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Keywords: Triangulation, Linked Input-Output Tables, Linear Ordering Problem, Productivity Growth

JEL classification: D24, D57, D58

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Productivity Growth and the Structure of Production

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Abstract

In this study, interactions between potential hierarchical value chains existing in the production structure and industry-wise productivity growths are sought. We applied generalized Chenery–Watanabe heuristics for matrix linearity maximization to triangulate the input–output incidence matrix for both Japan and the Republic of Korea, finding the potential directed flow of values spanning the industrial sectors of the basic (disaggregated) industry classifications for both countries. Sector specific productivity growths were measured by way of the Trönquvist index, using the 2000–2005 linked input–output tables for both Japan and Korea.

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1. Introduction

The structure of production, as defined by the input–output table, is the result of the interaction of a variety of forces that are prevalent in an economy. While there are variations in the relative scarcity of factors of production and differences in levels of income and final demand, we may expect similarity in the structure of production, to the extent that production is based on the same body of technological knowledge and constrained by the same physical laws. The structure of production has been investigated as to whether there is a significant relation between the degree of development and the hierarchy of industrial value chains, based on the triangulation of input–output tables. The pioneering study by Chenery and Watanabe (1958) indicated that the production structures of more developed countries are similar to certain extent. Simpson and Tsukui (1965) have argued the existence of a fundamental structure of production common to modern economic systems. In the same vein, Korte and Oberhofer (1971), Lamel et al. (1972), Song (1977), Fukui (1986), Östblom (1993), Kondo (2014) are also concerned with the similarities and stabilities of the structure of production in different economies.

The analysis of the industrial hierarchy leading from primary to final commodities forms a basis for comparison of economy-wide production structures. Such an inter-industrial value chain of activities is studied by triangulating input–output transactions. An input–output table records the flow of outputs from each industrial sector into each factor input of sectors as a factor-by-industry matrix. One may find an appropriate order for factor inputs and industry outputs that herds the entries into the upper-diagonal. If the inter-industrial transaction of industrial activities were

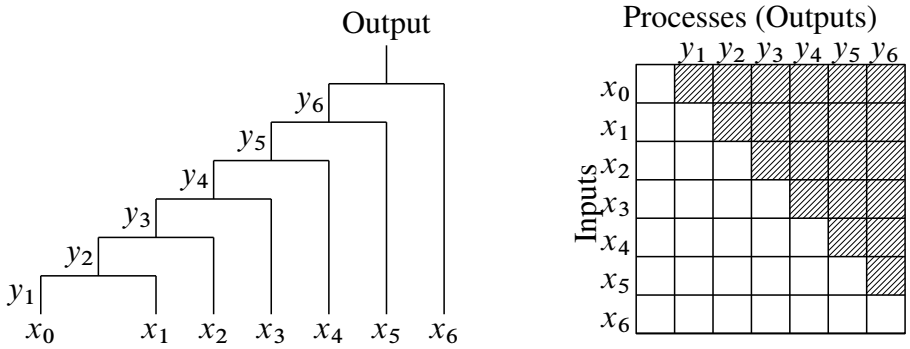

Figure 1: Production structure and the input–output configuration

perfectly hierarchical, such as that shown in Figure 1 (left), the input–output table can be established as an upper-diagonal matrix, such as that shown in Figure 1 (right). If, on the other hand, there are circular flows of commodities, we will not be able to observe such a perfect triangular system of production.

The degree to which an economic structure agrees with a triangular hierarchy of the industries is called *linearity*. Linearity of a matrix is the ratio of the sum of the elements above the diagonal to the sum of all elements except the diagonal. Naturally, the linearity of a perfectly triangular matrix is unity. Hence, the input–output table triangulation problem is to find the hierarchical order (sequence) of industries (and the corresponding commodities) that maximizes the linearity of the input–output table. This is also known as the linear ordering problem. Previous researchers have observed that large and highly developed economies tend to have a low degree of linearity whereas underdeveloped economies tend to exhibit a clearer linearity. According to Leontief (1986) typical linearity is around 70% for a developed economy and 90% for an underdeveloped economy.

