Estimation of Input-Output Tables and Simulations of Employment Inducement Focusing on Small Regions: Case of Kumamoto Prefecture

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The ongoing trend toward decentralization will enhance the future role that local governments play throughout the labor policy process. It will be important that local governments have clear visions and comprehensive strategies for job creation and that they properly implement labor policies specifically suited to the circumstances of their respective regions. However, few small local governments have their own visions or plans for job creation. In light of this situation, this study aims to develop and propose an approach for estimating regional input-output tables focused on small regions by applying a gravity model, and to create specific plans for investment and production activities and simulate employment inducement based on the comprehensive national strategy through the use of such tables, as a tool for small local governments to use in drafting visions or comprehensive strategies for job creation that incorporate specific numerical targets.

I. Introduction

The ongoing trend toward decentralization will enhance the future role that local governments play throughout the labor policy process, from planning to implementation. It will be important that local governments have clear visions and comprehensive strategies for job creation and that they properly implement labor policies specifically suited to the circumstances of their respective regions.

According to a 2004 survey conducted by the Japan Institute for Labour Policy and Training (JILPT), in contrast with prefectures and Cabinet order-designated cities, most smaller local governments, such as those of municipalities, had no visions or plans for job creation (Watanabe 2007). In the wake of the municipal merger movements that commenced in 1999, an increasing number of local governments have drafted visions or plans after such mergers, but the majority still have not (Watanabe 2009).

In view of this situation, this study aims to develop and propose an approach for estimating regional input-output tables focused on small regions and to simulate employment inducement through the use of such tables, as a tool for local governments to use in drafting visions or comprehensive strategies for job creation that incorporate specific numerical targets.

There are two possible approaches to setting target numbers for the creation of new jobs: a bottom-up approach and a top-down approach. In the bottom-up approach, the number of jobs that the various divisions within a local government intend to create by inviting

enterprises or carrying out investment plans are collected and totaled.[1] In the top-down approach, the number of new jobs to be created is based on information reported by the respective local government divisions, and also incorporates the interdependent relationships within overall regional economies, including trade with other regions. The approach adopted in this study, which is based on the input-output tables, is an example of the latter approach. This approach enables estimates which incorporate the repercussions between industries and the bounding-out effects between regions, or, in other words, estimates which reflect progress in the development of regional industrial clusters and inter-regional and inter-industry supply chains.

One obstacle to the use of this approach is the limited statistical data available concerning specific regions when compared to the nationwide data. For example, only a few surveys have captured inter-regional trade relationships in terms of monetary amounts. The Commodity Distribution Survey is one such survey, and is conducted by regional bureaus of economy, trade and industry to allow regional and prefectural versions of input-output tables to be compiled, but it is not useful for this study because it does not go into the details of trade between small regions—the main subject of this survey. An independent, detailed survey would be costly and difficult to perform accurately, however. To overcome this problem, material flow data can be used as a substitute. By making reference to the survey reports compiled by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) (namely, the Report on Cargo Flow in Japan, the Report on Passenger Flow in Japan, and the Survey on Net Cargo Flow in Japan [Material Flow Census]), it is possible to capture inter-prefectural transport volume in terms of material flow, by type of transportation and goods. However, this approach also fails to reveal the trade relationships among units smaller than prefectures.[2]

Due to the difficulty of directly investigating inter-regional trade relationships, a non-survey approach that estimates inter-regional trade based on other sources of information is often adopted as an effective methodology. There are two representative estimation methods for a non-survey approach.[3] One is the use of location quotient (LQ) techniques. This method uses a specification coefficient for each region to determine whether demand exceeds supply in the region, or in other words, whether the local economy in the region is self-sufficient, based on the assumption that an inflow of goods from other regions indicates a lack of self-sufficiency while an outflow of goods to other regions exists if supply exceeds demand in the region. However, this method is of course unable to estimate

[1] A problem that must be addressed in the first place is that small local governments mostly do not have divisions specialized in dealing with labor policy due to the limited financial and human resources.

[2] The Report on Cargo Flow in Japan and the Report on Passenger Flow in Japan provide data on subdivided regions only with regard to Hokkaido (seven blocks in the former and four blocks in the latter).

[3] For details of these non-survey approach methods, see Nakano and Nishimura (2012).

cross hauling—the simultaneous inflow and outflow of the same type of goods.

Another representative estimation method is a bi-proportional method, such as the RAS method, which takes into account the commodity balance, that is, the consistency with the sums of rows and the sums of columns in the input-output table matrices for a region. For example, it estimates the trade volume in the place of destination or place of origin so that it matches the total inflow or total outflow by sector that can be found in the input-output tables for the region. However, this method is also unable to account for cross hauling in its estimates of inter-regional trade unless cross hauling is included among the data available on inter-regional trade not included in the input-output tables.

As compared to these major estimation methods, a simpler method of estimating inter-regional trade while taking account of cross hauling is to employ a gravity model, such as the method advocated by Leontief and Strout (1963) (Begg 1985; Hitomi 2000; Kronenberg 2010).[4] There are many variations in this model according to the variables to be used; for example, whether the physical distance between regions or the freight charge amount are used as variables to take account of the possible obstacles they form to inter-regional trade. By employing such variables, this method makes it possible to estimate inter-regional trade without ignoring cross hauling.

This study also employs a gravity model for estimating inter-regional trade. In a great difference from preceding studies, this study applies the approach advocated by Nakano and Nishimura (2012), which divides existing regional input-output tables which include cross hauling—e.g. input-output tables compiled by prefectures and those complied by regional bureaus of economy, trade, and industry—into regions smaller than prefectures or regional blocks, without changing the inter-prefectural or inter-regional trade structure.

Thus, this study estimates multi-regional input-output tables for small regions while remaining consistent with existing input-output tables and without eliminating cross hauling, and then measures the amount of employment induced when given a forecast or numerical target for final demand. Specifically, this study uses the urban area of Kumamoto Prefecture as its target region.

This paper is organized in the following way. Section II presents an analytical model for measuring the amount of induced employment based on multi-regional input-output tables. Section III explains the method employed to estimate the multi-regional input-output tables using the Kumamoto urban area as an example, and examines supplementary employment coefficients. Section IV simulates to measure the amount of induced employment

[4] Kaneko (1967) and Ihara (1996) estimated parameters by applying a gravity model to the Inter-Regional Input-Output Tables compiled by the Ministry of International Trade and Industry. Ihara discussed the benefits and limits of the use of a gravity model when estimating inter-regional flows of goods. Hitomi (2000) attempted to rearrange the Inter-Regional Input-Output Tables into ten power distribution areas (which is different from this study's focus on smaller areas), and estimated the amount of trade between two regions based on a gravity model using data on inter-regional trade in the service sector.

by assigning the estimated input-output tables as well as variables including a forecast and numerical target for final demand to the analytical model. Section V presents conclusions drawn from the analysis.

II. Multi-Regional Input-Output Model

In the competitive inflow/import type input-output tables among the three regions to be estimated in this study, the equilibrium solution of regional production is obtained according to the following steps.

(i) The coefficient of inflow into region k from region l (the ratio of inflow to total demand in region k) is defined as described in formula (1).

$$r_i^{lk} = \frac{t_i^{lk}}{\sum_j x_{ij}^k + f_i^k} \qquad (1)$$

Wherein r_i^{lk} is the coefficient of inflow into region k from region 1 in sector i; t_i^{lk} is inflow from region l into region k in sector i (outflow from region l to region k); x_{ij}^k is the intermediate demand in sector i relating to sector j of region k; and f_i^k is the regional final demand in sector i of region k.

(ii) With the coefficient of inflow defined in (1), the equation for multi-regional input-output tables can be expressed by formula (2).

$$\mathbf{x} = \left(\mathbf{I} - \hat{\mathbf{M}} - \mathbf{T}\right)\left(\mathbf{Ax} + \mathbf{f}\right) + \mathbf{e} \qquad (2)$$

Wherein $\mathbf{x}$ is the regional production vector; $\mathbf{I}$ is the identity matrix; $\mathbf{A}$ is the input coefficient matrix; $\hat{\mathbf{M}}$ is the import coefficient matrix; $\mathbf{T}$ is the inflow coefficient matrix; $\mathbf{f}$ is the regional final demand vector; and $\mathbf{e}$ is the export vector.

The vectors and matrices contained in the above formula consist of the regional vectors and matrices shown below.

$$\mathbf{x} = \begin{pmatrix} \mathbf{x}^1 \\ \mathbf{x}^2 \\ \mathbf{x}^3 \end{pmatrix}, \quad \mathbf{A} = \begin{pmatrix} \mathbf{A}^1 & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{A}^2 & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{A}^3 \end{pmatrix}, \quad \hat{\mathbf{M}} = \begin{pmatrix} \hat{\mathbf{M}}^1 & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \hat{\mathbf{M}}^2 & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \hat{\mathbf{M}}^3 \end{pmatrix},$$

$$\mathbf{T} = \begin{pmatrix} \hat{\mathbf{R}}^{21} + \hat{\mathbf{R}}^{31} & -\hat{\mathbf{R}}^{12} & -\hat{\mathbf{R}}^{13} \\ -\hat{\mathbf{R}}^{21} & \hat{\mathbf{R}}^{12} + \hat{\mathbf{R}}^{32} & -\hat{\mathbf{R}}^{23} \\ -\hat{\mathbf{R}}^{31} & -\hat{\mathbf{R}}^{32} & \hat{\mathbf{R}}^{13} + \hat{\mathbf{R}}^{23} \end{pmatrix}, \quad \mathbf{f} = \begin{pmatrix} \mathbf{f}^1 \\ \mathbf{f}^2 \\ \mathbf{f}^3 \end{pmatrix}, \quad \mathbf{e} = \begin{pmatrix} \mathbf{e}^1 \\ \mathbf{e}^2 \\ \mathbf{e}^3 \end{pmatrix}$$

Wherein $\mathbf{x}^k$ is the regional production vector in region k; $\mathbf{A}^k$ is the input coefficient matrix in region k; $\hat{\mathbf{M}}^k$ is the import coefficient matrix in region k; $\hat{\mathbf{R}}^{lk}$ is the in-

flow coefficient matrix for the inflow into region k from region l; $\mathbf{f^k}$ is the regional final demand vector in region k; and $\mathbf{e^k}$ is the export vector in region k.

The regional vectors and matrices consist of the following elements.

$$\mathbf{x}^{\mathbf{k}} = \begin{pmatrix} x_1^k \\ \vdots \\ x_{44}^k \end{pmatrix}, \quad \mathbf{A}^{\mathbf{k}} = \begin{pmatrix} a_{1,1}^k & \cdots & a_{1,44}^k \\ \vdots & \ddots & \vdots \\ a_{44,1}^k & \cdots & a_{44,44}^k \end{pmatrix}, \quad \hat{\mathbf{M}}^{\mathbf{k}} = \begin{pmatrix} r_1^{m,k} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \ddots & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & r_{44}^{m,k} \end{pmatrix}.$$

$$\hat{\mathbf{R}}^{\mathbf{lk}} = \begin{pmatrix} r_1^{lk} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \ddots & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & r_{44}^{lk} \end{pmatrix}, \quad \mathbf{f}^{\mathbf{k}} = \begin{pmatrix} f_1^k \\ \vdots \\ f_{44}^k \end{pmatrix}, \quad \mathbf{e}^{\mathbf{k}} = \begin{pmatrix} e_1^k \\ \vdots \\ e_{44}^k \end{pmatrix}$$

Wherein x_i^k is the regional production in sector i of region k; a_{ij}^k is the input coefficient in sector j from sector i in region k; $r_i^{m,k}$ is the import coefficient in sector i of region k; and e_i^k is the export in sector i of region k.

(iii) By solving formula (2) in terms of x, formula (3) can be obtained. By assigning regional final demand and export to formula (3) and multiplying the Leontief inverse matrix, induced regional production can be calculated.

$$\mathbf{x} = \left\{\mathbf{I} - \left(\mathbf{I} - \hat{\mathbf{M}} - \mathbf{T}\right)\mathbf{A}\right\}^{-1}\left\{\left(\mathbf{I} - \hat{\mathbf{M}} - \mathbf{T}\right)\mathbf{f} + \mathbf{e}\right\} \qquad (3)$$

If the values calculated by dividing the number of employees and the number of employed persons at work by total production are referred to as employment coefficients, the employment coefficients by sector can be expressed by formulas (4) and (5).[5]

$$ue_j^k = \frac{em_j^k}{x_j^k} \qquad (4)$$

$$us_j^k = \frac{sh_j^k}{x_j^k} \qquad (5)$$

Wherein ue_j^k is the employment coefficient in sector j of region k (employee basis); em_j^k is the amount of induced employment in sector j of region k (employee basis); us_j^k is the employment coefficient in sector j of region k (employed-person-at-work basis); sh_j^k is the amount of induced employment in sector j of region k (employed-person-at-work basis).

