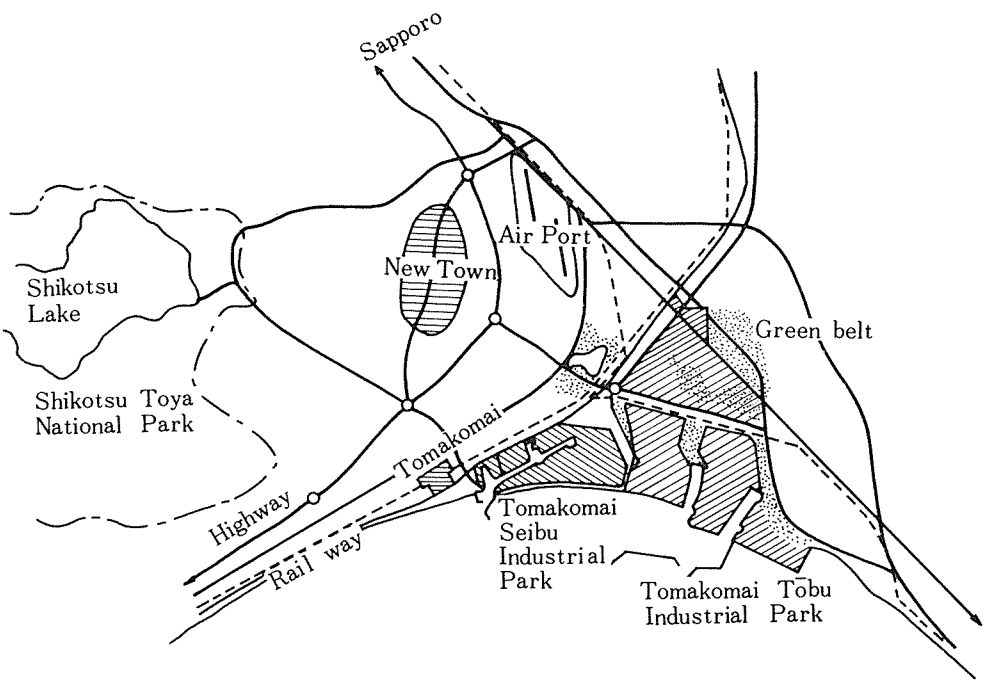

Fig. 4. The general plan of Tomakomai Tōbu Industrial Park.

Table 3. The Outputs and Employees of the Locational Industries.

years	1980		1985	
sectors	outputs	employees	outputs	employees
Petrochemicals	1,100	4.91	3,200	6.5
Petroleum	650	0.75	2,150	1.0
Steel manufacturing	1,700	6.0	4,300	10.0
Non-ferrous metal manufacturing	1,250	9.05	2,550	14.2
Transportation manufacturing	450	6.0	1,250	8.0
Relative industries	1,400	3.99	3,050	10.3
Total	6,550	30.7	16,500	50.0

(outputs; million dollars, employee; thousands)

total employment opportunities in othe regions is equal to the ones in Hokkaido. The remarkable feature is the expansion of the regional total employment opportunities in Kanto region advanced industrially.

(3) The regional total employment opportunities by industries in 1985 are shown in Fig. 6. The regional total employment opportunities of secondary industry in Hokkaido is 35 % of the total ones. This result influences the manufacturing with the relative lower level than the national level for good.