A linear ordering problem is usually associated with an immense feasible region, as the ordering involves permutations. Such a combinatorial optimization problem is known to be NP-hard; one has to assess the linearity of $n!$ permutations of n industries which can get quite large. Naturally, exact methodologies using ring shift permutation (Haltia, 1992; Östblom, 1993) or mixed integer programming (Kondo, 2014) for solving linear ordering problems have limitations in terms of the dimension of the matrix that can be handled. On the other hand, heuristic methods (such as tabu search, simulated annealing, genetic algorithms, evolution strategies, etc.) have shown to be able to efficiently find quality solutions in many combinatorial problems. One of the earliest efficient heuristics for the linear ordering problem was the one proposed by Chenery and Watanabe (1958). This heuristic method orders the industrial sector in a hierarchy according to the ratio of total factor inputs to the total intermediate output. Due to its simplicity, this method is applicable to large-scale linear ordering problems.

In this project, as we are concerned with triangulating input–output tables of the order of 400 industrial sectors, we naturally take the heuristic approach. More specifically, we generalize the heuristic method of hierarchical ordering of Chenery and Watanabe (1958) by differentiating the assessment of industry-wise ratios of total inputs and outputs. Our empirical study will be focused on a production structure comparison between Korea and Japan. Moreover, we will be comparing the triangulated ordering of the industrial sectors along with the total factor productivity growth, in

terms of the sector-wise Trönqvist indexes, for the two countries. In so doing, we use the 2000–2005 linked input–output tables for both Japan (MIAC, 2011) and Korea (BOK, 2015). The dimensions of these tables are 395 and 350 sector-by-commodity transactions for Japan and Korea, respectively. These linked input–output tables include factor-wise deflators (price indices) for input factors. For primary factors, i.e., labor and capital, the quality adjusted deflators were compiled by JIP (2015) for Japan and KIP (2015) for Korea.

The remainder of this paper is organized as follows. In the next section, we introduce the basics of matrix triangulation and productivity growth estimation using linked input–output transaction tables. In Section 3, we apply the protocol introduced in the previous section using the data observed for 2000–2005 in Japan and Korea, and discuss the observed correlations between the hierarchical order of sectors and the sector-wise productivity changes. Section 4 provides concluding remarks.

2. The Analytical Framework

2.1. Production Structure

The analysis of the hierarchy of sectors from the primary factor leading to final outputs forms a basis for the analysis of macroscopic production structures. Triangulation of the input–output transaction matrix is a standard method of arranging sectors into hierarchical order, such as processing sequences of intermediate commodities from upstream to downstream. The circular interdependences present in the macroscopic production, however, do not allow one to observe a perfect triangular structure of production as illustrated in Figure 1. The degree to which a macroscopic production structure agrees with a hierarchical order of processing sequences is called linearity.

In a perfectly linear structure, the processing sequences will cascade from upstream to downstream sectors but never the opposite; and in that case, we may arrange the rows and columns of the input–output matrix according to the hierarchical order to obtain an upper-triangular matrix (with all entries at and below the diagonal being zero). More specifically, for an n-sector output system with $n-1$ intermediate inputs (excluding self-input), the most upstream sector has no intermediate input with $n-1$ output destinations (i.e., zero column and $n-1$ row entries) whereas the most downstream sector has $n-1$ inputs with no intermediate output destination (i.e., $n-1$ column and zero row entries).[1]

Let us denote an order of n industrial sectors, whose initial order is $(1, 2, \cdots, n)$, by a permutation mapping $\pi : (\pi(1), \pi(2), \cdots, \pi(n))$. Further, we let $k(\pi) = \{k' \mid k = \pi(k')\}$, so that we may write a π permuted version of a matrix $\mathbf{M} = \{m_{ij}\}$ as

$$\mathbf{M}(\pi) = \{m(\pi)_{ij}\} = \{m_{i(\pi)j(\pi)}\}$$

For later discussion let us work on a discretized square input–output matrix $\mathbf{M}$, where we call it an input–output incidence matrix, whose element is binary i.e., $m_{ij} = 1$ if transaction $x_{ij} \neq 0$, and

[1] Note that, the primary input (the 0th input), which is essential in all production but is not produced by any of the n sectors, will be placed at the ultimate upstream position.

