Supplementary Note 1　Interindustry analysis used in Section 1 of Chapter 2

We would like readers to understand that for easier understanding by those who are little familiarized with analytical methods, in Supplementary Note (SN) 1 we gave priority to intuitive expressions over academically accurate expressions, repeating the same explanations where necessary.

In this paper we made much use of interindustry analyses. We did not use, however, textbook-like analyses or generally applied analyses. We selected data and improved computation methods so that they might suit our analytical purposes.[1] The main characteristic of such improvement is the combined use of general competitive-import type tables and noncompetitive-import type tables as well as the use of computation methods suitable for such purposes. SN 1 will explain about this analytical method.

Supplementary Note 1-1.　Difference between a competitive-import type table and a noncompetitive-import type table

Input-output table of competitive-import type and of noncompetitive-import type

Definitions of symbols used in Supplementary Note 1-1

i : Row (horizontal), indicative of the number of goods, positioned on the left side of a subscript

j : Column (vertical), indicative of the number of a production sector, positioned on the right side of a subscript, where the good produced by production sector i is good i.

If the sector is noted with $\bigcirc_{ij}$, it means that good i is supplied to production sector j.

z_{ij} : Intermediate input (domestic goods + imported goods)

zd_{ij} : Intermediate input of domestic goods

zm_{ij} : Intermediate input of imported goods

f_i : Domestic consumption of final goods (domestic demand)

fd_i : Consumption of domestic goods by domestic demand

fm_i : Consumption of imported goods by domestic demand

e_i : Exports (external demand)

m_i : Imports

ed_i : Domestic goods included in exports

em_i : Imported goods included in exports

v_j : Added value

x_i, x_j : Output

In this paper we used not only general competitive-import type tables (“competitive-import table”) but also noncompetitive-import type tables (“noncompetitive-import table”) in a combined manner.

1　For basic interindustry analyses refer to Miyazawa (2002), works supervised by Shishido (2010), and Fujikawa (2005). For the analyses used in this paper, refer to Uda (2011a), Uda (2011b), Uda (2012a), and Uda (2012b).

The difference between a competitive-import table and a noncompetitive-import table lies in whether a table uses for the value of supply to domestic demand the combined sum of domestic goods and imported goods, or one sum for domestic goods and another sum for imported goods by separating the two goods.

In other words, in compiling statistical data on consumption (demand) of a good a competitive-import table does not distinguish between a domestic good and an imported good and treat them as "competitive with each other," thereby representing them as one aggregated data (SN 1-1 Table), while a noncompetitive-import table treats a domestic good and an imported good as two different goods that are "noncompetitive with each other" and represent them as two different data (SN 1-2 Table).

Below we will explain about an example case of an input-output table ("I-O table") that relates to production involving two sectors. Each new symbol will be defined at the end of the item where it is used for the first time. All domestic final demand sectors will be represented collectively as "domestic demand" and exports as "external demand."

Supplementary Note 1-1 Table

Structure of a competitive-import type input-output table ("competitive-import table")

			Production sector		Final demand sector		Imports	Production
			Production 1	Production 2	Domestic demand	External demand		
Input of goods (supply)	Domestic goods + Imported goods	Good 1	z_{11}	z_{12}	f_1	e_1	$-m_1$	x_1
		Good 2	z_{21}	z_{22}	f_2	e_2	$-m_2$	x_2
Added value			v_1	v_2				
Production			x_1	x_2				

Data compiled by the Ministry of Economy, Trade and Industry.

Supplementary Note 1-2 Table

Structure of a noncompetitive-import type input-output table ("noncompetitive-import table")

			Production sector		Final demand sector		Imports	Production
			Production 1	Production 2	Domestic demand	External demand		
Input of goods (supply)	Domestic goods	Good 1	zd_{11}	zd_{12}	fd_1	e_1	0	x_1
		Good 2	zd_{21}	zd_{22}	fd_2	e_2	0	x_2
	Imported goods	Good 1	zm_{11}	zm_{12}	fm_1	0	$-m_1$	0
		Good 2	zm_{21}	zm_{22}	fm_2	0	$-m_2$	0
Added value			v_1	v_2				
Production			x_1	x_2				

Data compiled by the Ministry of Economy, Trade and Industry.

The following relationship exists between the input goods in SN 1-1 Table and the input goods in SN 1-2 Table as decomposed into domestic goods and imported goods:

Decomposition of intermediate goods: $z_{ij} = zd_{ij} + zm_{ij}$ (a1-1)

Decomposition of final goods: $f_i = fd_i + fm_i$ (a1-2)

In this paper we used published tables that have goods already decomposed, not tables where goods are hypothetically decomposed.[2]

2 For hypothetically created "noncompetitive-import table" see Supplementary Note 3 in White Paper

How "domestic production ratio" is computed

Of the "domestic production ratios" of an industry that show the ratio of domestic goods and of imported goods to the total goods it produces we used the "self-sufficient rate for supply" and the "local content ratio for production."[3]

The self-sufficient rate for supply means, in the case of cars for instance, the ratio of domestically produced cars to the total number of cars distributed in the country, or the ratio of domestic cars to the total number of cars supplied.

Self-sufficient rate for supply: $\dfrac{x_i}{x_i + m_i}$ (a1-3)

In the formula a1-3, SN 1-2 Table is computed in a horizontal direction.

The local content ratio for production means, in the same case of cars for instance, the ratio of domestic production to the total intermediate goods necessary for car production.

Local content ratio for production: $\dfrac{zd_{1j} + zd_{2j}}{zd_{1j} + zd_{2j} + zm_{1j} + zm_{2j}}$ (a1-4)

In the formula a1-4, SN 1-2 Table is computed in a vertical direction.

Supplementary Note 1-2. Basic computations

Computation of intermediate input coefficient

Definitions of symbols added in Supplementary Note 1-2

a_{ij} : Intermediate input coefficient

ad_{ij} : Intermediate input coefficient (domestic goods only)

b_{ij} : "Spillovers" (direct + indirect)

bd_{ij} : "Spillovers" (domestic goods only)

g_{ij} : "Indirect spillovers" (domestic goods + imported goods)

gd_{ij} : "Indirect spillovers" (domestic goods only)

In the first place, so as to know the purchase of intermediate goods necessary for goods production we compute the input value of intermediate goods necessary for each industry to produce one unit of a good.

Competitive-import table: $\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} = \begin{pmatrix} \dfrac{z_{11}}{x_1} & \dfrac{z_{12}}{x_2} \\ \dfrac{z_{21}}{x_1} & \dfrac{z_{22}}{x_2} \end{pmatrix}$ (computed using SN 1-1 Table) (a1-5)

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on International Economy and Trade 2011.