[5] "Employees" consists of "paid executives," "regular employees," and "temporary/daily employees." "Employed persons at work" includes "self-employed workers" and "family workers" in addition to "employees." There are also "employed persons not at work," who have jobs and are paid a wage or salary while absent from work due to sickness or paid leave.

Using formula (3) and the employment coefficients (formulas [4] and [5]), the amount of induced employment by sector can be expressed by formulas (6) and (7).

$$\mathbf{em} = \hat{\mathbf{U}}^{\mathbf{e}}\left\{\mathbf{I} - \left(\mathbf{I} - \hat{\mathbf{M}} - \mathbf{T}\right)\mathbf{A}\right\}^{-1}\left\{\left(\mathbf{I} - \hat{\mathbf{M}} - \mathbf{T}\right)\mathbf{f} + \mathbf{e}\right\} \qquad (6)$$

$$\mathbf{sh} = \hat{\mathbf{U}}^{\mathbf{s}}\left\{\mathbf{I} - \left(\mathbf{I} - \hat{\mathbf{M}} - \mathbf{T}\right)\mathbf{A}\right\}^{-1}\left\{\left(\mathbf{I} - \hat{\mathbf{M}} - \mathbf{T}\right)\mathbf{f} + \mathbf{e}\right\} \qquad (7)$$

Wherein **em** is the induced employment vector (employee basis); $\hat{\mathbf{U}}^{\mathbf{e}}$ is the employment coefficient matrix (employee basis); **sh** is the induced employment vector (employed-person-at-work basis); and $\hat{\mathbf{U}}^{\mathbf{s}}$ is the employment coefficient matrix (employed-person-at-work basis).

The regional composition of the vectors and matrices expressed by formulas (6) and (7) are as shown below.

$$\mathbf{em} = \begin{pmatrix} \mathbf{em}^1 \\ \mathbf{em}^2 \\ \mathbf{em}^3 \end{pmatrix}, \quad \hat{\mathbf{U}}^{\mathbf{e}} = \begin{pmatrix} \hat{\mathbf{U}}^{\mathbf{e},1} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \hat{\mathbf{U}}^{\mathbf{e},2} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \hat{\mathbf{U}}^{\mathbf{e},3} \end{pmatrix}, \quad \mathbf{sh} = \begin{pmatrix} \mathbf{sh}^1 \\ \mathbf{sh}^2 \\ \mathbf{sh}^3 \end{pmatrix}, \quad \hat{\mathbf{U}}^{\mathbf{s}} = \begin{pmatrix} \hat{\mathbf{U}}^{\mathbf{s},1} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \hat{\mathbf{U}}^{\mathbf{s},2} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \hat{\mathbf{U}}^{\mathbf{s},3} \end{pmatrix}$$

Wherein $\mathbf{em}^{\mathbf{k}}$ is the induced employment vector in region k (employee basis); $\hat{\mathbf{U}}^{\mathbf{e,k}}$ is the employment coefficient matrix in region k (employee basis); $\mathbf{sh}^{\mathbf{k}}$ is the induced employment vector in region k (employed-person-at-work basis); and $\hat{\mathbf{U}}^{\mathbf{s,k}}$ is the employment coefficient matrix in region k (employed-person-at-work basis).

The sectoral compositions of the above described vectors and matrices are as shown below.

$$\mathbf{em}^{\mathbf{k}} = \begin{pmatrix} em_1^k \\ \vdots \\ em_n^k \end{pmatrix}, \quad \hat{\mathbf{U}}^{\mathbf{e,k}} = \begin{pmatrix} ue_1^k & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \ddots & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & ue_n^k \end{pmatrix}, \quad \mathbf{sh}^{\mathbf{k}} = \begin{pmatrix} sh_1^k \\ \vdots \\ sh_n^k \end{pmatrix}, \quad \hat{\mathbf{U}}^{\mathbf{s,k}} = \begin{pmatrix} us_1^k & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \ddots & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & us_n^k \end{pmatrix}$$

Wherein em_i^k is the induced employment in sector i of region k (employee basis); ue_i^k is the employment coefficient in sector i of region k (employee basis); sh_i^k is the induced employment in sector i of region k (employed-person-at-work basis); and us_i^k is the employment coefficient in sector i of region k (employed-person-at-work basis).

By assigning final demand to formulas (3), (6) and (7), induced regional production and employment can be measured while taking inter-regional repercussions into account.

III. Estimation of Inter-Regional Input-Output Tables Focusing on the Kumamoto Urban Area

This study targets the Kumamoto urban area, which is composed of Kumamoto City and its surrounding municipalities (cities [*shi*], towns [*machi/cho*], and villages [*mura*]), and attempts to compile input-output tables for this area. There are two major reasons Kumamoto Prefecture in the Kyushu Region has been selected: the first is its proactive attitude toward inviting enterprises, and the second is its unique labor policies. In relation to the invitation of enterprises, the government of Kumamoto Prefecture provides more generous support to the enterprises it invites than the governments of other prefectures. In the interview survey, enterprises that moved to Kumamoto responded that while subsidies for the building of business establishments and tax benefits were available in other prefectures as well, Kumamoto's prompt and careful responses to their requests were superior to other prefectures. With regard to Kumamoto's unique labor policies, the "Kumamoto Prefecture Industry and Employment Creation Program (FY2008–FY2010)" is a recent example. This program was similar to the Regional Employment Creation Promotion Program (Package Program) spearheaded by the Ministry of Health, Labour and Welfare (MHLW), but was more convenient for local municipalities because the requirements for participation in the Kumamoto program were less strict than those of the MHLW program. Municipalities that participated in the Kumamoto program set up specialized units in charge of inviting enterprises, which led to further enhancement of the enterprise invitation system of Kumamoto Prefecture as a whole.

The Kumamoto urban area is composed of Kumamoto City and its neighboring municipalities, from which approximately 15% of residents commute to Kumamoto City to work or attend school (as of the 2005 Population Census). The constituent municipalities aim to cooperate to promote the growth of Kumamoto Prefecture as the center of the Kyushu Region, while reinforcing their own competitiveness within the area. This study divides Japan into three regions: the Kumamoto urban area, the other areas of Kumamoto, and areas of Japan other than Kumamoto Prefecture, and estimates multi-regional input-output tables to represent trade between these three regions. Figure 1 shows a model for representation. First, the tables for the Chenery-Moses model, or competitive inflow type, are estimated, and these are then converted into the Isard model, or non-competitive inflow type as shown in Figure 1, using the inflow coefficient. Since there are only two sets of input-output tables available for this study—the 2005 Input-Output Tables for Japan compiled by the Ministry of Internal Affairs and Communications (MIC) and the 2005 Input-Output Tables for Kumamoto Prefecture—, it is necessary to divide the Input-Output Tables for Kumamoto Prefecture into those related to the Kumamoto urban area and those related to the other areas of Kumamoto, and to estimate trade between the three regions mentioned above.

			Intermediate demand			Final demand					Regional production
			Kumamoto Prefecture		Other areas of Japan	Kumamoto Prefecture		Other areas of Japan	Export	Import	
			Urban area	Other areas		Urban area	Other areas				
Intermediate input	Kumamoto Prefecture	Urban area									
		Other areas									
	Other areas of Japan										
Value added											
Regional production											

Figure 1. Model for Multi-Regional Input-Output Tables for the Kumamoto Urban Area

Table 1. Municipalities Constituting the Kumamoto Urban Area and the Other Areas of Kumamoto

	Northern district	Central district	Southern district	Amakusa district
Kumamoto urban area	Koshi-shi Gyokuto-machi Ozu-machi Kikuyou-machi	Kumamoto-shi Uto-shi Uki-shi Mifune-machi Kashima-machi Mashiki-machi Kosa-machi Yamato-cho Misato-machi Nishihara-mura		
Other areas of Kumamoto	Arao-shi Tamana-shi Yamaga-shi Kikuchi-shi Nagomi-machi Nankan-machi Nagasu-machi Aso-shi Minamioguni-machi Oguni-machi Ubuyama-mura Takamori-machi Minamiaso-machi		Yatsushiro-shi Hitoyoshi-shi Minamata-shi Hikawa-cho Ashikita-machi Tsunagi-machi Nishiki-machi Asagiri-cho Taragi-machi Yunomae-machi Mizukami-mura Sagara-mura Itsuki-mura Yamae-mura Kuma-mura	Amakusa-shi Kamiamakusa-shi Reihoku-machi

Note: Since the former Ueki-machi, which is now part of Kumamoto City, is under the jurisdiction of the Kikuchi City public employment security office, the area of Kumamoto City extends over the northern and central districts.

1. Division of Input-Output Tables

Kumamoto Prefecture is divided into the Kumamoto urban area and the other areas of Kumamoto. Table 1 shows the municipalities that constitute the respective regions.[6] Kumamoto Prefecture is generally divided into four districts: the northern, central, southern, and Amakusa districts. The Kumamoto urban area covers the central district and part of the northern district.[7]

The Input-Output Tables for Kumamoto Prefecture have been divided via the following steps.

(i) Among the final demand sectors, private consumption expenditures, general government consumption expenditures, and prefectural production have been divided between the Kumamoto urban area and the other areas of Kumamoto based on other statistical data (for the indicators for proportional distribution, see Table 2[8]).

(ii) Among the final demand sectors, gross regional fixed capital formation (public/private) has been estimated as follows. (1) The capital coefficient[9] based on capital flow has been estimated by dividing gross capital formation according to investor sector or type of investment goods (which is provided in the fixed capital matrix supplemented to the nationwide input-output tables) by domestic production according to investor sector. (2) Prefectural production according to investor sector for Kumamoto Prefecture and for the Kumamoto urban area has been multiplied by the respective capital coefficient, and then gross fixed formation according to type of investment goods is obtained by aggregating the result of (1) for all investor sectors. (3) The ratio between the estimated gross fixed capital formation according to type of investment goods for Kumamoto Prefecture and the gross fixed capital formation according to type of investment goods provided in the publicly available Input-Output Tables for Kumamoto Prefecture has been calculated. (4) The final gross fixed capital formation is obtained by multiplying the estimated gross fixed capital formation according to type of investment goods for the Kumamoto urban area by such adjustment ratio calculated in (3).

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[6] The geographical range of the Kumamoto urban area that is the focus of this study corresponds to the range of the municipalities that form the Kumamoto Urban Area Council established on April 1, 2010.

[7] It should be noted that the municipalities that constitute the four districts differ depending on the statistical survey or analyst. This study adopts the classifications of the Kumamoto Labour Bureau based on the zoning of the jurisdictional districts of public employment security offices.

[8] It should be noted that this statistical data is not completely consistent with the concept of *activity* applicable to input-output tables. This study basically uses production data, but sometimes uses data on the number of employed persons at work if production data is unavailable.

[9] The term “capital coefficient” is usually used when the numerator is capital stock.

(iii) Intermediate input (demand) is estimated by multiplying the regional production calculated in (i) by the input coefficient based on the Input-Output Tables for Kumamoto Prefecture. Similarly, gross value added is estimated by multiplying the regional production by the ratio of gross value added according to the respective item (the ratio of gross value added to the prefectural production as provided in the Input-Output Tables for Kumamoto Prefecture).

(iv) Among the final demand sectors, consumption expenditure outside households (column) is calculated by aggregating the consumption expenditure outside households (one of the items included in the gross value added as estimated in [iii]) and dividing it into sectors according to the distribution ratio of consumption expenditure outside households (column) in the Input-Output Tables for Kumamoto Prefecture.

(v) Among the final demand sectors, increase in stocks is divided into regions according to the method employed by Nishimura (2006). (1) The stock ratio s_i (the ratio of the increase in stocks to prefectural final demand) is calculated based on the Input-Output Tables for Kumamoto Prefecture (formula [9]).[10] (2) Private consumption expenditures and general government consumption expenditures as regionally divided in (i) and the gross regional fixed capital formation (public/private) and consumption expenditure outside households (column) as estimated in (ii) and (iv), respectively, are summed up and then divided by 1-s_i to obtain the regional final demand for each region (formula [10]). (3) The increase in stocks for each region can be calculated by deducting the sum of the private consumption expenditures, general government consumption expenditures, gross regional fixed capital formation (public/private), and consumption expenditure outside households (column) from the regional final demand.

$$f_i = f_i^{hg} + f_i^{hm} + f_i^{go} + f_i^{fk} + f_i^{fm} + f_i^{st} \tag{8}$$

$$s_i = \frac{f_i^{st}}{f_i} \tag{9}$$

$$f_i^{k} = \frac{f_i^{hg,k} + f_i^{hm,k} + f_i^{go,k} + f_i^{fk,k} + f_i^{fm,k}}{1 - s_i} \tag{10}$$

Wherein f_i is the regional final demand in sector i; f_i^{hg} is the consumption expendi-

[10] With regard to sectors where the prefectural final demand is zero in the Input-Output Tables for Kumamoto Prefecture, the stock ratio s_i is defined as the ratio of the increase in stock to total prefectural demand. The total regional demand is calculated by dividing the total intermediate demand for each region by 1-s_i. And then, the increase in stocks for each region is calculated by deducting the total intermediate demand from the total regional demand for each region.

ture outside households (column) in sector i; f_i^{hm} is the private consumption expenditure in sector i; f_i^{go} is the general government consumption expenditure in sector i; f_i^{fk} is the gross fixed capital formation (public) in sector i; f_i^{fm} is the gross fixed capital formation (private) in sector i; f_i^{st} is the increase in stocks in sector i; and s_i is the stock ratio in sector i. Elements with a letter k in superscript in formula (10) relate to region k, which is part of Kumamoto Prefecture, and those without this letter in formulas (8) to (10) relate to Kumamoto Prefecture.