$m_{ij} = 0$ if $x_{ij} = 0$. The linearity ℓ of $\mathbf{M}$ under permutation π is defined as follows:

$$\ell = \frac{\sum_{i<j} m\left(\pi\right)_{ij}}{\sum_{i \neq j} m\left(\pi\right)_{ij}} = \frac{h\left(\mathbf{M}\left(\pi\right)\right)}{K}$$

Note that the denominator K, is a constant representing the sum of all the entries in the matrix, except for the diagonal entries. The numerator $h\left(\mathbf{M}\left(\pi\right)\right)$, on the other hand, is dependent on the permutation.

The triangulation problem of a matrix $\mathbf{M}$ is to find a permutation mapping that maximizes the linearity, that is to

$$\max_{\pi \in \Pi} \ell = h\left(\mathbf{M}\left(\pi\right)\right) / K$$

where, Π is the set of all possible permutations. This problem is also known as the linear ordering problem (see, e.g., Chaovalitwongse et al., 2011). Note that, for an $n \times n$ matrix, the number of possible permutations would be as large as $n!$. This can get quite large, and the problem is known to be NP-hard. Presumably, none of the exact methods (typically, by way of discrete optimization) will work when one attempts to handle a matrix of 395 sectors, as 395! is a huge number. Thus, we take a heuristic approach.

For that matter one may use the ratio of the input incidences total (column sum of $\mathbf{M}$) to the output incidences total (row sum of $\mathbf{M}$), which we denote by r_1 and arrange the permutation in the descending order of this ratio. [2] More specifically the ratio is defined as follows:

$$\ln r_1(k) = \ln \sum_{j=1}^{n} m_{kj} - \ln \sum_{i=1}^{n} m_{ik} \qquad k = 1, 2, \cdots, n$$

This heuristic method is a simple example of the approach proposed by Chenery and Watanabe (1958), except that the original study uses the input–output coefficient matrix. Note that in this case the set of possible permutations contains only one element, which we denote by π_1; that is, $\Pi = \{\pi_1\}$. In other words, permutation $\pi_1 : (\pi_1(1), \pi_1(2), \cdots, \pi_1(n))$ is the descending order of the above mentioned ratios $r_1 : (r_1(1), r_1(2), \cdots, r_1(n))$, or, $r_1(1(\pi_1)) \geq r_1(2(\pi_1)) \geq \cdots \geq r_1(n(\pi_1))$.

In this study we slightly generalize this Chenery–Watanabe heuristic approach. In particular, we take the *weighted* ratio of the input incidences total to the output incidences total, as described below, in order to expand the number of possible permutations Π.

$$\ln r_\gamma(k) = \ln \sum_{j=1}^{n} m_{kj} - \gamma \ln \sum_{i=1}^{n} m_{ik} \qquad k = 1, 2, \cdots, n$$

Obviously, this ratio includes the Chenery–Watanabe case by setting $\gamma = 1$. Accordingly, we evaluate the linearity of $\mathbf{M}$ with a permutation $\pi_\gamma : \left(\pi_\gamma(1), \pi_\gamma(2), \cdots, \pi_\gamma(n)\right)$ with respect to the

[2] In other words, sector k with large $r_1(k)$ is placed upstream of sectors with a smaller value.

descending order of the ratios $r_\gamma : \left(r_\gamma(1), r_\gamma(2), \cdots, r_\gamma(n)\right)$, such that $r_\gamma(1(\pi_\gamma)) \geq r_\gamma(2(\pi_\gamma)) \geq \cdots \geq r_\gamma(n(\pi_\gamma))$ for any $\gamma \in \Gamma$, where Γ is a set of allowable values for the weighting γ. Note that, γ must be nonnegative, according to the purpose of triangulation of matrix $\mathbf{M}$. Obviously enough, $\gamma \in [0, 1)$ if we are to put more weight on the outputs, and $\gamma \in (1, \infty)$ if we are to put more weight on the inputs. Our objective would hence be to search for the policy on γ that maximizes the linearity, that is to

$$\max_{\gamma \in \Gamma} \ell = h\left(\mathbf{M}\left(\pi_\gamma\right)\right) / K \tag{1}$$

Hereafter we call the order π_{γ^*} that maximizes the ℓ of (1) the flow order.