3 We followed the definitions given in Fujikawa (1998) where four types of "domestic production ratio" were used including these ratios.

Noncompetitive-import table: $\begin{pmatrix} ad_{11} & ad_{12} \\ ad_{21} & ad_{22} \end{pmatrix} = \begin{pmatrix} \frac{zd_{11}}{x_1} & \frac{zd_{12}}{x_2} \\ \frac{zd_{21}}{x_1} & \frac{zd_{22}}{x_2} \end{pmatrix}$ (computed using SN 1-2 Table) (a1-6)

Computation of Leontief inverse matrix

Next, we compute the so-called Leontief inverse matrix. The Leontief inverse matrix represents in matrices the "sum of direct and indirect spillovers generated in each industry by the consumption of one unit of a final good."

Competitive-import table: $\begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix} = \left[\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} - \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \right]^{-1}$ (a1-7)

Noncompetitive-import table: $\begin{pmatrix} bd_{11} & bd_{12} \\ bd_{21} & bd_{22} \end{pmatrix} = \left[\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} - \begin{pmatrix} ad_{11} & ad_{12} \\ ad_{21} & ad_{22} \end{pmatrix} \right]^{-1}$ (a1-8)

Computation of indirect spillovers

We can extract indirect spillovers by removing from the Leontief inverse matrix (sum of direct and indirect spillovers generated in each industry by the consumption of one unit of a final good) direct spillovers (final goods consumption that served to induce spillovers). The computation is made by subtracting unit matrices from the Leontief inverse matrix.

Competitive-import table: $\begin{pmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix} - \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ (a1-9)

Noncompetitive-import table: $\begin{pmatrix} gd_{11} & gd_{12} \\ gd_{21} & gd_{22} \end{pmatrix} = \begin{pmatrix} bd_{11} & bd_{12} \\ bd_{21} & bd_{22} \end{pmatrix} - \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ (a1-10)

Supplementary Note 1-3. Graphical representation of spillovers

Definitions of symbols added in Supplementary Notes 1-3

Skyline chart

sf_i : Amount of spillovers induced by domestic demand (denominator of the graph computation; benchmark)

se_i : Amount of spillovers induced by external demand

sm_i : Amount of spillovers curbed by imports

Graph of spillovers caused by trade

k : A superscript, which
shall be *a* if spillovers are divided among the production sectors that receive them, and
shall be *b* if spillovers are divided among the final goods that give them.

bf_{ij}^{k} : Amount of spillovers induced by domestic demand (denominator of the graph computation; benchmark)

ge_{ij}^{k} : Amount of indirect spillovers induced by external demand

gfm_{ij}^{k} : Of indirect spillovers induced by domestic demand, the amount caused to flow out by imports.

gem_{ij}^{k} : Of indirect spillovers induced by external demand, the amount caused to flow out by imports.

ss_{ij}^{k} : Degree of self-sufficiency in spillovers (not including spillovers caused to flow out by imports stemming from external demand)

bn_{ij}^{k} : Balance of spillovers (including spillovers caused to flow out by imports stemming from external demand)

How to draw a skyline chart

To draw a skyline chart, first we must compute the following output determination model. As shown by the formulas given below, for the computation we use a competitive-import table and treat imports as negative demand for final goods. So it would be appropriate to say "spillovers curbed by imports," not "spillovers caused to flow out by imports."

• **Output determination model:** $$\begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}\left[\begin{pmatrix} f_1 \\ f_2 \end{pmatrix} + \begin{pmatrix} e_1 \\ e_2 \end{pmatrix} + \begin{pmatrix} -m_1 \\ -m_2 \end{pmatrix}\right] \quad \text{(a1-11)}$$

• **Amount of spillovers induced by domestic demand:** $$\begin{pmatrix} sf_1 \\ sf_2 \end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}\begin{pmatrix} f_1 \\ f_2 \end{pmatrix} \quad \text{(a1-12)}$$

• **Amount of spillovers induced by external demand:** $$\begin{pmatrix} se_1 \\ se_2 \end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}\begin{pmatrix} e_1 \\ e_2 \end{pmatrix} \quad \text{(a1-13)}$$

• **Amount of induced spillovers curbed by imports:** $$\begin{pmatrix} sm_1 \\ sm_2 \end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}\begin{pmatrix} m_1 \\ m_2 \end{pmatrix} \quad \text{(a1-14)}$$

• **Supply-demand balance:** $$\begin{pmatrix} sf_1 \\ sf_2 \end{pmatrix} + \begin{pmatrix} se_1 \\ se_2 \end{pmatrix} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \begin{pmatrix} sm_1 \\ sm_2 \end{pmatrix} \quad \text{(a1-15)}$$

Then, we convert each of these values into a ratio to the amount of spillovers induced by domestic demand in each sector.

Supplementary Note 1-3 Table

Supplementary Note 1-1 Table as data processed for chart drawing

	Horizontal axis		Vertical axis			
			Supply		Demand	
	Ratio to production (reference)	Ratio to domestic demand	Domestic demand	Exports	Degree of self sufficiency	Imports
Good 1	$\frac{x_1}{x_1 + x_2}$	$\frac{sf_1}{sf_1 + sf_2}$	$\frac{sf_1}{sf_1}$	$\frac{se_1}{sf_1}$	$\frac{x_1}{sf_1}$	$\frac{sm_1}{sf_1}$
Good 2	$\frac{x_2}{x_1 + x_2}$	$\frac{sf_2}{sf_1 + sf_2}$	$\frac{sf_2}{sf_2}$	$\frac{se_2}{sf_2}$	$\frac{x_2}{sf_2}$	$\frac{sm_2}{sf_2}$

Data compiled by the Ministry of Economy, Trade and Industry.

We draw a skyline chart as shown by SN 1-4 Figure on the basis of the above converted values.