(vi) Among the final demand sectors, exports are assumed to be proportional to prefectural production whereas imports are assumed to be proportional to total prefectural demand, and the proportional ratios are calculated based on the Input-Output Tables for Kumamoto Prefecture (formulas [11] and [12]). By multiplying the regional production as calculated in (i) and the total regional demand as calculated from the data obtained in (ii) to (v) by these ratios, import and export for each region can be calculated.

$$r_i^e = \frac{e_i}{x_i} \qquad (11)$$

$$r_i^m = \frac{m_i}{\sum_j x_{ij} + f_i} \qquad (12)$$

Wherein r_i^e is the export ratio in sector i; e_i is the export amount in sector i; x_i is the prefectural production in sector i; r_i^m is the import ratio (import coefficient) in sector i; m_i is the import amount in sector i; and x_{ij} is the intermediate demand of sector i in sector j.

Regional production and final demand for areas of Japan other than Kumamoto Prefecture are calculated by deducting the data from the Input-Output Tables for Kumamoto Prefecture from the corresponding data from the Input-Output Tables for Japan.[11] For other areas of Japan, the input coefficient applicable to the nationwide input-output tables is used.

2. Estimation of Inter-Regional Trade

Given the regional production for each region and the final demand, excluding inter-regional trade (inflow/outflow) as calculated in the previous subsection, net inflow can be obtained using formula (13).

$$s_i = n_i - h_i = \left(\sum_j x_{ij} + f_i + e_i - m_i \right) - x_i \qquad (13)$$

Wherein s_i is the net inflow into sector i; n_i is the inflow into sector i; and h_i is the outflow from sector i.

[11] It should be noted that there are some differences between the nationwide and prefectural input-output tables in terms of the definition of sectors and estimation methods.

Table 2. Indicators for Proportional Distribution Employed to Divide the Input-Output Tables for Kumamoto Prefecture

	Sector	Indicator for proportional distribution	Data source
1	Crop cultivation	Amount of agricultural output	Statistics of Agricultural Income Produced
2	Livestock	Amount of agricultural output	Statistics of Agricultural Income Produced
3	Agricultural services	Average of 1 and 2	
4	Forestry	Forest area	Census of Agriculture and Forestry
5	Fisheries	Fish catches in marine fisheries	Statistics on Marine Fishery Production
6	Metallic ores	Number of persons engaged	Establishment and Enterprise Census
7	Non-metallic ores	Number of persons engaged	Establishment and Enterprise Census
8	Coal mining , crude petroleum and natural gas	No production in Kumamoto Prefecture	
9	Foods	Value of shipments	Census of Manufacturers
10	Beverage	Value of shipments	Census of Manufacturers; 10-12 aggregated as "beverage"
11	Feeds and organic fertilizer, n.e.c.	Value of shipments	Census of Manufacturers; 10-12 aggregated as "beverage"
12	Tobacco	Value of shipments	Census of Manufacturers; 10-12 aggregated as "beverage"
13	Textile products	Value of shipments	Census of Manufacturers
14	Wearing apparel and other textile products	Value of shipments	Census of Manufacturers
15	Timber and wooden products	Value of shipments	Census of Manufacturers
16	Furniture and fixtures	Value of shipments	Census of Manufacturers
17	Pulp, paper, paperboard, building paper	Value of shipments	Census of Manufacturers; 17-18 aggregated as "pulp/paper"
18	Paper products	Value of shipments	Census of Manufacturers; 17-18 aggregated as "pulp/paper"
19	Printing, plate making and book binding	Value of shipments	Census of Manufacturers
20	Chemical fertilizer	Value of shipments	Census of Manufacturers; 20-27 aggregated as "chemicals"
21	Industrial inorganic chemicals	Value of shipments	Census of Manufacturers; 20-27 aggregated as "chemicals"
22	Petrochemical basic products	No production in Kumamoto Prefecture	
23	Organic chemical products (except Petrochemical basic products)	Value of shipments	Census of Manufacturers; 20-27 aggregated as "chemicals"
24	Synthetic resins	Value of shipments	Census of Manufacturers; 20-27 aggregated as "chemicals"
25	Synthetic fibers	No production in Kumamoto Prefecture	
26	Medicaments	Value of shipments	Census of Manufacturers; 20-27 aggregated as "chemicals"
27	Final chemical products, n.e.c.	Value of shipments	Census of Manufacturers; 20-27 aggregated as "chemicals"
28	Petroleum refinery products	Value of shipments	Census of Manufacturers; 28-29 aggregated as "petroleum/coal"
29	Coal products	Value of shipments	Census of Manufacturers; 28-29 aggregated as "petroleum/coal"
30	Plastic products	Value of shipments	Census of Manufacturers
31	Rubber products	Value of shipments	Census of Manufacturers
32	Leather, fur skins and miscellaneous leather products	Number of persons engaged	Establishment and Enterprise Census
33	Glass and glass products	Value of shipments	Census of Manufacturers; 33-36 aggregated as "ceramic/stone and clay"
34	Cement and cement products	Value of shipments	Census of Manufacturers; 33-36 aggregated as "ceramic/stone and clay"
35	Pottery, china and earthenware	Value of shipments	Census of Manufacturers; 33-36 aggregated as "ceramic/stone and clay"
36	Other ceramic, stone and clay products	Value of shipments	Census of Manufacturers; 33-36 aggregated as "ceramic/stone and clay"
37	Pig iron and crude steel	No production in Kumamoto Prefecture	
38	Steel products	Value of shipments	Census of Manufacturers; 38-40 aggregated as "iron and steel"
39	Cast and forged steel products	Value of shipments	Census of Manufacturers; 38-40 aggregated as "iron and steel"

Table 2 (*Continued*)

Sector		Indicator for proportional distribution	Data source
40	Other iron or steel products	Value of shipments	Census of Manufacturers; 38-40 aggregated as "iron and steel"
41	Non-ferrous metals	Number of persons engaged	Establishment and Enterprise Census
42	Non-ferrous metal products	Number of persons engaged	Establishment and Enterprise Census
43	Metal products for construction and architecture	Value of shipments	Census of Manufacturers; 43-44 aggregated as "metal"
44	Other metal products	Value of shipments	Census of Manufacturers; 43-44 aggregated as "metal"
45	General industrial machinery	Value of shipments	Census of Manufacturers; 45-48 aggregated as "general machines"
46	Special industrial machinery	Value of shipments	Census of Manufacturers; 45-48 aggregated as "general machines"
47	Other general machines	Value of shipments	Census of Manufacturers; 45-48 aggregated as "general machines"
48	Machinery for office and service industry	Value of shipments	Census of Manufacturers; 45-48 aggregated as "general machines"
49	Electrical devices and parts	Value of shipments	Census of Manufacturers; 49-52 aggregated as "electrical equipment"
50	Applied electronic equipment and electric measuring instruments	Value of shipments	Census of Manufacturers; 49-52 aggregated as "electrical equipment"
51	Other electrical equipment	Value of shipments	Census of Manufacturers; 49-52 aggregated as "electrical equipment"
52	Household electric appliances	Value of shipments	Census of Manufacturers; 49-52 aggregated as "electrical equipment"
53	Household electronics equipment	Value of shipments	Census of Manufacturers; 53-54 aggregated as "information and communication equipment"
54	Electronic computing equipment and accessory equipment of electronic computing equipment	Value of shipments	Census of Manufacturers; 53-54 aggregated as "information and communication equipment"
55	Semiconductor devices and Integrated circuits	Value of shipments	Census of Manufacturers; 55-56 aggregated as "electronic components"
56	Other electronic components	Value of shipments	Census of Manufacturers; 55-56 aggregated as "electronic components"
57	Passenger motor cars	No production in Kumamoto Prefecture	
58	Other cars	Value of shipments	Census of Manufacturers; 58-61 aggregated as "transportation equipment"
59	Motor vehicle parts and accessories	Value of shipments	Census of Manufacturers; 58-61 aggregated as "transportation equipment"
60	Ships and repair of ships	Value of shipments	Census of Manufacturers; 58-61 aggregated as "transportation equipment"
61	Other transportation equipment and repair of transportation equipment	Value of shipments	Census of Manufacturers; 58-61 aggregated as "transportation equipment"
62	Precision instruments	Value of shipments	Census of Manufacturers
63	Miscellaneous manufacturing products	Value of shipments	Census of Manufacturers
64	Reuse and recycling	Annual sales of goods	Census of Commerce, wholesale trade, recovered material
65	Building construction	Contracted construction price (total)	Statistical Yearbook on Buildings
66	Repair of construction	Amount of municipal tax in account settlement (fixed asset tax)	Account Settlement Card
67	Public construction	Amount of expenditure in municipal general account settlement (civil engineering expenditure/agriculture, forestry and fisheries expenditure)	Account Settlement Card
68	Other civil engineering and construction	Average of 69 and 78	
69	Electricity	Power output and generation capacity at major power stations in Kumamoto Prefecture	Electric Power Survey Statistics, Kumamoto Prefecture Enterprise Bureau website, etc.
70	Gas and heat supply	Number of persons engaged	Establishment and Enterprise Census
71	Water supply	Quantity of water supply	Kumamoto Prefecture Statistical Yearbook

Table 2 (*Continued*)

Sector		Indicator for proportional distribution	Data source
72	Waste management service	Number of persons engaged	Establishment and Enterprise Census
73	Commerce	Annual sales of goods	Census of Commerce
74	Finance and insurance	Number of persons engaged	Establishment and Enterprise Census
75	Real estate agencies and rental services	Number of persons engaged	Establishment and Enterprise Census
76	House rent	Total floor space per household	Population Census
77	House rent (imputed house rent)	Total floor space per household (owner-occupied dwellings)	Population Census
78	Railway transport	Number of persons engaged	Establishment and Enterprise Census
79	Road transport (except transport by private cars)	Number of cars owned	Kumamoto Prefecture Statistical Yearbook
80	Self-transport by private cars	Number of cars owned (same as 79)	Kumamoto Prefecture Statistical Yearbook
81	Water transport	Inflow (import)/outflow (export)	Kumamoto Prefecture Statistical Yearbook
82	Air transport	Number of persons engaged	Establishment and Enterprise Census
83	Freight forwarding	Number of persons engaged	Establishment and Enterprise Census
84	Storage facility service	Number of persons engaged	Establishment and Enterprise Census
85	Services relating to transport	Number of persons engaged	Establishment and Enterprise Census
86	Communication	Number of persons engaged	Establishment and Enterprise Census
87	Broadcasting	Number of persons engaged	Establishment and Enterprise Census
88	Information services	Number of persons engaged	Establishment and Enterprise Census
89	Internet based services	Number of persons engaged	Establishment and Enterprise Census
90	Image information, character information production and distribution	Number of persons engaged	Establishment and Enterprise Census
91	Public administration	Number of municipal officials (No. of prefectural officials assigned to Kumamoto City)	Kumamoto Prefecture Statistical Yearbook
92	Education	Number of persons engaged	Establishment and Enterprise Census
93	Research	Number of persons engaged	Establishment and Enterprise Census
94	Medical service and health	Number of persons engaged	Establishment and Enterprise Census
95	Social security	Number of persons engaged	Establishment and Enterprise Census
96	Nursing care	Number of persons engaged	Establishment and Enterprise Census
97	Other public services	Number of persons engaged	Establishment and Enterprise Census
98	Advertising services	Number of persons engaged	Establishment and Enterprise Census
99	Goods rental and leasing services	Number of persons engaged	Establishment and Enterprise Census
100	Repair of motor vehicles and machine	Number of persons engaged	Establishment and Enterprise Census
101	Other business services	Number of persons engaged	Establishment and Enterprise Census
102	Amusement and recreational services	Number of persons engaged	Establishment and Enterprise Census
103	Eating and drinking places	Number of persons engaged	Establishment and Enterprise Census
104	Accommodations	Number of persons engaged	Establishment and Enterprise Census
105	Cleaning, barber shops, beauty shops and public baths	Number of persons engaged	Establishment and Enterprise Census
106	Other personal services	Number of persons engaged	Establishment and Enterprise Census
107	Office supplies	Number of employed persons	Population Census
108	Activities not elsewhere classified	Number of employed persons	Population Census
F1	Private consumption expenditures	Number of households	Population Census
F2	General government consumption expenditures	Amount of expenditure in municipal general account settlement	Account Settlement Card

Inflow and outflow can be expressed by formulas (14) and (15) on the basis of the total value of inter-regional trade according to counterparty. For example, the outflow from the Kumamoto urban area into the other areas of Kumamoto is the total input from the Kumamoto urban area to the intermediate demand and final demand in the other areas of Kumamoto, as shown in Figure 1. The inflow into the other areas of Kumamoto from the Kumamoto urban area is the opposite of this as viewed from the perspective of the other areas of Kumamoto.

$$n_i^k = \sum_l t_i^{lk} \qquad (14)$$

$$h_i^k = \sum_l t_i^{kl} \qquad (15)$$

Wherein n_i^k is the inflow into sector i of region k; h_i^k is the outflow from sector i of region k; and t_i^{kl} is the outflow from sector i of region k into the same sector of region l (which also represents the inflow into region l from region k).