2.2. Productivity Growth

Below we describe the production function of an industrial sector. (Note that we omit the industrial sector-wise index j.)

$$y = zF\left(x_0, x_1, \cdots, x_n\right) \tag{2}$$

where, y is the output of production, x_i is the ith factor input, and z is the (total factor) productivity or the TFP. TFP represents the level of technology of the industry. The main production function F is assumed to be homogeneous of degree one (or, constant returns to scale) reflecting perfect competition among the many firms within the industry.

By taking logarithms and time derivatives we obtain

$$\frac{\dot{y}}{y} = \frac{\dot{z}}{z} + \left(\frac{\partial F}{\partial x_0}\frac{x_0}{F}\right)\frac{\dot{x_0}}{x_0} + \left(\frac{\partial F}{\partial x_1}\frac{x_1}{F}\right)\frac{\dot{x_1}}{x_1} + \cdots + \left(\frac{\partial F}{\partial x_n}\frac{x_n}{F}\right)\frac{\dot{x_n}}{x_n} \tag{3}$$

As we assume perfect competition, the marginal rate of technical substitution (MRTS) must equal the price ratio: that is,

$$\text{MRTS} = \frac{\partial zF}{\partial x_i} = \frac{w_i}{c} \tag{4}$$

Note that w_i and c denote the ith factor price and the unit output cost which equals the price, respectively. Using (4) we can show that the parts of (3) in parentheses equal the cost share, which we denote by a_i:

$$\frac{\partial F}{\partial x_i}\frac{x_i}{F} = \frac{\partial zF}{\partial x_i}\frac{x_i}{zF} = \frac{w_i}{c}\frac{x_i}{y} = a_i \tag{5}$$

Alternatively, we may work on the following unit cost function that is compatible with the production function (2):

$$c = z^{-1}H\left(w_0, w_1, \cdots, w_n\right) \tag{6}$$

By taking logarithms and time derivatives we obtain

$$\frac{\dot{c}}{c} = -\frac{\dot{z}}{z} + \left(\frac{\partial H}{\partial w_0}\frac{w_0}{H}\right)\frac{\dot{w_0}}{w_0} + \left(\frac{\partial H}{\partial w_1}\frac{w_1}{H}\right)\frac{\dot{w_1}}{w_1} + \cdots + \left(\frac{\partial H}{\partial w_n}\frac{w_n}{H}\right)\frac{\dot{w_n}}{w_n} \tag{7}$$

As we assume perfect competition we apply Shepherd's Lemma to (6) then we have

$$\frac{\partial z^{-1}H}{\partial w_i} = \frac{x_i}{y} \tag{8}$$

Using (8) we can show that the parts of (7) in parentheses equal the cost share:

$$\frac{\partial H}{\partial w_i}\frac{w_i}{H} = \frac{\partial z^{-1}H}{\partial w_i}\frac{w_i}{z^{-1}H} = \frac{x_i}{y}\frac{w_i}{c} = a_i \tag{9}$$

Now, the productivity growth, i.e., $\Delta \ln z$ where Δ indicates the difference between the two periods, can be found by integrating (3) or (7) over two periods $t = 0, 1$:

$$\Delta \ln z = \int_0^1 \mathrm{d}\ln z = \int_0^1 \mathrm{d}\ln y - \sum_{i=0}^{n}\int_0^1 a_i \mathrm{d}\ln x_i = -\int_0^1 \mathrm{d}\ln c + \sum_{i=0}^{n}\int_0^1 a_i \mathrm{d}\ln w_i$$

Note, however, that the integrations can be evaluated only if we know the time trajectory of a_i. Nonetheless, if we can approximate the time variate a_i with a constant such as

$$a_i = \frac{a_i^0 + a_i^1}{2}$$

where the superscripts indicate the equilibrium states (0 for reference, 1 for current states), the productivity growth can be evaluated by

$$\Delta \ln z = \Delta \ln y - \sum_{i=0}^{n}\frac{a_i^0 + a_i^1}{2}\Delta \ln x_i = -\Delta \ln c + \sum_{i=0}^{n}\frac{a_i^0 + a_i^1}{2}\Delta \ln w_i \tag{10}$$