As explained in "ratio to production" (for reference purposes) in SN 1-3 Table, a general skyline chart places each sector's ratio to output χ in the horizontal axis; in this paper, however, we placed

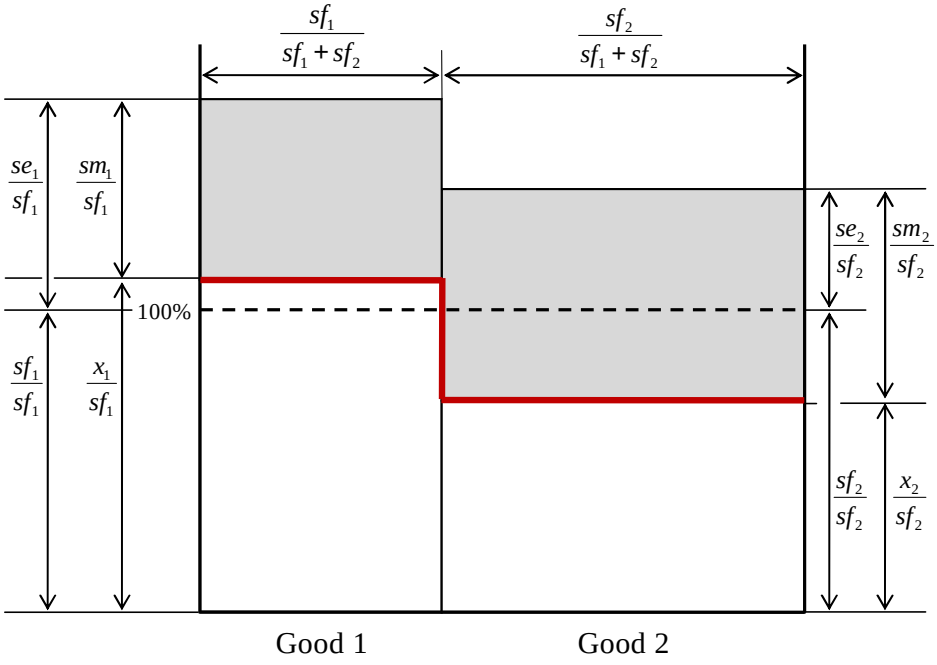
each sector's ratio to domestic demand in the same axis. As a result, in a general skyline chart, sectors whose self-sufficient rate is close to zero have a narrower width as in the case of the mining industry, which makes it easier to know where the weaknesses of Japanese industries lie. For drawing the skyline chart we used "*Ray* skyline chart drawing tool."[4]

Basic computation that serves as a premise

Computation of values necessary for making a graph of spillovers caused by trade seems complicated when compared with the computation of values of a skyline chart; however, computation requires us to only sum up vertically or horizontally the values computed as in SN 1-5 Table.

Supplementary Note 1-4 Figure

How to draw a skyline chart



Data compiled by the Ministry f Economy, Trade and Industry.

Supplementary Note 1-5 Table

Sample of a spillover matrix (competitive-import table in the case of domestic demand)

		Direct spillovers	Indirect spillovers (final goods consumption)	
		Final goods consumption	Good 1	Good 2
Direct spillovers	Final goods consumption		f_1	f_2
Indirect spillovers (production sector)	Sector 1	f_1	$g_{11}\ f_1$	$g_{12}\ f_2$
	Sector 2	f_2	$g_{21}\ f_1$	$g_{22}\ f_2$

Note: Parts in grey represent direct spillovers generated by final goods consumption.
Data compiled by the Ministry of Economy, Trade and Industry.

4 For "*Ray* skyline drawing tool" refer to Uda (2011b).

SN 1-5 Table shows the computation of spillovers caused by domestic demand made using a competitive-import table. We make these computations using also a noncompetitive-import table, as well as using domestic demand and external demand for values of final goods consumption. And combining the four tables obtained as the result we make necessary computations.

The sum of rows of these matrices (horizontal summation) represents the spillovers that are received by each production sector. A general interindustry analysis is made using these values. The sum of direct and indirect spillovers caused by domestic demand and external demand, which is found using noncompetitive-import tables, is the output. The spillovers represented as the sum of rows are noted with (R) (short for Recipient) because they represent spillovers that each production sector receives.[5]

On the other hand, the sum of columns of these matrices (vertical summation) represents the spillovers that are given by the consumption of a final good. Consequently, (G) (short for Giver) is put to the spillovers represented as the sum of columns.

Note that the matrix prepared using a competitive-import table represents the spillovers that should have been induced in the absence of imports, and the matrix prepared using a noncompetitive-import table shows the spillovers domestically induced as the result of partial spillovers that were caused to flow out by imports. By comparing the difference between the two spillovers we can obtain the matrix of the spillovers that flowed out of the country.

How to compute spillovers caused by trade

Using SN 1-5 Table shown as an example we decompose the spillovers induced by exports and the outflow of spillovers caused by imports into spillovers caused by domestic demand and by external demand, as well as into direct spillovers and indirect spillovers.

In the first place, we compute spillovers (R) that would be generated by domestic demand were it not for imports by horizontally totaling the sums of rows of the matrix of SN 1-5 Table as in the formula a1-16a. Spillovers (G) are computed by vertically totaling the sums of columns as in the formula a1-16b.

- **Spillovers induced by domestic demand (R):**

$$\begin{pmatrix} bf_1^a \\ bf_2^a \end{pmatrix} = \begin{pmatrix} f_1 \\ f_2 \end{pmatrix} + \begin{pmatrix} g_{11}f_1 + g_{12}f_2 \\ g_{12}f_1 + g_{22}f_2 \end{pmatrix} \qquad \text{(a1-16a)}$$

- **Spillovers induced by domestic demand (G):**

$$\begin{pmatrix} bf_1^b \\ bf_2^b \end{pmatrix} = \begin{pmatrix} f_1 \\ f_2 \end{pmatrix} + \begin{pmatrix} g_{11}f_1 + g_{21}f_1 \\ g_{12}f_2 + g_{22}f_2 \end{pmatrix} \qquad \text{(a1-16b)}$$

The first term of the right-hand side of the formula a1-16 represents direct spillovers, and the second term, indirect spillovers.

The value given in the formula a1-16 serves as the benchmark (denominator) in making a graph of spillovers caused by trade, while the value obtained in the formula a1-16a (R) serves as the denominator for computing a skyline analysis.

Next, we find direct spillovers caused by external demand, which are common to spillovers (R) and

5 In terms generally used in interindustry analyses, (G) represents backward linkage effect, and (R), forward linkage effect. In Section 1 of Chapter 2 we use expressions (G) and (R).

spillovers (G), by the formula a1-17.[6]

• **DS induced by ED (C):** $\begin{pmatrix} ed_1 \\ ed_2 \end{pmatrix} = \begin{pmatrix} e_1 \\ e_2 \end{pmatrix} - \begin{pmatrix} em_1 \\ em_2 \end{pmatrix}$ (a1-17)

Indirect spillovers caused by external demand are found by the formula a1-18.