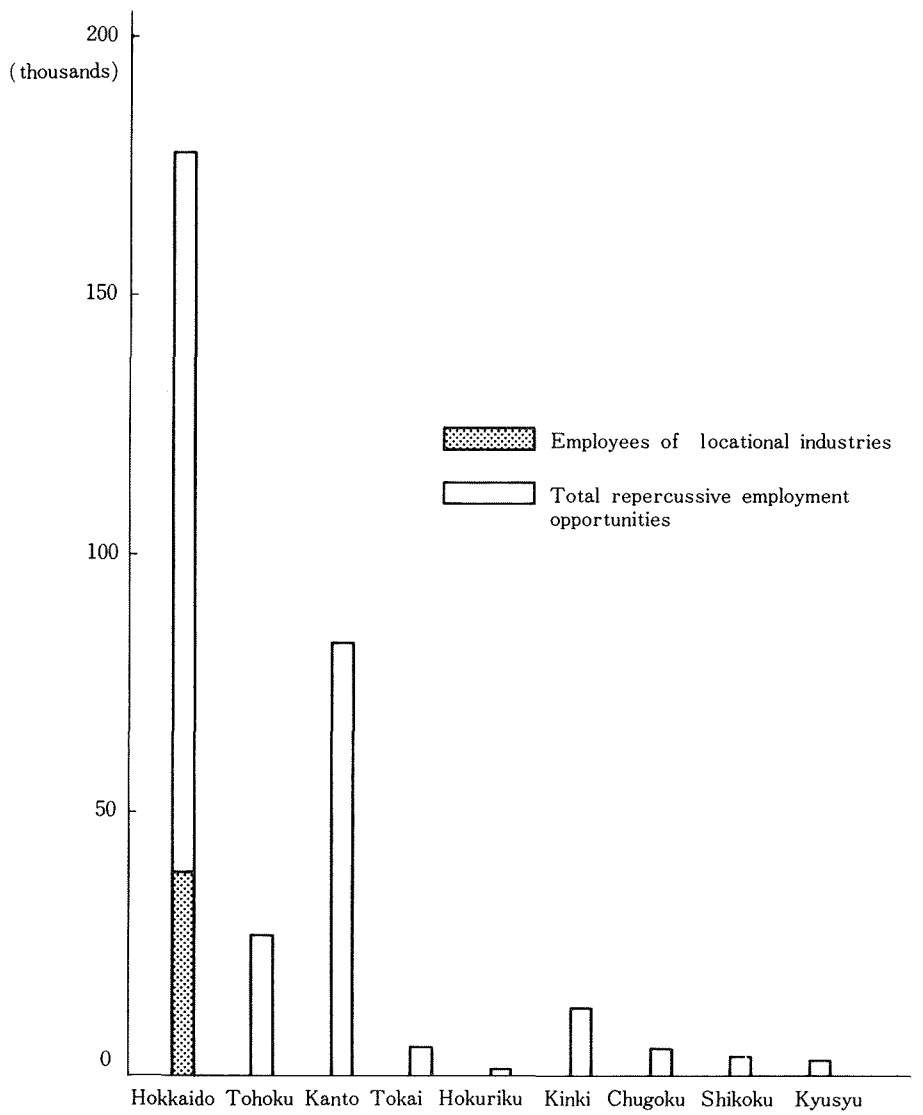

Fig. 5. The regional employment opportunities.

The remarkabel feature is that the expansion of the regional total employment opportunities of tertiary industry is 60 % of total ones. This main cause is the indirect repercussive impact of the locational industries.

(4) The method of forward and backward linkage effects is to increase the intraregional input coefficients of Hokkaido region. In this case, especially the intraregional input coefficients of locational industries such as Machinary, Metal and Other industries in Hokkaido region increase 50 % than the before values of intraregional input coefficients. And this increase values are subtracted from the intraregional input coefficients of Kanto region advanced industrially. Therefore, the regional employment opportunities increase 12,000 persons and the employment opportunities of manufacturing industries increase remarkably. It appears to be clear from the results that the forward and backward linkage effects influence the manufacturing of Hokkaido region with the relative lower level than the national level for good.