The measurement of the relative productivity change, i.e., $\exp(\Delta \ln z) = z^1/z^0$, via (10) is known as the Törnqvist index. Diewert (1976) showed its exactness in measuring the productivity growth of Translog functions. Thus, we know that (10) is equal to the productivity growth of the underlying Translog function with or without knowledge of its parameters. Star and Hall (1976) showed that the Törnqvist index is a good approximation of productivity growth measurement irrespective of the type of aggregator function and the interval of observations. For practical purposes, we measure productivity growth in terms of the Törnqvist index, which we denote by TFPg, using the formula

$$\text{TFPg} = -\ln p + \sum_{i=0}^{n}\left(\frac{a_i^0 + a_i^1}{2}\right)\ln p_i \tag{11}$$

where, p_i denotes the current (factor) price relative to the reference state, or the deflator, such that

$$p_i = \exp(\Delta \ln w_i) = w_i^1 / w_i^0$$

3. Empirical Analysis

3.1. The Data

A set of linked input–output tables includes sectoral transactions in both nominal and real terms. The 1995–2000–2005 linked input–output tables for both Japan (MIAC, 2011) and Korea (BOK, 2015) include factor-wise deflators spanning the fiscal years recorded in the tables. A deflator is a price index that standardizes the nominal value of a commodity at the target state into a real value relative to the reference state. The above mentioned linked input–output tables include 395 factor-by-sector and 350 factor-by-sector transaction tables for Japan and Korea, respectively, along with the corresponding factor-wise deflators, for three five-year periods. These tables, however, do not include deflators for primary factors (i.e., labor and capital) and, therefore, we used the quality-adjusted price indexes compiled by JIP (2015) for Japan and by KIP (2015) for Korea in order to inflate the primary inputs observed in nominal values. In this study, we use input–output transactions for the year 2000 as the reference state and that of 2005 as the current state.

3.2. Results and Discussion

In Figures 2 and 3, we show the results of searches for an optimal γ for Japan and Korea, respectively, where we used the domain $\Gamma = [0, 3]$ in (1). The maximizing policy was $\gamma^* = 1.61$ for Japan, and $\gamma^* = 1.47$ for Korea, where the maximized linearities were $\ell(\gamma^*) = 0.83$ for Japan and $\ell(\gamma^*) = 0.74$ for Korea. Note that the linearities of the original sector classification order based on Colin Clark's three-sector theory were very close: $\ell(\text{original}) = 0.43$ for Japan and $\ell(\text{original}) = 0.43$ for Korea. Also note that the *densities* of the input–output incidence matrix, that is, $\sum_{ij} m_{ij}/n^2$, were 0.274 for Japan and 0.297 for Korea. Figures 4 and 5 show the triangulation of the input–output incidence matrix of the original order (left) to that of the triangulated flow order (right) for Japan and Korea, respectively.

The productivity growths (TFPg) obtained using (11) for all industrial sectors are summarized in Table 2 and 3 (Appendix) for Japan and Korea, respectively. Note that the industrial sectors are sorted by the flow order (upstream to downstream) according to the maximized linearity. In Figures 6 and 7 we display TFPg against the flow order of industrial sectors for Japan and Korea, respectively. The average TFPg, $\sum_j \text{TFPg}_j/n$, was -0.0052 for Japan and -0.0399 for Korea. The variances of TFPg, as is apparent from the figures, are different: the standard deviation for Japan was 0.115 whereas that for Korea was 0.204. Any correlation between TFPg and flow order was hardly observable, however.