• **IS induced by ED (R):** $\begin{pmatrix} ge_1^a \\ ge_2^a \end{pmatrix} = \begin{pmatrix} gd_{11}\, ed_1 + gd_{12}\, ed_2 \\ gd_{21}\, ed_1 + gd_{22}\, ed_2 \end{pmatrix}$ (a1-18a)

• **IS induced by ED (G):** $\begin{pmatrix} ge_1^b \\ ge_2^b \end{pmatrix} = \begin{pmatrix} gd_{11}\, ed_1 + gd_{21}\, ed_1 \\ gd_{12}\, ed_2 + gd_{22}\, ed_2 \end{pmatrix}$ (a1-18b)

(Note: DS is short for direct spillovers, ED for external demand, IS for indirect spillovers, C for common, R for recipient, and G for giver.)

As is shown by the formulas a1-16 to a1-18, the computation of spillovers induced by external demand little differs from the computation made using a competitive-import table for both direct and indirect spillovers, while the outflow of spillovers caused by imports is greater in the case of indirect spillovers.

In the first place, from the formula a1-19 we find the amounts of direct outflow of spillovers of domestic demand caused by imports, which are common to (R) and (G).

• **DOS of DD caused by I (C):** $\begin{pmatrix} fm_1 \\ fm_2 \end{pmatrix} = \begin{pmatrix} f_1 \\ f_2 \end{pmatrix} - \begin{pmatrix} fd_1 \\ fd_2 \end{pmatrix}$ (a1-19)

(Note: DOS is short for direct outflow of spillovers, DD for domestic demand, and I for imports.)

We should notice that the above value does not include imports of intermediate goods.

From the formula a1-20 we find the amount of indirect outflow of spillovers caused by use of imported goods in the production process for domestic demand.

• **IOS by use of IG for DD (R):** $\begin{pmatrix} gfm_1^a \\ gfm_2^a \end{pmatrix} = \begin{pmatrix} gd_{11}\, fd_1 + gd_{12}\, fd_2 \\ gd_{21}\, fd_1 + gd_{22}\, fd_2 \end{pmatrix} - \begin{pmatrix} g_{11}\, f_1 + g_{12}\, f_2 \\ g_{21}\, f_1 + g_{22}\, f_2 \end{pmatrix}$ (a1-20a)

• **IOS by use of IG for DD (G):** $\begin{pmatrix} gfm_1^b \\ gfm_2^b \end{pmatrix} = \begin{pmatrix} gd_{11}\, fd_1 + gd_{21}\, fd_1 \\ gd_{12}\, fd_2 + gd_{22}\, fd_2 \end{pmatrix} - \begin{pmatrix} g_{11}\, f_1 + g_{21}\, f_1 \\ g_{12}\, f_2 + g_{22}\, f_2 \end{pmatrix}$ (a1-20b)

(Note: IOS is short for indirect outflow of spillovers, IG for imported goods, and DD for domestic demand.)

The amount of direct outflow of spillovers of external demand caused by imports is found from the formula a1-21.

• **DOS caused by I for ED (C):** $\begin{pmatrix} em_1 \\ em_2 \end{pmatrix} = \begin{pmatrix} e_1 \\ e_2 \end{pmatrix} - \begin{pmatrix} ed_1 \\ ed_2 \end{pmatrix}$ (a1-21)

(Note: DOS is short for direct outflow of spillovers, I for imports, and ED for external demand.)

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6 In many of input-output tables including those of Japan, imports for external demand become zero, because even when goods imported through intermediary trade are exported, in the I-O table such goods are recorded as output of the transportation sector, not as imports of the industry that produces the goods. Note, however, that in noncompetitive-import tables of some countries covered by OECD Statistics Directorate (Germany, for instance) “imports” in the export vector are not zero.

The right-hand side of the formula a1-21 shows that imports for external demand become zero for the reason explained in the formula a1-17.

The indirect outflow of spillovers caused by use of imported goods in the production process for external demand is found from the formula a1-17.

• **IOS by use of IG for ED (R):** $$\begin{pmatrix} gem_1^a \\ gem_2^a \end{pmatrix} = \begin{pmatrix} gd_{11}\, ed_1 + gd_{12}\, ed_2 \\ gd_{21}\, ed_1 + gd_{22}\, ed_{d2} \end{pmatrix} - \begin{pmatrix} g_{11}\, e_1 + g_{12}\, e_2 \\ g_{21}\, e_1 + g_{22}\, e_2 \end{pmatrix} \quad \text{(a1-22a)}$$

• **IOS by use of IG for ED (G):** $$\begin{pmatrix} gem_1^b \\ gem_2^b \end{pmatrix} = \begin{pmatrix} gd_{11}\, ed_1 + gd_{21}\, ed_1 \\ gd_{12}\, ed_2 + gd_{22}\, ed_2 \end{pmatrix} - \begin{pmatrix} g_{11}\, e_1 + g_{21}\, e_1 \\ g_{12}\, e_2 + g_{22}\, e_2 \end{pmatrix} \quad \text{(a1-22b)}$$

(Note: IOS is short for indirect outflow of spillovers, IG for imported goods, and ED for external demand.)

By comparing the difference between spillovers induced by external demand and outflow of spillovers caused by imports we can find the degree of self-sufficiency in, and balance of, spillovers.

• **DSS in spillovers (C):** $$\begin{pmatrix} ss_1^k \\ ss_2^k \end{pmatrix} = \left[\begin{pmatrix} ed_1 \\ ed_2 \end{pmatrix} + \begin{pmatrix} ge_1^k \\ ge_2^k \end{pmatrix} \right] - \left[\begin{pmatrix} fm_1 \\ fm_2 \end{pmatrix} + \begin{pmatrix} gfm_1^k \\ gfm_2^k \end{pmatrix} \right] \quad \text{(a1-23)}$$

• **Balance of spillovers (C):** $$\begin{pmatrix} bn_1^k \\ bn_2^k \end{pmatrix} = \left[\begin{pmatrix} ed_1 \\ ed_2 \end{pmatrix} + \begin{pmatrix} ge_1^k \\ ge_2^k \end{pmatrix} \right] - \left[\begin{pmatrix} fm_1 \\ fm_2 \end{pmatrix} + \begin{pmatrix} gfm_1^k \\ gfm_2^k \end{pmatrix} + \begin{pmatrix} em_1 \\ em_2 \end{pmatrix} + \begin{pmatrix} gem_1^k \\ gem_2^k \end{pmatrix} \right] \quad \text{(a1-24)}$$

(Note: DSS is short for degree of self efficiency.)

Graphical representation of spillovers caused by trade

In this paper, we create a graph that combines the graphical representation of balance of payments and the representation of a skyline chart using computations per formulas a1-17 to a1-23 and conduct an analysis. For the purpose of graphical representations, as is shown by SN 1-6 Table we divide each value of formulas a1-17 to a1-23 by the formula a1-16 and determine the ratio of each value to domestic demand.