These factors are inadequate to allow inflow/outflow to be estimated by region or sector. Therefore, a gravity model has been used to divide outflow by region according to the method employed by Nakano and Nishimura (2012). The outflow from region k into region l is assumed to be as indicated in formula (16). It is determined based on the regional production in region k, which represents the region's supply capacity, the total regional demand in region l, which represents the scale of demand in the region, the distance between these regions, and the per-capita gross value added, which is a wealth indicator for households in region l.

$$\ln t_i^{kl} = \alpha + \beta \ln x_i^k + \gamma \ln y_i^l + \delta \ln d^{kl} + \kappa \ln p^l + u_i^{kl} \qquad (16)$$

Wherein x_i^k is the regional production in sector i of region k; y_i^l is the total regional demand in sector i of region k $\left(y_i^l = \sum_j x_{ij}^l + f_i^l \right)$; d^{kl} is the distance between regions k and l; p^l is the per-capita gross value added in region l; and u_i^{kl} is a disturbance term.

The ratio between the value of the inflow in sector i from region k into region l and that from region k into region m can be expressed by formula (17).

$$\ln \frac{t_i^{kl}}{t_i^{km}} = \gamma \ln \frac{y_i^l}{y_i^m} + \delta \ln \frac{d^{kl}}{d^{km}} + \kappa \ln \frac{p^l}{p^m} + u_i^{kl} - u_i^{km} \qquad (17)$$

In this formula, if the parameters γ, δ, and κ are determined, inflow and outflow can be calculated for each region. The inter-regional distance applied here is the population-weighted average distance[12] between region k and region l, which is defined by formula (18), where a is a city in region k ($a \in$ k) and the distance between city a and city b ($b \in$ l) is d^{kl}.

[12] Some studies use the physical distance between the populated cities in the target regions or the physical distance between the points of intersection of the diagonal lines of the rectangles that encompass the target regions (Ihara 1996). Another alternative is economic distance that takes into account traveling time, transportation costs, etc. (internal data compiled by the Measurement Section of the Planning Bureau of the Economic Planning Agency, cited by Kaneko [1967]). The distance metric adopted in this study is something of a hybrid between these types.

Table 3. Population-Weighted Average Distance Employed to Estimate Parameters

(Unit: day)

	Hokkaido	Tohoku	Kanto	Chubu	Kinki	Chugoku	Shikoku	Kyushu
Hokkaido								
Tohoku	0.574							
Kanto	0.738	0.184						
Chubu	0.889	0.339	0.215					
Kinki	0.983	0.433	0.275	0.124				
Chugoku	1.113	0.561	0.403	0.253	0.152			
Shikoku	1.146	0.601	0.444	0.293	0.186	0.122		
Kyushu	1.296	0.744	0.586	0.436	0.335	0.138	0.284	

Note: Calculated by the author based on the 2005 Population Census (MIC) using the Google Map route search service.

$$d^{kl} = \sum_{b \in l} \sum_{a \in k} \frac{p_a p_b}{\sum_{b \in l} \sum_{a \in k} p_a p_b} d^{ab} \qquad (18)$$

Wherein p_a is the population in city a and p_b is the population in city b.

In this study, the 2005 Inter-Regional Input-Output Tables compiled by the Ministry of Economy, Trade and Industry (METI) have been used to estimate the parameters. These tables represent inter-regional input-output data including cross hauling, and divide the entire area of Japan into nine regions: Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, Kyushu, and Okinawa. When calculating the inter-regional distance, the three most populous cities are selected for each region (with the exception of Okinawa), and the distance between these selected cities is calculated on the basis of the time distance between the locations of their city halls using the Google Map route search service.[13] The distances between the regions are as indicated in Table 3.

In this study, formula (17) has been estimated using a Tobit model, using the outflow and gross regional demand provided in the 2005 Inter-Regional Input-Output Tables as well as the regional distance indicated in Table 3. The estimation results are as indicated in Table 4. A one-to-one concordance does not exist for all sectors between the multi-regional input-output tables for the Kumamoto urban area (which this study attempts to estimate) and the Inter-Regional Input-Output Tables compiled by METI because the level of aggregation by sector is higher in the METI tables. Accordingly, if two or more sectors in the input-output tables estimated in this study correspond to a given sector in the METI tables, a common parameter is applied to these sectors.

[13] Although this study adopts time distance measured by car travel, it is possible to use data related to other forms of transportation, such as trains.

Table 4. Results of Estimation Using a Tobit Model

	γ	δ	κ	σ	Log likelihood	Sample size
Agriculture, forestry, fisheries	0.808	1.238	1.954	0.875	-141.585	168
	(0.095)***	(0.125)***	(0.498)***	(0.062)***		
Mining	-0.632	1.094	6.686	1.472	-203.692	168
	(0.187)***	(0.183)***	(0.776)***	(0.107)***		
Coal mining , crude petroleum and natural gas	-1.347	-3.854	13.137	0.668	-6.704	9
	(1.136)	(3.669)	(10.143)	(0.224)***		
Foods and beverage	0.049	0.072	0.336	0.034	-69.130	168
	(0.000)***	(0.000)***	(0.877)***	(0.000)***		
Textile products	0.488	0.358	2.174	0.691	-92.622	150
	(0.071)***	(0.104)***	(0.461)***	(0.057)***		
Wearing apparel and other textile products	1.674	1.162	-2.812	1.206	-165.343	168
	(0.150)***	(0.160)***	(0.968)***	(0.083)***		
Timber and wooden products/furniture	1.631	1.210	-1.506	0.919	-131.634	168
	(0.123)***	(0.135)***	(0.688)**	(0.067)***		
Pulp, paper, paperboard, building paper	1.095	1.024	0.818	0.938	-139.021	168
	(0.127)***	(0.135)***	(0.733)	(0.068)***		
Printing, plate making and book binding	0.652	1.349	4.383	1.837	-194.398	168
	(0.168)***	(0.244)***	(1.343)***	(0.143)***		
Basic chemical products	0.512	1.385	1.110	1.332	-152.434	162
	(0.184)***	(0.210)***	(1.286)	(0.104)***		
Synthetic resins	0.833	0.272	-0.872	0.832	-102.240	147
	(0.079)***	(0.122)**	(0.779)	(0.066)***		
Final chemical products	0.874	0.616	-1.769	0.757	-118.587	168
	(0.067)***	(0.103)***	(0.601)***	(0.053)***		
Medicaments	0.447	0.216	0.477	0.562	-103.249	168
	(0.054)***	(0.070)***	(0.383)	(0.045)***		
Petroleum/coal products	1.015	2.710	-0.925	2.740	-241.578	168
	(0.340)***	(0.384)***	(2.448)	(0.198)***		
Plastic products	0.472	1.076	0.805	0.826	-122.637	168
	(0.052)***	(0.125)***	(0.526)	(0.062)***		
Ceramic, stone and clay products	1.442	1.466	-2.086	1.219	-156.047	168
	(0.143)***	(0.179)***	(0.844)**	(0.087)***		
Iron and steel	0.711	1.133	0.820	1.245	-154.114	168
	(0.075)***	(0.180)***	(0.772)	(0.090)***		
Non-ferrous metals	0.720	0.543	1.643	0.998	-144.709	168
	(0.068)***	(0.140)***	(0.598)***	(0.073)***		
Metal products	0.869	1.474	-0.412	1.218	-154.392	162
	(0.104)***	(0.180)***	(0.840)	(0.087)***		
General machinery	0.714	0.378	0.213	0.641	-99.496	168
	(0.054)***	(0.091)***	(0.439)	(0.047)***		
Machinery for office and service industry	0.605	0.285	2.446	1.625	-173.042	141
	(0.081)***	(0.190)	(1.092)**	(0.124)***		
Electrical devices and parts	0.625	0.564	2.116	0.733	-113.112	162
	(0.046)***	(0.101)***	(0.434)***	(0.053)***		
Other electrical equipment	0.984	0.047	-0.636	0.738	-113.196	162
	(0.081)***	(0.093)	(0.633)	(0.055)***		
Household electric appliances	0.791	0.360	-1.371	1.113	-136.390	150
	(0.095)***	(0.139)***	(0.897)	(0.086)***		
Household electronics equipment	0.713	0.097	-0.525	0.502	-90.018	168
	(0.047)***	(0.061)	(0.416)	(0.036)***		
Electronic computing equipment and accessory equipment of electronic computing equipment	0.877	0.178	2.213	1.996	-151.816	112
	(0.226)***	(0.258)	(1.772)	(0.182)***		

Table 4 (*Continued*)

	γ	δ	κ	σ	Log likelihood	Sample size
Electronic components	0.550	-0.340	3.098	1.009	-159.820	168
	(0.053)***	(0.114)***	(0.563)***	(0.074)***		
Passenger motor cars	0.669	0.207	-0.186	0.512	-58.736	126
	(0.048)***	(0.076)***	(0.459)	(0.043)***		
Other cars	0.052	-0.099	2.013	1.281	-168.611	136
	(0.100)	(0.141)	(1.313)	(0.103)***		
Motor vehicle parts and accessories	0.695	0.731	-1.599	1.349	-146.779	162
	(0.044)***	(0.185)***	(0.811)**	(0.108)***		
Other transportation equipment	0.641	0.828	1.039	1.390	-185.800	168
	(0.126)***	(0.166)***	(0.919)	(0.104)***		
Precision instruments	1.140	0.663	-2.481	1.038	-147.349	168
	(0.102)***	(0.132)***	(0.782)***	(0.074)***		
Miscellaneous manufacturing products	1.129	0.745	-1.582	1.058	-151.306	168
	(0.097)***	(0.140)***	(0.753)**	(0.075)***		
Reuse and recycling	0.330	1.387	5.618	2.353	-250.335	156
	(0.182)*	(0.298)***	(1.431)***	(0.162)***		
Construction	1.019	0.857	-2.445	1.243	-170.943	168
	(0.149)***	(0.156)***	(0.876)***	(0.095)***		
Electricity	0.952	2.154	10.640	2.286	-215.020	162
	(0.297)***	(0.316)***	(1.559)***	(0.167)***		
Gas and heat supply	0.424	0.979	-1.344	1.650	-216.530	162
	(0.111)***	(0.197)***	(1.038)	(0.116)***		
Water supply and management	0.136	1.268	-3.739	1.450	-167.249	151
	(0.179)	(0.205)***	(1.083)***	(0.113)***		
Commerce	0.510	0.823	0.375	0.305	-26.818	168
	(0.026)***	(0.049)***	(0.223)*	(0.022)***		
Finance and insurance	1.189	-0.266	-1.707	1.365	-226.027	168
	(0.145)***	(0.132)**	(0.961)*	(0.088)***		
Real estate	0.891	1.857	-5.029	2.315	-209.767	168
	(0.239)***	(0.309)***	(1.788)***	(0.186)***		
Transport	1.159	1.058	-1.176	0.621	-93.463	168
	(0.076)***	(0.094)***	(0.513)**	(0.044)***		
Other information and communications services	0.861	1.247	0.408	1.003	-139.861	168
	(0.115)***	(0.153)***	(0.812)	(0.073)***		
Information services	0.999	1.807	2.495	2.021	-178.754	151
	(0.193)***	(0.290)***	(1.833)	(0.160)***		
Education and research	1.104	1.162	-0.410	1.011	-143.339	168
	(0.119)***	(0.148)***	(0.730)	(0.073)***		
Medical service and health/ social security/nursing care	1.882	1.826	3.304	1.207	-150.122	157
	(0.184)***	(0.188)***	(0.822)***	(0.086)***		
Advertising services	0.593	1.533	-1.496	0.831	-112.518	168
	(0.058)***	(0.139)***	(0.617)**	(0.065)***		
Goods rental and leasing services	0.244	0.820	1.465	0.556	-92.335	168
	(0.045)***	(0.085)***	(0.383)***	(0.040)***		
Other business services	0.827	1.211	-1.583	1.064	-149.791	168
	(0.101)***	(0.154)***	(0.761)**	(0.078)***		
Personal services	1.043	2.077	0.978	1.064	-140.393	168
	(0.110)***	(0.170)***	(0.774)	(0.080)***		

Notes: 1. Figures in parentheses are standard errors.