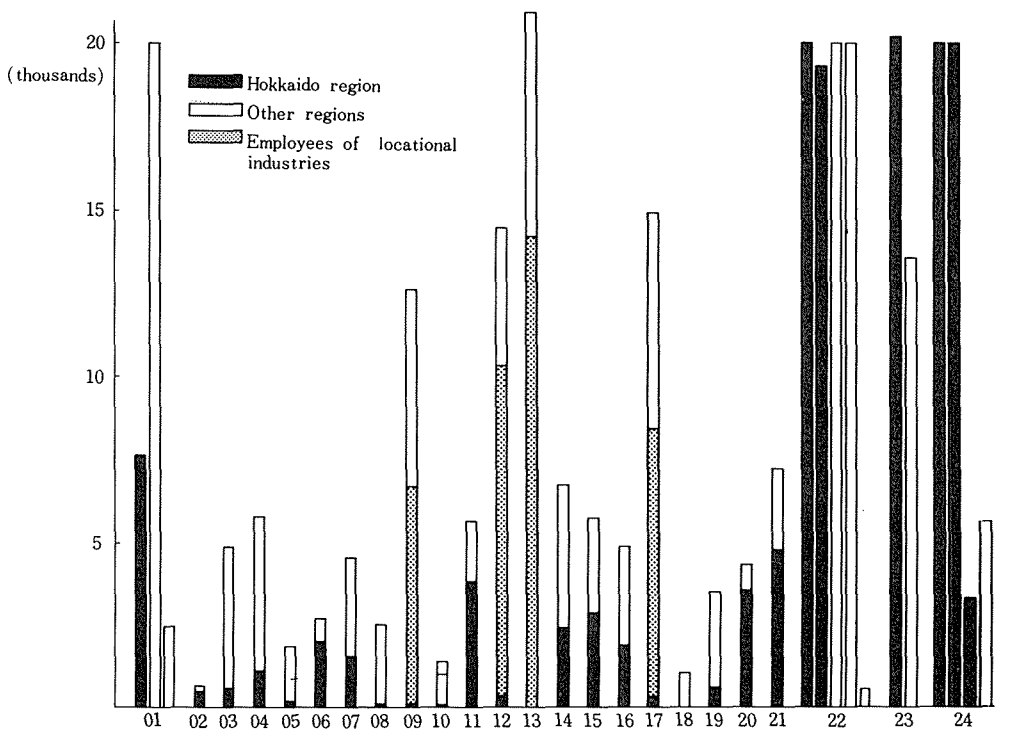

Fig. 6. The regional employment opportunities by industries.

5. Conclusion

In summary, we have investigated the new method of the impact of the regional employment opportunities arising from the industrial locations in the Large-Scale Industrial Park.

By using the new method, we can estimate the direct and indirect repercussive employment opportunities arising from the many industrial locations in the Tomakomai Tōbu Industrial Park. Therefore, we can measure the repercussive employment opportunities not only Hokkaido region but also the other regions by using the interregional input-output analysis.

Futhermore, we can estimate the impact of the forward and backward linkage effects of Hokkaido region.

Acknowlegements

The auther wishes to express his gratitude to Dean Kiyohide Seki of the Graduate School of Environmental Science of Hokkaido University and the staffs of the regional planning laboratory for suggesting the problem throughout the work.

Finally, the numerical calculations in the chapter 4 were made on Hokkaido University Computing Center.

Annotation

1) Isard model has been represented the paper, Interregional and Regional Input-Output Analysis; A Model of a Space Economy, Review of Economics and Statistics, Nov. 1951.
2) Leontief model has been represented the paper, The Economic Impact-Industrial and Regional-of an Arms Cut, The Review of Economics and Statistics, Aug. 1965 by Leontief. W, Morgan. A, Polenske. K, Simpson. D and E. Tower.
3) Moses・Chenery model has been represented the papers, Regional Analysis, The Structure and Growth of the Italian Economy, 1953 by Chenery. H. B, and the Stability of Interregional Trading Patterns and Input-Output Analysis, American Economic Review, Dec. 1955 by Moses. L. N.
4) Isard. W and R. E. Kuenne represented the paper, The Impact of Steel upon the Greater New-York-Philadelphia Industrial Region, The Review of Economics and Statistics, Nov. 1953, and Miller. R. E. represented the paper, The Impact of the Aluminum Industry of the Pacific Northwest, A Regional Input-Output Analysis, The Review of Economics and Statistics, May. 1957.
5) The auther represented in the chapter 5 of the book, Regional Balance Growth, Taimeidō Co. L. D. 1977.
6) Hirshman. A. O represented in the chapters 5 and 6 of the book, The Strategy of Economic Development. 1958.