Supplementary Note 1-6 Table

Data for graphical representation of spillovers caused by trade

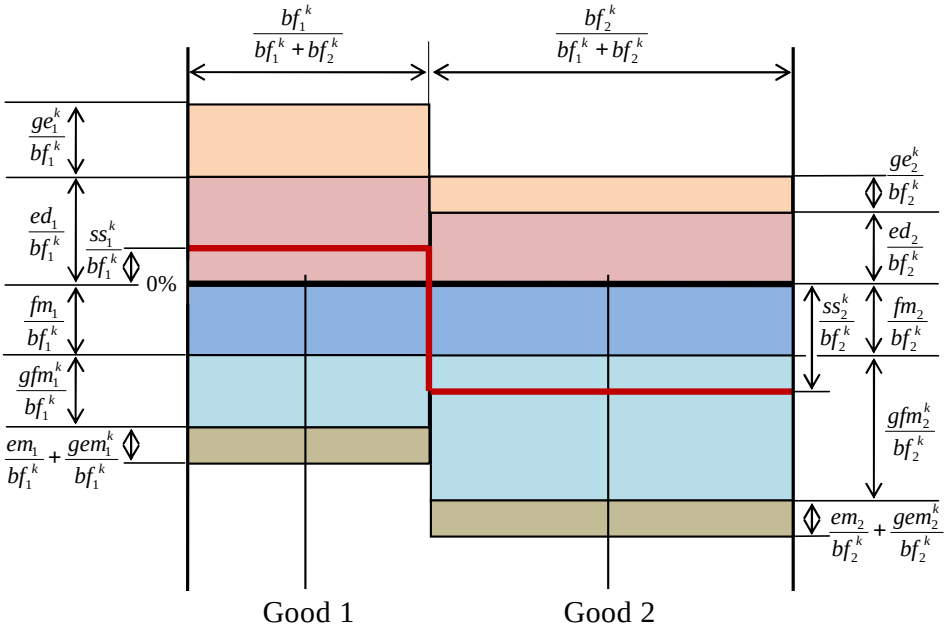
	Horizontal axis	Vertical axis					
	Ratio to domestic demand	Exports (induced)		Imports (outflow)			Degree of self sufficiency
		External demand		Domestic demand		External demand	
		Direct spillovers	Indirect spillovers	Direct outflow of spillovers	Indirect outflow of spillovers	Direct spillovers + Indirect spillovers	
		Induced by external demand	Induced by external demand	Caused by domestic demand	Caused by domestic demand	Caused by external demand	
Good 1	$\frac{bf_1^k}{bf_1^k + bf_2^k}$	$\frac{ed_1}{bf_1^k}$	$\frac{ge_1^k}{bf_1^k}$	$\frac{fm_1}{bf_1^k}$	$\frac{gfm_1^k}{bf_1^k}$	$\frac{em_1}{bf_1^k} + \frac{gem_1^k}{bf_1^k}$	$\frac{ss_1^k}{bf_1^k}$
Good 2	$\frac{bf_2^k}{bf_1^k + bf_2^k}$	$\frac{ed_2}{bf_2^k}$	$\frac{ge_2^k}{bf_2^k}$	$\frac{fm_2}{bf_2^k}$	$\frac{gfm_2^k}{bf_2^k}$	$\frac{em_2}{bf_2^k} + \frac{gem_2^k}{bf_2^k}$	$\frac{ss_2^k}{bf_2^k}$

Data compiled by the Ministry of Economy, Trade and Industry.

SN 1-7 Figure is a graphical representation of the values in SN 1-6 Table. The total of the values given in SN 1-7 Figure is the same as the value given in SN 1-4 Figure as an example of a skyline chart.

Supplementary Note 1-7 Figure

How to graphically represent spillovers caused by trade



Data compiled by the Ministry of Economy, Trade and Industry.

As is shown in SN 1-7 Figure, the graph of spillovers caused by trade cannot show spillovers induced domestically by domestic demand as is shown in a skyline chart, but it can divide spillovers

induced domestically by external demand and the outflow of spillovers due to domestic demand and external demand into direct and indirect outflow shown in a separate manner. However, as DOS (direct outflow of spillovers) becomes zero in many I-O tables, we treat DOS and IOS (indirect outflow of spillovers) collectively as OS (outflow of spillovers.)

Supplementary Note 1-4. Computation of domestic content rate

The method for computing the domestic content rate for "production process" and for "total process" is different.

Because, while for the production process we make computations assuming that domestic goods have been consumed by the final demand sector (domestic demand or external demand), for the total process we incorporate in the computations the "competition" that has existed between domestic goods and imported goods for consumption by the final demand sector.

Supplementary Note 1-8 Table

Computation and alignment of "domestic content rate" for "production process"

		Consumption of final goods Good 1	Consumption of final goods Good 2
Direct spillovers			
Indirect spillovers	Production Sector 1	$\frac{gd_{11}}{g_{11}}$	$\frac{gd_{12}}{g_{12}}$
	Production Sector 2	$\frac{gd_{21}}{g_{21}}$	$\frac{gd_{22}}{g_{22}}$

Note: Blank spaces in the row of direct spillovers need to be filled in with what corresponds to the items and formulas written in Total Process.
Data compiled by the Ministry of Economy, Trade and Industry.

Supplementary Note 1-9 Table

Computation and alignment of "domestic content rate" for "total process"

		Consumption of final goods Good 1	Consumption of final goods Good 2
Direct spillovers	Consumption of final goods	$\frac{fd_1 + ed_1}{f_1 + e_1}$	$\frac{fd_2 + ed_2}{f_2 + e_2}$
Indirect spillovers	Production Sector 1	$\frac{gd_{11}}{g_{11}} \frac{fd_1 + ed_1}{f_1 + e_1}$	$\frac{gd_{12}}{g_{12}} \frac{fd_2 + ed_2}{f_2 + e_2}$
	Production Sector 2	$\frac{gd_{21}}{g_{21}} \frac{fd_1 + ed_1}{f_1 + e_1}$	$\frac{gd_{22}}{g_{22}} \frac{fd_2 + ed_2}{f_2 + e_2}$

Data compiled by the Ministry of Economy, Trade and Industry.

Supplementary Note 1-5. Input-output tables and sector consolidation used for analyses

For examining and understanding the structure of the Japanese economy it is preferable to use I-O tables prepared by the Ministry of Internal Affairs and Communications (MIC). In this paper, however, we decided to use principally the I-O table processed by OECD into the same sector classification (48 sectors) (relating to Japan, the United States, and Germany for 1995 and 2005), given that the principal purpose of this paper is comparing Japan with other countries. In addition, for reference values we used the values provided in the tables prepared by Eurostat (relating to EU27 for 2000), MIC (relating to Japan for 1980), and BEA (relating to the United States for 1972).