Hence, we looked into the quadrant classification for industrial sectors, referring to Chenery and Watanabe (1958), using two dimensions, namely, the incidence sums of inputs and outputs. More specifically, we first classified the industrial sectors into two groups, according to the sector-wise number of outputs (row sum of the incidence matrix): the upper half (with many output incidences) is called *Manufacturing* whereas the lower half is called *Primary*. Next, we classified each group, (*Manufacturing* and *Primary*), into two groups, according to the sector-wise number

Table 1: Quadrant classification of Industrial Sectors

	Final Inputs with lower $\sum_j m_{ij}$	Intermediate Inputs with higher $\sum_j m_{ij}$
Manufacturing	III	II
	Final Manufacture	Intermediate Manufacture
Outputs with	Made from Many	Made from Many
higher $\sum_i m_{ij}$	Used by Few	Used by Many
	26% of all sectors (JPN)	24% of all sectors (JPN)
	20% of all sectors (KOR)	30% of all sectors (KOR)
	TFPg (average) $= -0.0062$ (JPN)	TFPg (average) $= -0.0197$ (JPN)
	TFPg (average) $= -0.0670$ (KOR)	TFPg (average) $= -0.0610$ (KOR)
Primary	IV	I
	Final Primary	Intermediate Primary
Outputs with	Made from Few	Made from Few
lower $\sum_i m_{ij}$	Used by Few	Used by Many
	24% of all sectors (JPN)	26% of all sectors (JPN)
	30% of all sectors (KOR)	20% of all sectors (KOR)
	TFPg (average) $= -0.0069$ (JPN)	TFPg (average) $= -0.0020$ (JPN)
	TFPg (average) $= -0.0150$ (KOR)	TFPg (average) $= -0.0200$ (KOR)

of inputs (column sum of the incidence matrix); the upper half (with many input incidences) is called *Intermediate* whereas the lower half is called *Final*. The quadrant classifications of sectors are hence called (I) *Intermediate Primary*, (II) *Intermediate Manufacture*, (III) *Final Manufacture*, and (VI) *Final Primary*. The quadrant classification is summarized in Table 1. Note that the upper stream sector corresponds to category I, the lower stream sector corresponds to category III.

In Japan 26% of all sectors (103 out of 395) were categorized as I and III, and 24% (95 out of 395) were categorized as II and IV. In Korea, 20% of all sectors (70 out of 350) were categorized as I and III, and 30% (105 out of 350) were categorized as II and IV. The average TFPg values for categories I, II, III, and IV, were -0.0020, -0.0197, -0.0062, -0.0069, respectively; in other words, sectors in category I (Intermediate Primary) had the largest productivity growth, and those in category II (Intermediate Manufacture) had the least productivity growth, whereas the sectors in the Final categories (III and IV) had moderate growth in Japan. In contrast, the average TFPg values for categories I, II, III, and IV, were -0.0200, -0.0610, -0.0670, -0.0150, respectively in Korea; in other words, sectors in the Primary categories (I and IV) gained more productivity than the sectors in the Manufacturing categories (II and III). Figures 8 and 9 illustrate TFPg with respect to the quadrant classification for the two countries. Also, in Tables 2 and 3 the column sum and the row sum of the input–output incidence matrix are displayed as "Column" and "Row", respectively. The corresponding segment Category is also attached.

4. Concluding Remarks

Indubitably, productive improvement in upstream industry, rather than in the downstream industry, has a greater impact on a highly integrated production economy. Thus, in this study, we looked into correlations between the hierarchical value chain that exists in the production structure, and industry-wise productivity growths. We applied generalized Chenery–Watanabe heuristics for matrix linearity maximization, in order to triangulate the input–output incidence matrix for both Japan and Korea, thus finding the directed flow of values of input–output transactions among the industrial sectors in both countries.

In this study we have found larger variance in productivity growth among industrial sectors for Korea than for Japan, while the productivity growths were, on average, much the same. As regards the directed flow of values, the correlations between productivity growths were rather equivocal. However, as we aggregate the hierarchical order of industrial sectors by way of quadrant classification, we have found that the Intermediate Primary (i.e., upstream) segment had improved more, in terms of productivity, relative to other segments, in both countries. On the other hand, rather counter-intuitively, the Intermediate Manufacture segment had less improvement in terms of productivity in both countries.