2. Level of statistical significance: *** at 1%, ** at 5%, and * at 10%.

Table 5. Population-Weighted Average Distance Employed to Estimate Inflow/Outflow

(unit: day)

	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan
Kumamoto urban area			
Other areas of Kumamoto	0.038		
Other areas of Japan	0.591	0.600	

Note: Calculated by the author based on the 2005 Population Census (MIC) and using the Google Map route search service

According to formulas (13) to (15), as well as formula (17) which uses estimated parameters, inflow and outflow for each region are estimated. The inter-regional distances used in this estimate are as indicated in Table 5.

3. Consideration of Employment Coefficients

In order to estimate the number of employees or number of employed persons at work by sector in accordance with multi-regional input-output tables focused on the Kumamoto urban area, this study uses the employment tables supplemented to the existing input-output tables. In this study, the value of trade in the input-output tables has been estimated on the assumption that the production technology (the input coefficient and the rate of gross value added) applied to each sector is the same in all areas in Kumamoto Prefecture. Accordingly, it may be possible to consider the number of employees or employed persons at work necessary for a unit of production (employment coefficient) to be the same in all areas, and thus, it may make sense to use the publicly available employment tables.[14]

Specifically, the employment tables appended to the Input-Output Tables for Japan and those appended to the Input-Output Tables for Kumamoto Prefecture have been used. For both the Kumamoto urban area and the other areas of Kumamoto, the employment coefficient according to sector calculated based on the employment tables of the Input-Output Tables for Kumamoto Prefecture have been used. The number of employees (employed persons at work) according to sector for areas of Japan other than Kumamoto Prefecture is obtained by deducting the data in the employment tables of the Input-Output Tables for Kumamoto Prefecture from the data in the employment tables of the Input-Output Tables

[14] Another approach would be to use the Population Census compiled by MIC, considering that it is relatively easy to compare this data set with other labor statistics and that this data set is capable of accurately indicating labor administration. As this study based its estimates on the Population Census as well, any person who needs the relevant information may feel free to inquire of the author. Nakano (2011) explains the method used to estimate the employment tables in accordance with the input-output tables through an approach compatible with the Population Census, although the targeted regions were the regional blocks governed by the bureaus of economy, trade and industry, which are larger than the regions targeted in this study.

for Japan. This estimation method is simple and clear, and also consistent with the concept of input-output tables compiled on the basis of activity, but it has two problems. The first is that the level of aggregation by sectoral classification is somewhat higher in the employment tables of the Input-Output Tables for Kumamoto Prefecture. While the value of trade tables—the most detailed of the publicly available tables among the Input-Output Tables for Kumamoto Prefecture—are divided into 108 sectors, the publicly available employment tables have 33 sectors. Accordingly, the amount of induced production estimated separately for the 108 sectors is first aggregated into the 33 sectors and then multiplied by the sectoral employment coefficient, which could result in reducing the amount of information initially obtained. Another problem is double counting of the number of persons in the employment tables. When the number of employees or employed persons at work is aggregated in the employment tables, a single person who is engaged in two or more production activities is counted in each of the sectors in which he/she is engaged in accordance with the concept of activity, thus resulting in double counting. As a result, the amount of induced employment is likely to exceed the actual labor demand when it is measured by means of the employment coefficient calculated based on the publicly available employment tables.

The employment coefficient calculated by sector is indicated in Table 6.[15]

IV. Simulations of Employment Inducement[16]

1. Induced Employment per Unit of Regional Final Demand

It may be possible to estimate the amount of induced employment by means of formulas (6) and (7) for each policy or plan to be evaluated. However, if the amount of induced employment per unit of regional final demand according to sector (per one million yen) is calculated beforehand, it is possible to measure the amount of induced employment as necessary by a simple method; by multiplying the amount of investment according to

[15] Based on the employment tables appended to the input-output tables, the employment coefficient for areas of Japan other than Kumamoto Prefecture is estimated by dividing the number of employees (employed persons at work) for the 105 sectors in the nationwide input-output tables by the amount of domestic production. The amount of induced employment is measured by first calculating the amounts separately for the 105 sectors and then aggregating the amounts into the 33 sectors used in the publicly available employment tables.

[16] To understand the amount of induced employment estimated by the method discussed in this subsection, attention should be paid to the following two points. The first point relates to the number of working hours. When production activities are induced, enterprises do not immediately increase employment; they first increase the number of hours of overtime work for their current workforces. The second point is that the amount of induced employment increases with final demand, which in turns increases expenses, and if the increased expenses are to be covered by public funds, the fiscal balance should be taken into consideration. The author has provided a simple estimate of the increased tax revenues arising from the increase in final demand. Any person who needs the relevant information may feel free to inquire of the author.

Table 6. Employment Coefficient by Sector

(unit: person / million yen [valued at 2005 producer prices])

Input-output tables for Kumamoto Prefecture, based on employment tables			
	Employed persons at work	Employees (incl. paid executives)	Employees (excl. paid executives)
Agriculture, forestry, fisheries	0.300	0.034	0.030
Mining	0.036	0.036	0.031
Foods and beverage	0.045	0.042	0.039
Textile products	0.181	0.154	0.147
Pulp, paper, paperboard, building paper	0.045	0.037	0.033
Chemical products	0.032	0.032	0.031
Petroleum/coal products	0.026	0.026	0.024
Ceramic, stone and clay products	0.070	0.067	0.062
Iron and steel	0.025	0.024	0.023
Non-ferrous metals	0.028	0.028	0.027
Metal products	0.057	0.054	0.052
General machinery	0.026	0.026	0.025
Other electrical equipment	0.045	0.042	0.040
Information and communications equipment	0.065	0.064	0.063
Electronic components	0.047	0.046	0.046
Transportation equipment	0.024	0.023	0.023
Precision instruments	0.047	0.047	0.043
Miscellaneous manufacturing products	0.053	0.047	0.044
Construction	0.119	0.095	0.079
Electricity/gas and heat supply	0.013	0.013	0.013
Water supply and management	0.071	0.069	0.064
Commerce	0.203	0.173	0.157
Finance and insurance	0.047	0.043	0.041
Real estate	0.011	0.008	0.005
Transport	0.064	0.059	0.056
Information and communications services	0.042	0.040	0.038
Public administration	0.065	0.065	0.065
Education and research	0.077	0.077	0.076
Medical service and health/social security/nursing care	0.124	0.118	0.114
Other public services	0.122	0.107	0.080
Business services	0.128	0.102	0.094
Personal services	0.159	0.132	0.124
Office supplies	0.000	0.000	0.000
Activities not elsewhere classified	0.011	0.010	0.009

Note: Calculated by the author based on the Input-Output Tables for Kumamoto Prefecture.

sector by the amount of induced employment per unit, for example.[17] In addition, through comparison of the amounts of induced employment per unit in different sectors, it is possible to see which sector has an advantage in inducing employment in the region.

From this standpoint, the amount of induced employment per unit of regional final demand according to sector is indicated in Supplementary Tables 1 and 2. Supplementary Table 1 (pp. 131–33) shows the amount of employment induced by one unit of regional final demand according to sector generated in the Kumamoto urban area, according to employment status (employees/employed persons at work) and according to region (Kumamoto urban area/other areas of Kumamoto/areas of Japan other than Kumamoto Prefecture). Supplementary Table 2 (pp. 134–36) shows the amount of employment induced by one unit of regional final demand according to sector generated in the other areas of Kumamoto. Specifically, these tables can be read as follows. When one unit of demand for general industrial machinery is generated by plant and equipment investment in the Kumamoto urban area, it induces employment for 0.048 persons (employees other than paid executives) in the Kumamoto urban area, while at the same time inducing employment for 0.001 persons in the other areas of Kumamoto and 0.039 persons in areas of Japan other than Kumamoto Prefecture, leading to a total induced employment for 0.089 persons nationwide.

2. Target for Employment Inducement through Invitation of Enterprises

When an enterprise is invited to move to Kumamoto Prefecture, a location agreement is reached among the enterprise, Kumamoto Prefecture, and the municipality that governs the location of the enterprise's new business establishment, and the target number of new employees and the target amount of investment to be induced are determined. As these figures are set as targets, they do not always coincide with the actual figures, but they at least provide a rough estimate of the scale of the invited enterprise. Table 7 shows the number of enterprises recently invited to move to Kumamoto Prefecture and their target numbers of new employees and target amounts of investment.

This subsection describes the measurement of the amount of employment induced by the successful invitation of enterprises in the Kumamoto urban area, which is roughly divided into two types: employment induced by plant and equipment investment which is a temporary factor such as construction demand, and employment induced by ordinary production activities.

The factor to be used to estimate the amount of the former type of induced employment is the average target amount of investment induced by the invitation of enterprises over approximately the past ten years (Table 7). Since most manufacturing establishments which have moved to Kumamoto Prefecture are related to semiconductors and transportation equipment, it is assumed that multiple manufacturers of semiconductor-making equipment

[17] To be precise, if the amount of final demand is indicated by the purchaser price rather than the producer price, it needs to be converted into an amount based on the producer price.

Table 7. Number of Enterprises Recently Invited to Move to Kumamoto Prefecture

FY	Number of invited enerprises	Planned number of new employees (persons)	Planned amount of investment (million yen)
1998	7	362	5,221
1999	11	1,432	8,002
2000	14	1,909	26,674
2001	10	974	8,589
2002	7	122	4,500
2003	7	172	4,330
2004	17	733	62,742
2005	22	718	83,182
2006	40	2,496	179,741
2007	35	1,424	141,854
2008	18	3,101	87,096
2009	17	573	19,615
2010	22	735	80,512
2011	27	718	92,795
Average	18	1,105	57,490

Source: Enterprise Location Division, New Industry Promotion Bureau, Commerce, Manufacturing and Tourism Department, Kumamoto Prefecture.

Notes: 1. The numbers include both new establishments and expansions of existing establishments.
2. The data for FY2011 is as of the end of December 2011.

make the same amounts of plant and equipment investment as the average target amount of investment. As the average target amount of investment shown in Table 7 is the total amount of investment, it needs to be divided by type of goods for this measurement. Semiconductor-making equipment, which is taken as an example, is classified as special industrial machinery in the input-output tables estimated in this study. Accordingly, the distribution ratio according to type of investment goods is calculated in relation to an investor which belongs to the special industrial machinery sector in the fixed capital matrix (private) supplemented to the nationwide input-output tables, and the total amount of investment is multiplied by this ratio.[18] The amount of induced employment can be measured by assigning the amount of plant and equipment investment thus calculated according to type of investment goods to formulas (6) and (7) or by multiplying this amount by the amount of induced employment per unit shown in Supplementary Tables 1 and 2.

To estimate the amount of employment induced by ordinary production activities carried out at an establishment invited to move to a certain region, information concerning the scale of such production activities is a prerequisite factor. However, it is difficult to estimate

[18] Using the distribution ratio of a fixed capital matrix means assuming the national average of investment activities carried out in the investor's sector in 2005, including construction of new establishments and expansions of existing establishments. The description given here does not assume any specific investment project because it only provides an example of calculation. If the amount of investment according to type of investment goods is known, such data can be used for calculation.

the value of production to be generated from such activities at an establishment not yet in operation, irrespective of whether it is newly constructed or an expansion of an existing establishment.[19] Therefore, the amount of induced employment is estimated by calculating the value of shipments per establishment which has already moved to Kumamoto Prefecture and then multiplying this value by the average number (18) of invited enterprises as shown in Table 7. According to the preliminary data from 2010 Census of Manufactures compiled by METI, 255 manufacturing establishments were invited to move to Kumamoto Prefecture and the total shipments of these establishments amounted to 1.544 trillion yen.[20] The value of shipments per establishment may depend on the industry or scale of the establishment. The average for the manufacturing industry as a whole is used here as an approximation. The estimated value of production is determined by compiling all of this data, but this value cannot immediately be assigned to the model defined in Section II because production, unlike investment, is not final demand. Therefore, this study employs a simple calculation method generally adopted by prefectures, in which an inverse matrix is modified to make the sector subject to estimation exogenous (excluding the indirect influence of other sectors).[21] Specifically, the value of production relating to the production activities carried out in a given region and sector is estimated by: (i) extracting a row for the region and sector from the inverse matrix represented by formula (3) (for example, special industrial machinery in the Kumamoto urban area); (ii) dividing the inverse matrix coefficients listed in this row by the factor for the region and sector; and (iii) multiplying the results by the estimated value of production (in special industrial machinery). Finally, the amount of employment induced by ordinary production activities can be estimated by multiplying the value of production by region and sector by the employment coefficient.