The I-O table prepared by OECD covers 48 sectors, but as the table fails to cover some of production sectors relating to certain countries or years, we made necessary adjustments to sectoral data so that all sectors should have zero output. We also took into consideration differences between

the Eurostat table's sector classification and that of the BEA table, and made adjustments to the two sector classifications so that they might be closer to our major 34-sector classification made in 2005. As a result, the consolidated table has 28 sectors.

Note here that the domestic content rate is apt to vary for the primary and secondary industries because imports are easy in any of the target countries, while the rate is high and little likely to vary for the tertiary industry. In view of such a phenomenon, for the purpose of indicating the domestic content rate, of the 28 sectors we consolidated "Sector 19. Commerce" through "Sector 28. Services for Individuals and Businesses" into "19. Service Industry."

Supplementary Note 1-10 Table

Input-output table sector consolidation

28 sectors	OECD (48 sectors)
1. Agriculture, forestry and fisheries	1 Agriculture, hunting, forestry and fishing
2. Mining	2 Mining and quarrying (energy)
	3 Mining and quarrying (non-energy)
3. Food and beverages	4 Food products, beverages and tobacco
4. Textile products	5 Textiles, textile products, leather and footwear
5. Pulp, paper and wood products	6 Wood and products of wood and cork
	7 Pulp, paper, paper products, printing and publishing
6. Chemical products	9 Chemicals excluding pharmaceuticals
	10 Pharmaceuticals
7. Petroleum and coal products	8 Coke, refined petroleum products and nuclear fuel
8. Ceramic and cement products	12 Other non-metallic mineral products
9. Iron and nonferrous metal products	13 Iron & steel
	14 Non-ferrous metals
10. Metal products	15 Fabricated metal products, except machinery & equipment
11. General machinery	16 Machinery & equipment, nec
12. Electrical machinery	17 Office, accounting & computing machinery
13. Information and communication equipment	18 Electrical machinery & apparatus, nec
	19 Radio, television & communication equipment
14. Transportation machinery	21 Motor vehicles, trailers & semi-trailers
	22 Building & repairing of ships & boats
	23 Aircraft & spacecraft
	24 Railroad equipment & transport equip nec.
15. Precision machinery	20 Medical, precision & optical instruments
16. Other manufacturing industrial products	11 Rubber & plastics products
	25 Manufacturing nec; recycling (include Furniture)
17. Construction	30 Construction
18. Electricity, gas, heat, water supply and waste	26 Production, collection and distribution of electricity
	27 Manufacture of gas; distribution of gaseous fuels through mains
	28 Steam and hot water supply
	29 Collection, purification and distribution of water
19. Commerce	31 Wholesale & retail trade; repairs
	32 Hotels & restaurants
20. Finance and insurance	38 Finance & insurance
21. Real estate	39 Real estate activities
22. Transportation	33 Land transport; transport via pipelines
	34 Water transport
	35 Air transport
	36 Supporting and auxiliary transport activities; activities of travel agencies
23. Information and communication	37 Post & telecommunications
24. Public administration	44 Public admin. & defence; compulsory social security
25. Education and research	45 Education
26. Health and social work	46 Health & social work
27. Other public services	47 Other community, social & personal services
28. Services for individuals and businesses	40 Renting of machinery & equipment
	41 Computer & related activities
	42 Research & development
	43 Other Business Activities
	48 Private households with employed persons & extra-territorial organisations & bodies

Data compiled by the Ministry of Economy, Trade and Industry.

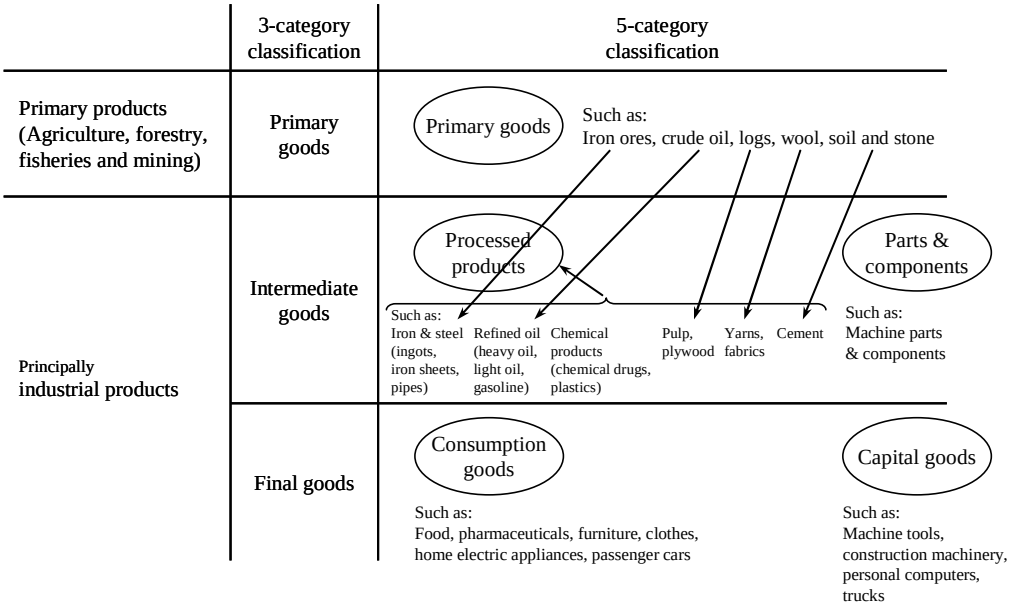
Supplementary Note 2. Item-wise image of trade goods classification by production process

In analyses of international division of production we classify trade goods by production process for purposes of consideration and examination. For specific classified data we utilized database RIETI-TID2011 compiled by the Research Institute of Economy, Trade and Industry (see SN 3 RIETI-TID2011).

Here we give specific samples of items to give a clear image of each good.

Supplementary Note 2-1 Table

Classification of trade goods by production process



Data compiled by the Ministry of Economy, Trade and Industry.

Supplementary Note 3. Explanations about RIETI-TID2011

In this paper, for the purpose of classifying trade data as classified in accordance with United Nations SITC (Rev. 3) into primary goods, intermediate goods and final goods for each major industry and showing amounts of trade between countries and regions in chronological order, we used RIETI-TID2011 compiled by the Research Institute of Economy, Trade and Industry (RIETI) and analyzed the trade structure prevalent in the world and East Asia. In this section, we explain about the basic concept and method of the RIETI-TID2011 classification.