Table 8 shows the amount of employment induced by semiconductor-making equipment manufacturing establishments invited to move to the Kumamoto urban area, as estimated through the abovementioned process. In the Kumamoto urban area, where business establishments have been constructed as a result of investment activities, employment of about 4,380 persons (excluding paid executives) is induced, and by way of the repercussions between regions, this leads to induced employment of about 170 persons in the other areas of Kumamoto and of about 1,860 persons in areas of Japan other than Kumamoto Prefecture, respectively. On the other hand, ordinary production activities in the Kumamoto urban area induced employment of about 6,870 persons in the Kumamoto urban area, about

[19] Naturally, enterprises specify the production scale they intend to achieve by means of the plant and the equipment to be constructed in their investment plans. If this information is available beforehand, a more precise estimate will be possible. However, it should be noted that how the new or expanded plant and equipment will actually be operated is uncertain at the time of estimation.

[20] Data published by the Enterprise Location Division, New Industry Promotion Bureau, Commerce, Manufacturing and Tourism Department, Kumamoto Prefecture.

[21] For examples, see the reference published by Miyazaki Prefecture, titled "Plain Input-Output Analysis: Case Analysis Using Simple Analytical Data (in Japanese)," available at:
http://www.pref.miyazaki.lg.jp/contents/org/honbu/toukei/sangyo/tebikisyo.html.

Table 8. Amount of Employment Induced by Semiconductor-Making Equipment Manufacturing Establishments Invited to Move to the Kumamoto Urban Area

(unit: person [number of employees, excluding paid executives])

	Investment				Ordinary production			
	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Total	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Total
Agriculture, forestry, fisheries	2	3	2	6	4	5	3	12
Mining	1	1	2	4	1	1	4	5
Foods and beverage	0	0	1	2	2	1	3	6
Textile products	16	10	8	35	50	17	15	81
Pulp, paper, paperboard, building paper	12	6	29	47	13	4	30	47
Chemical products	4	1	13	19	18	6	33	57
Petroleum/coal products	0	1	3	3	0	2	5	6
Ceramic, stone and clay products	14	4	18	36	15	4	18	36
Iron and steel	24	0	77	100	77	0	146	223
Non-ferrous metals	8	0	26	35	26	0	43	69
Metal products	33	1	96	129	69	2	191	261
General machinery	545	0	203	749	2,867	0	105	2,972
Other electrical equipment	100	51	255	407	46	10	103	158
Information and communications equipment	0	10	10	20	0	0	1	1
Electronic components	35	17	62	114	97	9	13	120
Transportation equipment	6	0	48	53	5	0	11	17
Precision instruments	12	0	36	48	8	0	24	32
Miscellaneous manufacturing products	26	20	112	158	73	98	252	422
Construction	336	1	19	356	37	2	23	62
Electricity/gas and heat supply	1	7	11	18	1	19	20	40
Water supply and management	7	1	5	14	21	4	6	31
Commerce	2,245	14	210	2,469	1,399	13	200	1,612
Finance and insurance	98	2	41	141	149	3	46	198
Real estate	3	0	10	13	5	0	8	13
Transport	173	8	90	272	266	12	119	397
Other information and communications services	91	0	96	188	114	0	82	196
Public administration	0	0	3	3	0	0	3	3
Education and research	153	2	72	226	877	1	45	923
Medical service and health/social security/nursing care	0	0	0	0	1	0	0	1
Other public services	7	2	5	14	29	8	5	41
Business services	420	9	287	715	585	12	279	875
Personal services	6	0	5	11	12	0	6	18
Office supplies	0	0	0	0	0	0	0	0
Activities not elsewhere classified	2	0	1	3	9	0	1	10
Total	4,382	171	1,855	6,408	6,873	235	1,840	8,947

Note: Compiled by the author based on the assumptions given in Section IV, using the multi-regional input-output tables and employment coefficients estimated in this study.

240 persons in the other areas of Kumamoto, and about 1,840 persons in areas of Japan other than Kumamoto Prefecture.

3. Increase in Demand in Growth Fields

The New Growth Strategy decided on by the cabinet on June 18, 2010, has selected fields with growth potential, such as "environment," "health," "Asia," and "tourism," and has set medium-term targets for the market size and number of jobs to be created in these respective fields. As these targets are set on a nationwide basis, Nakano (2011) estimated the target potential for employment inducement according to regional block and also according to prefecture in a simpler version. This study attempts more detailed, municipal-level estimates, for areas such as the Kumamoto urban area and the other areas of Kumamoto, focusing on the environmental- and health-related fields.

(1) Environmental-Related Field

The national target for this field is to create over 50 trillion yen in new environmental-related markets by 2020. As was done by Nakano (2011), this study estimates the market size in this field according to the sector classifications in the input-output tables and divides it into three regions and 108 sectors subject to analysis. The national target is set without taking into account any decrease in final demand for products manufactured using conventional technology due to the replacement with products manufactured using newly introduced technology. As a reference value, this study also estimates the amount of induced employment while taking into account the negative impact of such a replacement of products. The indicators for proportional distribution for division according to region and sector are as indicated in Table 9. With regard to the potential for the introduction of renewable energy, only data for Kumamoto Prefecture as a whole is available. Therefore, this data is divided and assigned evenly to the Kumamoto urban area and the other areas of Kumamoto.[22]

The estimated final demand without taking into account the negative impact of the replacement of products is about 330 billion yen in the Kumamoto urban area, about 170 billion yen in the other areas of Kumamoto, and about 49.49 trillion yen in areas of Japan other than Kumamoto Prefecture. With this impact taken into account, the estimated final demand is about 150 billion yen in the Kumamoto urban area, about 120 billion yen in the other areas of Kumamoto, and about 26.73 trillion yen in areas of Japan other than Kumamoto Prefecture.

(2) Health-Related Field (Medical and Nursing Care)

With regard to the health-related field, which consists of medical and nursing care, health services, and state-of-the-art medical technology, the national target is to create 50

[22] With regard to geothermal power generation, the data for Kumamoto Prefecture as a whole has been assigned to areas of Kumamoto other than the urban area, where Kurokawa Hot Spring is located.

Table 9. Indicators for Proportional Distribution to Divide the Size of New Markets (Final Demand) in the Environmental Field

Sector	Indicator for proportional distribution	Data source
Industry/non-energy	Production and export, by sector	Multi-regional input-output tables compiled in this study
Household		
Air conditioning/ lighting	Private consumption expenditures on household electric appliances	
Hot water supply	Private consumption expenditures on other metal products	
Commercial		
Air conditioning/ lighting	Gross domestic fixed capital formation (private) in household electric appliances	
Hot water supply	Gross domestic fixed capital formation (private) in other metal products	
Transport		
Non-infrastructure-related	Private consumption expenditures on and gross domestic fixed capital formation (private) in passenger motor cars and other cars	
Infrastructure-related	Gross domestic fixed capital formation (public) in public construction	
Household		
Solar power generation Housing-related	Number of dwellings by municipality	MIC, *2008 Dwellings and Land Survey*
Commercial		Ministry of the Environment, *Report on the 2009 Study of Potential for the Introduction of Renewable Energy (2010)* Kumamoto Prefecture, *Estimated Population Survey Report* METI, *Census of Manufacturers*
Solar power generation	Potential for the introduction of renewable energy	
New energy		
Excl. biomass		
Commercial		
Building-related	Floor area of non-residential buildings in Kumamoto Prefecture, proportionally distributed according to population, product shipment, etc. by municipality	
New energy		
Biomass	Land area available for producing and harvesting biomass resources in Kumamoto Prefecture, proportionally distributed according to forest area by municipality and type of ownership	Mechanical Social Systems Foundation, *Summary of the Research Report on Promising Scenarios for Innovative Biomass Utilization Systems (2008)* Kumamoto Prefecture, *Statistical Yearbook*

trillion yen in new markets by 2020, of which the medical and nursing care markets will amount to 37 trillion yen. Final demand is divided between medical and nursing care in accordance with the ratio between the costs for medical and nursing care as of 2025 based on the B2 Scenario in the Simulations of Medical and Nursing Care Costs for Discussions at the National Council on Social Security,[23] thereby estimating final demand for each of the three regions subject to analysis. Medical and nursing care costs are estimated according to region using the estimation approach employed in creating the abovementioned simulations using the data on population projections according to municipality extracted from the Population Projections for Japan by Municipality, compiled by the National Institute of Population and Social Security Research (December 2008). The estimated final demand is about 310 billion yen in the Kumamoto urban area, about 250 billion yen in the other areas of Kumamoto, and about 36.44 trillion yen in areas of Japan other than Kumamoto Prefecture.

Table 10 shows simulation results of employment inducement based on the target sizes of the new markets specified in the New Growth Strategy. The amount of induced employment (excluding paid executives) in the environmental field (without replacement of products) is about 10,000 persons in the Kumamoto urban area, about 5,000 persons in the other areas of Kumamoto, and about 1,385,000 persons in areas of Japan other than Kumamoto Prefecture. The amount in the Kumamoto urban area and the other areas of Kumamoto accounts for about 2% of the total number of employees in 2005 (including paid executives).[24] Even in the same environmental field, regional differences can be observed in relation to sectors where a large amount of employment is induced, depending on industrial structure or final demand structure.

The amount of induced employment estimated as a reference value taking into account the negative impact of the replacement of products manufactured using conventional technology is about 6,000 persons in the Kumamoto urban area, about 3,000 persons in the other areas of Kumamoto, and about 739,000 persons in areas of Japan other than Kumamoto Prefecture—nearly half the amount estimated without such replacement. The amount is smaller in transportation equipment, but is large in sectors such as construction and electrical machinery with or without such replacement.

The amount of induced employment in the field of medical and nursing care is about 26,000 persons in the Kumamoto urban area, about 13,000 persons in the other areas of Kumamoto, and about 2,569,000 persons in areas of Japan other than Kumamoto. The amount in the Kumamoto urban area and the other areas of Kumamoto accounts for about 5% of the number of employees in 2005 (including paid executives).

[23] Using the B2 Scenario, estimation results are provided based on multiple assumptions. In this study, by calculating a simple average of these results, it is found that medical care costs are about 2.8 times those in relation to nursing care.

[24] The unemployment rate may be used as an indicator to understand this value. According to the model estimates by prefecture based on the Labor Force Survey compiled by MIC, the unemployment rate in Kumamoto Prefecture was 4.5% in 2005 and 4.8% in 2010.

Table 10. Amount of Induced Employment According to Sector, Estimated Based on the Target Sizes of the New Markets Specified in the New Growth Strategy

(unit: person [number of employees, excluding paid executives])

	Environment (without replacement of products)				Medical and nursing care				(Reference) Environment (with replacement of products)			
	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Total	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Total	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Total
Agriculture, forestry, fisheries	6	16	711	733	63	108	6,519	6,690	3	10	444	457
Mining	4	19	1,094	1,117	0	2	192	194	3	16	938	957
Foods and beverage	2	2	181	185	120	79	14,667	14,866	1	1	99	102
Textile products	18	39	3,274	3,331	56	88	3,759	3,903	10	24	1,692	1,726
Pulp, paper, paperboard, building paper	21	75	10,348	10,443	33	86	12,116	12,235	13	50	6,648	6,710
Chemical products	35	22	5,118	5,175	361	170	43,704	44,235	16	10	2,837	2,863
Petroleum/coal products	0	3	541	544	0	2	318	320	0	2	288	290
Ceramic, stone and clay products	265	171	19,374	19,810	14	18	2,535	2,567	136	157	16,825	17,117
Iron and steel	29	3	13,950	13,983	2	0	886	889	12	2	5,656	5,670
Non-ferrous metals	21	21	7,505	7,547	5	2	948	954	11	15	4,442	4,468
Metal products	167	230	57,476	57,873	14	27	5,572	5,614	72	112	19,464	19,647
General machinery	61	8	16,778	16,847	4	0	1,458	1,462	38	7	12,621	12,666
Other electrical equipment	151	521	69,388	70,060	2	6	488	496	91	417	56,997	57,505
Information and communications equipment	0	15	3,059	3,074	0	0	61	61	0	15	2,088	2,103
Electronic components	329	160	7,462	7,950	38	16	1,234	1,287	196	96	4,592	4,884
Transportation equipment	685	282	95,550	96,517	12	5	1,337	1,354	76	36	12,813	12,925
Precision instruments	1	0	474	474	20	0	4,591	4,611	0	0	233	233
Miscellaneous manufacturing products	156	266	47,508	47,930	97	117	20,450	20,664	86	138	28,004	28,228
Construction	664	475	68,855	69,994	53	32	11,364	11,449	653	469	64,358	65,480
Electricity/gas and heat supply	2	31	4,380	4,412	4	45	4,259	4,307	1	18	2,262	2,280
Water supply and management	29	33	6,807	6,869	110	84	11,807	12,000	16	18	3,612	3,646
Commerce	5,488	1,970	641,892	649,351	2,002	578	139,406	141,986	3,221	1,222	329,665	334,107
Finance and insurance	162	49	30,664	30,875	218	66	24,413	24,697	91	32	16,428	16,551
Real estate	6	2	9,470	9,478	9	3	7,813	7,825	4	1	5,028	5,033
Transport	358	211	70,987	71,556	426	228	38,655	39,310	211	141	36,663	37,015
Other information and communications services	191	16	29,940	30,146	203	15	27,345	27,563	126	12	16,920	17,058
Public administration	0	0	1,464	1,464	0	0	1,250	1,250	0	0	851	851
Education and research	449	29	32,715	33,193	121	7	22,171	22,299	211	18	17,322	17,550
Medical service and health/social security/nursing care	1	0	26	27	20,279	10,932	1,978,789	2,010,000	1	0	14	14
Other public services	11	10	2,263	2,285	34	30	3,998	4,062	6	6	1,231	1,243
Business services	588	197	122,917	123,702	1,024	308	144,714	146,047	344	137	66,602	67,082
Personal services	16	6	2,529	2,551	315	163	32,096	32,573	9	4	1,329	1,341
Office supplies	0	0	0	0	0	0	0	0	0	0	0	0
Activities not elsewhere classified	8	2	492	502	6	1	421	428	5	1	286	292
Total	9,925	4,884	1,385,191	1,400,000	25,644	13,220	2,569,335	2,608,199	5,660	3,188	739,247	748,095

Note: Compiled by the author based on the assumptions given in Section IV, using the multi-regional input-output tables and employment coefficients estimated in this study.

V. Conclusion

This study has attempted to develop and propose an approach for estimating regional input-output tables and simulate employment inducement through the use of such tables, as a tool to be used by relatively small local governments in drafting visions or comprehensive strategies for job creation incorporating specific numerical targets. As an example case, this study actually estimated multi-regional input-output tables for the Kumamoto urban area, which covers multiple municipalities, but the same approach can be applied when estimating input-output tables for a single municipality.[25] Thus, once input-output tables for a given region have been estimated and the corresponding employment tables compiled, the amount of induced employment can be measured by assigning the planned or expected data relating to final demand and production activities, such as investment and consumption, to an input-output model. In order to understand the estimation results, however, it is necessary to give due consideration to adjustment in terms of the number of working hours and the fiscal balance.

Although this study does not evaluate job creation measures, it may be possible to compare multiple such measures in terms of efficiency by calculating the ratio between their costs (final demand) and benefits (induced employment) taking their tax revenues into consideration. Considering that the amount of induced employment in a particular region is determined by the size and structure of final demand, with the industrial and technical structures of the region as given factors, it can provide clues during the process of exploring the job creation measures suitable for the region—that is, the size and structure of final demand achieved by these measures.

There may be an argument that the amount of employment that will be induced in the future cannot be estimated on the basis of current technical and industrial structures because new technologies or goods will become available. If it is possible to assume the cost structure of a new technology or the market structure for new goods in data form beforehand, that problem can be overcome by putting it into the rows and columns of the input-output tables estimated in this study. It may also be possible to deduce future structural changes from an economic model using these estimated tables as part of the data, but it would be difficult to obtain valid estimation results without choosing a technology based on the abovementioned information. A similar problem is the difficulty of estimating the level of future improvement in man-hour-based labor productivity. If basic data is unavailable, there would be no other way but to conduct a sensitivity analysis assuming multiple rates of change in productivity based on the historical data. How to link the static estimate achieved in this study to dynamic estimates is an issue that remains to be studied in the future.

[25] What is more, while this study divides Japan into three regions—namely, the Kumamoto urban area and the other areas of Kumamoto and areas other than Kumamoto Prefecture—in order to make its estimates, further division may be possible.

Supplementary Table 1. Amount of Induced Employment per Unit of Regional Final Demand in the Kumamoto Urban Area, According to Sector

(Unit: person/million yen [valued at 2005 producer prices])

*Per 1 million yen of regional final demand in the Kumamoto urban area		No. of employed persons at work			No. of employees (excl. paid executives)		
		Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan
1	Crop cultivation	0.230	0.003	0.201	0.037	0.001	0.025
2	Livestock	0.255	0.173	0.080	0.042	0.027	0.024
3	Agricultural services	0.306	0.031	0.019	0.050	0.007	0.011
4	Forestry	0.200	0.121	0.005	0.029	0.017	0.003
5	Fisheries	0.093	0.215	0.023	0.019	0.033	0.013
6	Metallic ores	0.000	0.000	0.000	0.000	0.000	0.000
7	Non-metallic ores	0.054	0.048	0.013	0.045	0.040	0.011
8	Coal mining, crude petroleum and natural gas	0.000	0.000	0.012	0.000	0.000	0.011
9	Foods	0.063	0.056	0.117	0.032	0.019	0.050
10	Beverage	0.041	0.042	0.027	0.032	0.032	0.016
11	Feeds and organic fertilizer, n.e.c.	0.047	0.006	0.175	0.024	0.002	0.054
12	Tobacco	0.038	0.000	0.010	0.026	0.000	0.002
13	Textile products	0.160	0.002	0.068	0.124	0.001	0.045
14	Wearing apparel and other textile products	0.084	0.137	0.041	0.067	0.110	0.029
15	Timber and wooden products	0.044	0.101	0.006	0.020	0.033	0.005
16	Furniture and fixtures	0.053	0.009	0.070	0.039	0.003	0.052
17	Pulp, paper, paperboard, building paper	0.065	0.008	0.035	0.049	0.003	0.029
18	Paper products	0.015	0.009	0.089	0.011	0.006	0.072
19	Printing, plate making and book binding	0.071	0.001	0.041	0.057	0.001	0.033
20	Chemical fertilizer	0.024	0.001	0.032	0.022	0.001	0.027
21	Industrial inorganic chemicals	0.029	0.002	0.040	0.026	0.001	0.034
22	Petrochemical basic products	0.000	0.000	0.019	0.000	0.000	0.017
23	Organic chemical products (except Petrochemical basic products)	0.065	0.003	0.015	0.059	0.002	0.012
24	Synthetic resins	0.010	0.000	0.043	0.009	0.000	0.037
25	Synthetic fibers	0.000	0.000	0.058	0.000	0.000	0.050
26	Medicaments	0.020	0.001	0.054	0.018	0.000	0.046
27	Final chemical products, n.e.c.	0.036	0.001	0.053	0.031	0.001	0.046
28	Petroleum refinery products	0.000	0.000	0.006	0.000	0.000	0.006
29	Coal products	0.008	0.062	0.013	0.007	0.052	0.011
30	Plastic products	0.019	0.001	0.094	0.015	0.000	0.080
31	Rubber products	0.008	0.088	0.035	0.007	0.067	0.026
32	Leather, fur skins and miscellaneous leather products	0.004	0.001	0.143	0.003	0.000	0.086
33	Glass and glass products	0.058	0.003	0.045	0.050	0.002	0.039
34	Cement and cement products	0.094	0.033	0.011	0.080	0.028	0.009
35	Pottery, china and earthenware	0.018	0.001	0.097	0.016	0.001	0.072
36	Other ceramic, stone and clay products	0.050	0.014	0.053	0.043	0.011	0.043

Supplementary Table 1 (*Continued*)

*Per 1 million yen of regional final demand in the Kumamoto urban area		No. of employed persons at work			No. of employees (excl. paid executives)		
		Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan
37	Pig iron and crude steel	0.000	0.000	0.048	0.000	0.000	0.042
38	Steel products	0.025	0.002	0.039	0.021	0.001	0.034
39	Cast and forged steel products	0.008	0.001	0.073	0.007	0.000	0.062
40	Other iron or steel products	0.028	0.001	0.058	0.023	0.001	0.050
41	Non-ferrous metals	0.006	0.000	0.033	0.005	0.000	0.028
42	Non-ferrous metal products	0.025	0.001	0.042	0.022	0.000	0.036
43	Metal products for construction and architecture	0.069	0.002	0.044	0.059	0.001	0.036
44	Other metal products	0.028	0.001	0.088	0.024	0.000	0.069
45	General industrial machinery	0.056	0.002	0.046	0.048	0.001	0.039
46	Special industrial machinery	0.067	0.003	0.019	0.059	0.002	0.016
47	Other general machines	0.038	0.002	0.061	0.031	0.001	0.050
48	Machinery for office and service industry	0.003	0.000	0.088	0.002	0.000	0.075
49	Electrical devices and parts	0.033	0.002	0.078	0.029	0.001	0.067
50	Applied electronic equipment and electric measuring instruments	0.022	0.013	0.063	0.019	0.012	0.056
51	Other electrical equipment	0.023	0.017	0.056	0.019	0.015	0.047
52	Household electric appliances	0.003	0.000	0.080	0.003	0.000	0.069
53	Household electronics equipment	0.001	0.000	0.081	0.001	0.000	0.071
54	Electronic computing equipment and accessory equipment of electronic computing equipment	0.005	0.023	0.004	0.004	0.021	0.004
55	Semiconductor devices and integrated circuits	0.049	0.029	0.025	0.045	0.026	0.022
56	Other electronic components	0.100	0.005	0.015	0.090	0.004	0.012
57	Passenger motor cars	0.000	0.000	0.092	0.000	0.000	0.081
58	Other cars	0.065	0.004	0.043	0.059	0.003	0.037
59	Motor vehicle parts and accessories	0.037	0.003	0.065	0.033	0.002	0.057
60	Ships and repair of ships	0.011	0.001	0.073	0.010	0.001	0.062
61	Other transportation equipment and repair of transportation equipment	0.001	0.000	0.078	0.001	0.000	0.069
62	Precision instruments	0.026	0.002	0.077	0.023	0.001	0.066
63	Miscellaneous manufacturing products	0.020	0.001	0.075	0.015	0.001	0.050
64	Reuse and recycling	0.101	0.003	0.008	0.085	0.003	0.007
65	Building construction	0.164	0.007	0.018	0.115	0.003	0.015
66	Repair of construction	0.163	0.004	0.021	0.115	0.003	0.017
67	Public construction	0.148	0.024	0.016	0.104	0.017	0.013
68	Other civil engineering and construction	0.160	0.005	0.016	0.113	0.004	0.013
69	Electricity	0.003	0.018	0.021	0.003	0.016	0.018
70	Gas and heat supply	0.013	0.000	0.033	0.011	0.000	0.028

Supplementary Table 1 (*Continued*)

	*Per 1 million yen of regional final demand in the Kumamoto urban area	No. of employed persons at work			No. of employees (excl. paid executives)		
		Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan
71	Water supply	0.104	0.007	0.014	0.089	0.006	0.012
72	Waste management service	0.075	0.022	0.011	0.065	0.019	0.009
73	Commerce	0.229	0.001	0.007	0.178	0.001	0.006
74	Finance and insurance	0.071	0.001	0.007	0.060	0.000	0.006
75	Real estate agencies and rental services	0.021	0.001	0.003	0.013	0.000	0.002
76	House rent	0.034	0.001	0.004	0.022	0.000	0.003
77	House rent (imputed house rent)	0.019	0.003	0.002	0.012	0.002	0.001
78	Railway transport	0.053	0.001	0.030	0.046	0.001	0.027
79	Road transport (except transport by private cars)	0.090	0.001	0.010	0.077	0.001	0.009
80	Self-transport by private cars	0.150	0.006	0.016	0.123	0.005	0.013
81	Water transport	0.031	0.032	0.024	0.026	0.028	0.021
82	Air transport	0.093	0.001	0.024	0.080	0.001	0.020
83	Freight forwarding	0.040	0.000	0.076	0.034	0.000	0.068
84	Storage facility service	0.072	0.002	0.029	0.061	0.001	0.025
85	Services relating to transport	0.075	0.002	0.022	0.063	0.001	0.018
86	Communication	0.074	0.001	0.008	0.065	0.001	0.006
87	Broadcasting	0.090	0.001	0.018	0.077	0.001	0.015
88	Information services	0.047	0.001	0.050	0.040	0.000	0.042
89	Internet based services	0.091	0.001	0.020	0.078	0.001	0.016
90	Image information, character information production and distribution	0.045	0.001	0.053	0.038	0.001	0.044
91	Public administration	0.084	0.001	0.007	0.080	0.001	0.005
92	Education	0.097	0.001	0.006	0.091	0.001	0.005
93	Research	0.113	0.002	0.013	0.105	0.001	0.010
94	Medical service and health	0.163	0.002	0.018	0.146	0.001	0.015
95	Social security	0.118	0.006	0.027	0.107	0.005	0.023
96	Nursing care	0.148	0.004	0.012	0.130	0.002	0.006
97	Other public services	0.135	0.034	0.017	0.093	0.024	0.013
98	Advertising services	0.113	0.001	0.044	0.087	0.000	0.036
99	Goods rental and leasing services	0.096	0.001	0.030	0.072	0.001	0.025
100	Repair of motor vehicles and machine	0.166	0.006	0.025	0.127	0.004	0.021
101	Other business services	0.124	0.001	0.036	0.093	0.000	0.029
102	Amusement and recreational services	0.161	0.002	0.022	0.126	0.002	0.018
103	Eating and drinking places	0.161	0.011	0.081	0.119	0.005	0.051
104	Accommodations	0.130	0.007	0.055	0.097	0.003	0.038
105	Cleaning, barber shops, beauty shops and public baths	0.179	0.001	0.007	0.140	0.001	0.006
106	Other personal services	0.184	0.009	0.010	0.143	0.007	0.007
107	Office supplies	0.070	0.006	0.057	0.055	0.004	0.045
108	Activities not elsewhere classified	0.136	0.034	0.049	0.087	0.011	0.033