(Visit RIETI website at http://www.rieti.go.jp/jp/projects/rieti-tid/index.html.)

1. Basic concept

In RIETI-TID2011, from the viewpoint of grasping activities of manufacturing industries in East Asia from trade trends, we focused our attention on industries actively engaged in trade transactions in the region, classified all trade goods in accordance with the Major Consolidated Division adopted in the input-output table of Japan, and thereby prepared a trade industry classification table that further organized trade goods by industry and by production process (SN 3-2 Figure). By so doing, we make an analysis of the structure of triangular trade that reflects progress in production fragmentation (division of production processes among different countries) by industry, and thereby show dynamic changes in competition, complementary relationships and other matters that exist among and between target countries.

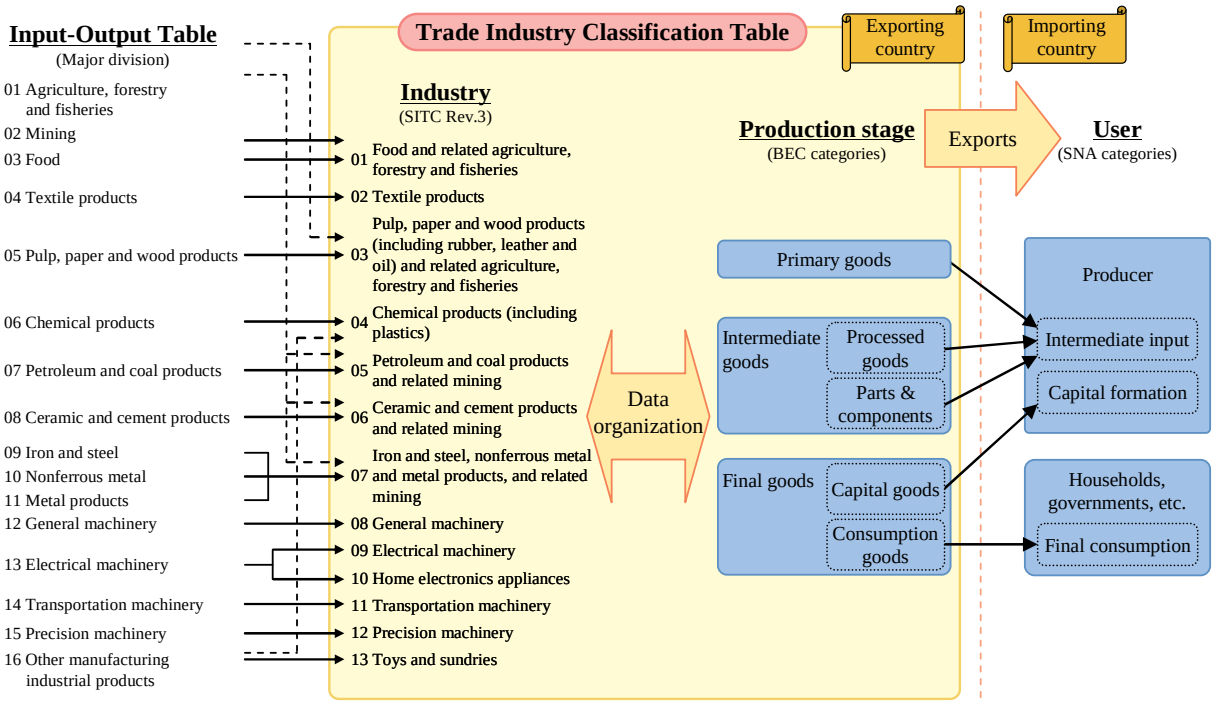
Supplementary Note 3-1Table

Outline of trade database RIETI-TID2011

Target country/region	[Asia]	Japan, China, Hong Kong, Taiwan, South Korea, Singapore, Thailand, Malaysia, Indonesia, Philippines, Vietnam, Brunei, Cambodia, India
	[North America]	U.S., Canada, Mexico
	[Europe]	United Kingdom, Germany, France, Italy, Spain, Netherlands, Austria, Belgium, Greece, Luxemburg, Finland, Sweden, Ireland, Portugal, Denmark, Poland, Czech, Slovakia, Hungary, Lithuania, Latvia, Slovenia, Estonia, Cyprus, Malta, Romania, Bulgaria, Russia, Turkey, Norway
	[South America]	Argentina, Brazil, Paraguay, Uruguay, Chile, Venezuela, Colombia, Ecuador, Peru, Bolivia
	[Oceania]	Australia, New Zealand
Target year	1980 through 2010 (data are unavailable on some countries for certain years).	
Contents of the database	Value of imports and exports made by each country/region is arranged and organized by partner country (including trade groups and total world trade), by industry (13 categories), by production process (5 stages), and by year.	
Notes	• The database is prepared basically on the basis of CIF import prices (including cost, insurance and freight). • Imports by target countries from Taiwan are converted into a CIF import price basis by multiplying Taiwan's export price by 1.1. • The sum of trade made by countries/regions other than the target countries is expressed as RoW (Rest of the World). • Total world trade is the sum of trade made by target countries (including Taiwan) and by Row. • Because of limited data availability the Czech Republic and Slovakia are treated as one country in the same manner as are Belgium and Luxemburg. • The value of trade made by each target country is expressed in the U.S. dollar at the nominal rate of exchange between the country's currency and the U.S. dollar. (The rate of exchange rate between each country's currency and the U.S. dollar for each year can be checked on the UN Comtrade website at http://comtrade.un.org/db/mr/daExpNotebyRebYear.aspx)	

Supplementary Note 3-2 Figure

Structure of trade industry classification



2. Industry classification

We organized industries into 13 industries (SN 3-3 Table) on the basis of the classification of manufacturing industries that include agriculture, forestry, fisheries and mining under the Consolidated Major Division (consisting of 32 sectors) adopted in Japan's input-output table. We made the following adjustments to the classification in order to efficiently reflect progress achieved in production fragmentation in East Asia.

(1) Of all different production processes, "agriculture, forestry and fisheries" and "mining" that are engaged in the production of raw materials and primary materials are not classified as independent industries as they are in the input-output table, and are organized as upstream industries of related manufacturing industries. Specifically, "food" and "pulp and paper" are classified including "goods related to agriculture, forestry and fisheries"; "chemical products," "petroleum and coal products," "ceramic and cement products" and "iron, steel, nonferrous metal and metal products" are classified including "mining industry-related products."