Supplementary Table 2. Amount of Induced Employment per Unit of Regional Final Demand in the Areas of Kumamoto Other Than the Kumamoto Urban Area, by Sector

(Unit: person/million yen [valued at 2005 producer prices])

	*Per 1 million yen of regional final demand in the other areas of Kumamoto	No. of employed persons at work			No. of employees (excl. paid executives)		
		Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan
1	Crop cultivation	0.005	0.260	0.138	0.004	0.039	0.020
2	Livestock	0.009	0.426	0.071	0.006	0.066	0.022
3	Agricultural services	0.005	0.333	0.017	0.004	0.052	0.011
4	Forestry	0.003	0.318	0.005	0.002	0.044	0.004
5	Fisheries	0.011	0.295	0.024	0.007	0.045	0.013
6	Metallic ores	0.000	0.000	0.000	0.000	0.000	0.000
7	Non-metallic ores	0.007	0.093	0.016	0.006	0.077	0.013
8	Coal mining , crude petroleum and natural gas	0.000	0.000	0.012	0.000	0.000	0.011
9	Foods	0.068	0.030	0.135	0.034	0.008	0.059
10	Beverage	0.010	0.071	0.027	0.007	0.055	0.017
11	Feeds and organic fertilizer, n.e.c.	0.014	0.074	0.146	0.008	0.034	0.047
12	Tobacco	0.001	0.038	0.007	0.000	0.025	0.002
13	Textile products	0.003	0.066	0.109	0.002	0.051	0.074
14	Wearing apparel and other textile products	0.010	0.216	0.036	0.007	0.173	0.026
15	Timber and wooden products	0.004	0.141	0.006	0.003	0.049	0.005
16	Furniture and fixtures	0.002	0.018	0.117	0.002	0.012	0.087
17	Pulp, paper, paperboard, building paper	0.010	0.067	0.034	0.008	0.047	0.028
18	Paper products	0.006	0.080	0.020	0.005	0.058	0.017
19	Printing, plate making and book binding	0.007	0.073	0.031	0.006	0.059	0.026
20	Chemical fertilizer	0.006	0.027	0.026	0.005	0.025	0.022
21	Industrial inorganic chemicals	0.003	0.016	0.048	0.003	0.014	0.042
22	Petrochemical basic products	0.000	0.000	0.019	0.000	0.000	0.017
23	Organic chemical products (except Petrochemical basic products)	0.018	0.023	0.029	0.016	0.021	0.024
24	Synthetic resins	0.000	0.001	0.047	0.000	0.001	0.041
25	Synthetic fibers	0.000	0.000	0.058	0.000	0.000	0.050
26	Medicaments	0.003	0.016	0.054	0.003	0.015	0.046
27	Final chemical products, n.e.c.	0.001	0.001	0.071	0.001	0.001	0.061
28	Petroleum refinery products	0.000	0.001	0.007	0.000	0.000	0.006
29	Coal products	0.009	0.063	0.013	0.007	0.054	0.010
30	Plastic products	0.004	0.020	0.090	0.003	0.017	0.077
31	Rubber products	0.008	0.088	0.035	0.007	0.067	0.026
32	Leather, fur skins and miscellaneous leather products	0.004	0.018	0.126	0.003	0.013	0.076
33	Glass and glass products	0.004	0.033	0.060	0.004	0.028	0.052
34	Cement and cement products	0.009	0.116	0.014	0.007	0.099	0.011
35	Pottery, china and earthenware	0.006	0.059	0.054	0.005	0.050	0.041

Supplementary Table 2 (*Continued*)

	*Per 1 million yen of regional final demand in the other areas of Kumamoto	No. of employed persons at work			No. of employees (excl. paid executives)		
		Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan
36	Other ceramic, stone and clay products	0.016	0.100	0.019	0.014	0.085	0.015
37	Pig iron and crude steel	0.000	0.000	0.048	0.000	0.000	0.042
38	Steel products	0.000	0.003	0.050	0.000	0.003	0.044
39	Cast and forged steel products	0.001	0.002	0.078	0.001	0.002	0.067
40	Other iron or steel products	0.001	0.002	0.079	0.001	0.002	0.068
41	Non-ferrous metals	0.006	0.017	0.029	0.005	0.015	0.025
42	Non-ferrous metal products	0.004	0.016	0.047	0.003	0.014	0.040
43	Metal products for construction and architecture	0.006	0.053	0.053	0.005	0.046	0.044
44	Other metal products	0.001	0.016	0.101	0.001	0.014	0.079
45	General industrial machinery	0.002	0.010	0.083	0.002	0.009	0.071
46	Special industrial machinery	0.024	0.012	0.046	0.021	0.011	0.039
47	Other general machines	0.002	0.006	0.098	0.001	0.005	0.081
48	Machinery for office and service industry	0.001	0.001	0.089	0.000	0.000	0.077
49	Electrical devices and parts	0.012	0.044	0.063	0.011	0.038	0.053
50	Applied electronic equipment and electric measuring instruments	0.021	0.074	0.021	0.019	0.065	0.017
51	Other electrical equipment	0.017	0.069	0.022	0.014	0.059	0.018
52	Household electric appliances	0.003	0.012	0.072	0.003	0.010	0.062
53	Household electronics equipment	0.006	0.041	0.045	0.005	0.039	0.040
54	Electronic computing equipment and accessory equipment of electronic computing equipment	0.005	0.023	0.004	0.004	0.021	0.004
55	Semiconductor devices and integrated circuits	0.050	0.034	0.021	0.045	0.031	0.018
56	Other electronic components	0.027	0.060	0.029	0.024	0.055	0.025
57	Passenger motor cars	0.000	0.000	0.092	0.000	0.000	0.081
58	Other cars	0.011	0.041	0.056	0.010	0.037	0.049
59	Motor vehicle parts and accessories	0.003	0.010	0.087	0.002	0.009	0.076
60	Ships and repair of ships	0.002	0.009	0.074	0.001	0.008	0.062
61	Other transportation equipment and repair of transportation equipment	0.000	0.000	0.081	0.000	0.000	0.071
62	Precision instruments	0.000	0.000	0.097	0.000	0.000	0.083
63	Miscellaneous manufacturing products	0.005	0.037	0.054	0.004	0.028	0.037
64	Reuse and recycling	0.075	0.029	0.009	0.063	0.024	0.007
65	Building construction	0.060	0.107	0.024	0.042	0.072	0.019
66	Repair of construction	0.009	0.154	0.026	0.007	0.107	0.021
67	Public construction	0.007	0.159	0.023	0.005	0.111	0.019
68	Other civil engineering and construction	0.032	0.129	0.020	0.023	0.090	0.017
69	Electricity	0.005	0.026	0.010	0.004	0.023	0.008
70	Gas and heat supply	0.001	0.005	0.043	0.001	0.005	0.037

Supplementary Table 2 (*Continued*)

	*Per 1 million yen of regional final demand in the other areas of Kumamoto	No. of employed persons at work			No. of employees (excl. paid executives)		
		Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan	Kumamoto urban area	Other areas of Kumamoto	Other areas of Japan
71	Water supply	0.005	0.101	0.020	0.004	0.086	0.017
72	Waste management service	0.006	0.091	0.010	0.005	0.079	0.008
73	Commerce	0.082	0.145	0.011	0.064	0.112	0.009
74	Finance and insurance	0.009	0.039	0.029	0.008	0.033	0.025
75	Real estate agencies and rental services	0.003	0.013	0.013	0.002	0.007	0.010
76	House rent	0.010	0.020	0.009	0.007	0.012	0.007
77	House rent (imputed house rent)	0.001	0.019	0.003	0.001	0.011	0.003
78	Railway transport	0.001	0.020	0.050	0.001	0.017	0.045
79	Road transport (except transport by private cars)	0.004	0.084	0.014	0.003	0.072	0.012
80	Self-transport by private cars	0.013	0.137	0.021	0.010	0.112	0.018
81	Water transport	0.005	0.083	0.014	0.004	0.072	0.011
82	Air transport	0.001	0.044	0.049	0.001	0.038	0.042
83	Freight forwarding	0.001	0.023	0.096	0.001	0.020	0.086
84	Storage facility service	0.004	0.067	0.031	0.003	0.057	0.027
85	Services relating to transport	0.002	0.065	0.031	0.002	0.055	0.025
86	Communication	0.055	0.017	0.010	0.048	0.015	0.008
87	Broadcasting	0.072	0.017	0.021	0.062	0.014	0.017
88	Information services	0.000	0.002	0.101	0.000	0.002	0.086
89	Internet based services	0.006	0.026	0.084	0.005	0.023	0.065
90	Image information, character information production and distribution	0.001	0.013	0.079	0.001	0.011	0.065
91	Public administration	0.047	0.037	0.008	0.045	0.036	0.007
92	Education	0.046	0.043	0.016	0.043	0.041	0.014
93	Research	0.085	0.014	0.025	0.078	0.013	0.022
94	Medical service and health	0.051	0.111	0.022	0.044	0.100	0.018
95	Social security	0.003	0.134	0.007	0.002	0.121	0.005
96	Nursing care	0.011	0.139	0.013	0.009	0.122	0.008
97	Other public services	0.008	0.155	0.025	0.006	0.105	0.020
98	Advertising services	0.001	0.005	0.086	0.001	0.004	0.070
99	Goods rental and leasing services	0.002	0.079	0.038	0.002	0.059	0.032
100	Repair of motor vehicles and machine	0.012	0.150	0.033	0.010	0.113	0.028
101	Other business services	0.001	0.064	0.110	0.001	0.048	0.090
102	Amusement and recreational services	0.004	0.160	0.023	0.003	0.125	0.019
103	Eating and drinking places	0.016	0.163	0.072	0.010	0.118	0.046
104	Accommodations	0.009	0.136	0.050	0.006	0.100	0.034
105	Cleaning, barber shops, beauty shops and public baths	0.003	0.172	0.012	0.003	0.134	0.009
106	Other personal services	0.005	0.184	0.013	0.004	0.142	0.010
107	Office supplies	0.049	0.036	0.047	0.038	0.027	0.037
108	Activities not elsewhere classified	0.092	0.073	0.054	0.060	0.034	0.037

References

Begg, Robert Burns. 1985. Non-Survey Interregional Input-Output Modeling. PhD thesis, University of Iowa.

Hitomi, Kazumi. 2000. Denryoku kyokyu ni awaseta zenkoku 10 chiikikan sangyo renkan hyo no kaihatsu [On the estimation of 10 power-supply region inter-regional input-output table: 1990]. *Denryoku Keizai Kenkyu*, no. 43:7–20.

Ihara, Takeo. 1996. *Chiiki no keizai bunseki* [Economic analysis for regions]. Tokyo: Chuo Keizai-sha.

Kaneko, Yukio. 1967. *Keizai hendo to sangyo renkan* [Economic changes and input-output relations]. Tokyo: Shinhyoron.

Kronenberg, Tobias. 2010. Construction of regional input-output tables using nonsurvey methods. *International Regional Science Review 32* (1):40–64.

Leontief, Wassily, and Allen Strout. 1963. Multiregional input-output analysis. In *Structural interdependence and economic development*, ed. Tibor Barna. New York: St. Martin's Press.

Nakano, Satoshi. 2011. Shin seicho senryaku ni yoru chiiki no koyo yuhatsu shimyureshon [Simulations of employment induced in regions based on the New Growth Strategy]. JILPT Discussion Paper Series 11-01. The Japan Institute for Labour Policy and Training, Tokyo.

Nakano, Satoshi, and Kazuhiko Nishimura. 2012. A nonsurvey multiregional input-output estimation allowing cross-hauling: Partitioning two regions into three or more parts. *The annals of regional science*. http://dx.doi.org/10.1007/s00168-012-0521-5.

Nishimura, Kazuhiko. 2006. Chita hanto chiikikan sangyo renkan hyo no sakusei to oyo [Multiregional input-output table with cross hauling: Estimation and application to Chita-hanto region]. *The Journal of Economic Studies*, no. 33:103–14.

Watanabe, Hiroaki. 2007. Shichoson no koyo soshutsu he no torikumi to kongo no kadai [Efforts of municipalities toward job creation and future challenges]. In *Chiiki koyo soshutsu no shin choryu* [New trends in job creation in regions], ed. the Japan Institute for Labour Policy and Training, 197–244. Tokyo: The Japan Institute for Labour Policy and Training.

———. 2009. Chiho jichitai ni okeru koyo soshutsu he no torikumi ni kansuru chosa [Research on efforts of local governments toward job creation]. JILPT Research Series no. 60. The Japan Institute for Labour Policy and Training, Tokyo.