(2) Nonferrous metal and metal products are classified under one industry because these products can be considered to have similar production processes. Further, iron and steel products are also classified under the same industry because these products are classified only as processed products in BEC's classification based on their production process.

(3) Electrical machinery is organized into electrical machinery and home electric appliances in consideration of production fragmentation underway in East Asia.

(4) Other manufactured industrial goods are organized as sundries and toys. Plastic products, which are included in "other manufacturing industry" in the classification of the input-output table, are included in chemical products, not in sundries and toys, in view of their production

process.

Supplementary Note 3-3 Table

Trade industry classification

Production stage		Primary goods	Intermediate goods		Final goods	
			Processed goods	Parts & components	Capital goods	Consumption goods
Industry		1	2	3	4	5
1	Food and related agriculture, forestry and fisheries	◎	◎		◎	◎
2	Textile products	◎	◎	◎		◎
3	Pulp, paper and wood products (including rubber, leather and oil), and related agriculture, forestry and fisheries)	◎	◎	◎		◎
4	Chemical products (including plastics)	◎	◎			◎
5	Petroleum and coal products, and related mining	◎	◎			
6	Ceramic and cement products, and related mining	◎	◎			◎
7	Iron and steel, nonferrous metal and metal products, and related mining	◎	◎	◎	◎	◎
8	General machinery		◎	◎	◎	◎
9	Electrical machinery		◎	◎	◎	
10	Home electronics appliances		◎	◎	◎	◎
11	Transportation machinery	◎		◎	◎	◎
12	Precision machinery		◎	◎	◎	◎
13	Toys and sundries		◎	◎	◎	◎

3. Classification of industries by production stage

We further classified the industries organized into 13 fields into three categories (five subcategories): namely, primary goods, intermediate goods (processed products, parts & components), and final goods (capital goods, consumption goods) (SN 3-4 Table).[1] We grouped each industry's trade data into three categories on the basis of trade goods' characters in the production process using the United Nations BEC (Broad Economic Categories) Classification, and then classified the grouped trade data in accordance with the SNA (System of National Account) criteria.[2]

1 For the classification by production stage, refer to F. Lemoine et al., (2004), "China's Integration in Asian Production Networks and Its Implications."

2 BEC Classification corresponds to the 1968 SNA classification based on the use of basic products (Intermediate consumption, Final consumption and Gross capital formation).

Supplementary Note 3-4 Table

Trade goods classification by production process

Category	Sub-category	BEC code	BEC Title
Primary goods		111	Food and beverages, primary, mainly for industry
		21	Industrial supplies, n.e.s., primary
		31	Fuels and lubricants, primary
Intermediate goods	Processed goods	121	Food and beverages, processed, mainly for industry
		22	Industrial supplies, n.e.s., processed
		32	Fuels and lubricants, processed
	Parts & components	42	Parts and accessories of capital goods, except transport equipment
		53	Parts and accessories of transport equipment
Final goods	Capital goods	41	Capital goods, except transport equipment
		521	Other industrial transport equipment
	Consumption goods	112	Food and beverages, primary, mainly for household consumption
		122	Food and beverages, processed, mainly for household consumption
		51	Passenger motor cars
		522	Other non-industrial transport equipment
		61	Durable consumer goods n.e.s.
		62	Semi-durable consumer goods n.e.s.
		63	Non-durable consumer goods n.e.s.

Notes: 1. This classification table categorizes BEC-classified trade goods by production process stage pursuant to the SNA (System of National Account) classification criteria (refer to CEPII research results). As SNA classifies trade goods by user (producers and households), capital goods (capital formation) and final goods (final consumption) fall under different items; however, in this paper we treat capital goods as part of final goods because our idea is to organize and categorize trade goods by production process stage.

2. Under BEC code 32, 321-motor spirits may be divided into "use for household consumption" and "use for other industrial transport equipment"; however, in this paper we do not divide the item in such a manner.

4. Data used

RIETI-TID2011 uses SITC data provided by United Nations COMTRADE.[3] While the SITC classification is likely to be rougher than the HS classification, the SITC classification is characteristic in that it reflects raw materials, manufacturing stages, use of commodities, technological progress and other things,[4] and therefore is more preferable in having production fragmentation reflected.

5. Definition of regions

The following are the regions and their definitions searchable on websites relating to exporting countries and importing countries.

3 HS uses a 6-digit classification while the most detailed level of the SITC classification is 5 digits.

4 The UN website explains the characteristics of the SITC classification as follows: "The commodity groupings of SITC reflect (a) the materials used in production, (b) the processing stage, (c) market practices and uses of the products, (d) the importance of the commodities in terms of world trade, and (e) technological changes." The UN website also gives the following explanation about the characteristics of the HS classification: "The HS contributes to the harmonization of Customs and trade procedures, and the non-documentary trade data interchange in connection with such procedures, thus reducing the costs related to international trade." (World Customs Organization) "In the Harmonized System goods are classified by what they are, and not according to their stage of fabrication, their use, or origin. The Harmonized System nomenclature is logically structured by economic activity or component material." (University of British Columbia)

Supplementary Note 3-5 Table

Definitions of regions referred to in the present database

Region	Country
EAST ASIA	Japan, China, Hong Kong, South Korea, Taiwan, Singapore, Indonesia, Malaysia, Philippine, Thailand, Brunei, Cambodia, Vietnam
NAFTA	U.S., Canada, Mexico
MERCOSUR	Argentina, Brazil, Paraguay, Uruguay, Venezuela
EU15	United Kingdom, France, Germany, Italy, Austria, Belgium•Luxembourg, Denmark, Finland, Greece, Ireland, Holland, Portugal, Spain, Sweden
EU27	United Kingdom, France, Germany, Italy, Austria, Belgium•Luxembourg, Denmark, Finland, Greece, Ireland, Holland, Portugal, Spain, Sweden, Bulgaria, Cyprus, Czech•Slovakia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovenia
ASEAN4	Indonesia, Malaysia, Philippine, Thailand
ASEAN	Indonesia, Malaysia, Philippine, Singapore, Thailand, Brunei, Cambodia, Vietnam
ASEAN + 6	Australia, China, India, Indonesia, Japan, Malaysia, Philippine, South Korea, Singapore, Thailand, Brunei, Cambodia, New Zealand, Vietnam

Notes: 1. “Not ASEAN” or “Not EU” denotes countries other than those indicated above.
If you select Exporter “East Asia” and Importer “Japan,” the value of trade between countries of East Asia other than Japan and Japan will be displayed.
2. Data of imports made by Uruguay and Vietnam in 2010 have not been published and therefore are not reflected.