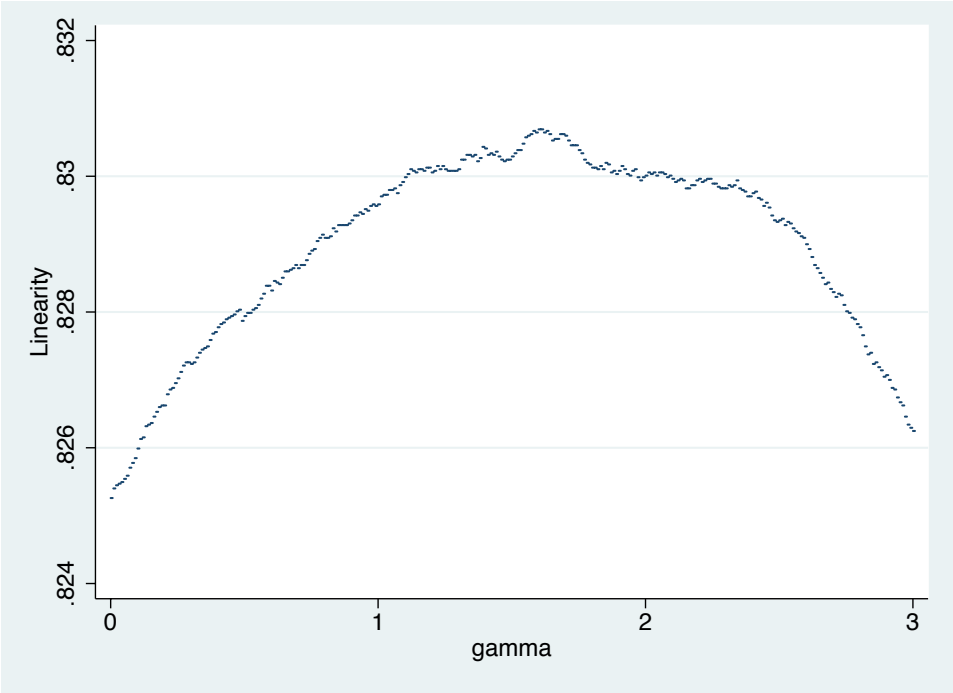

Figure 2: Linearity maximization (Japan 2000–2005)

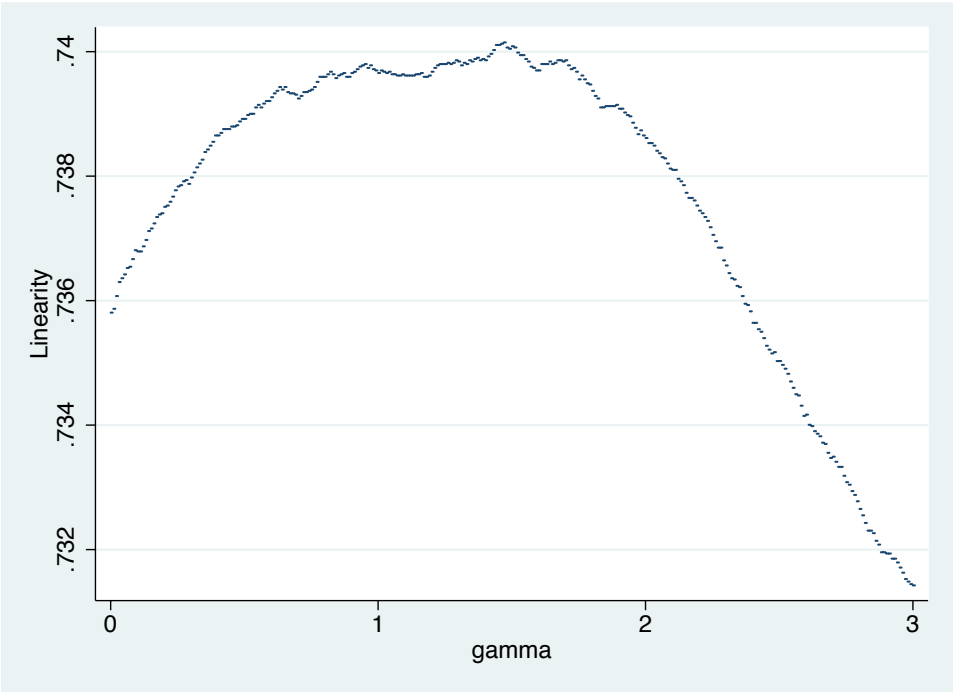

Figure 3: Linearity maximization (Korea 2000–2005)

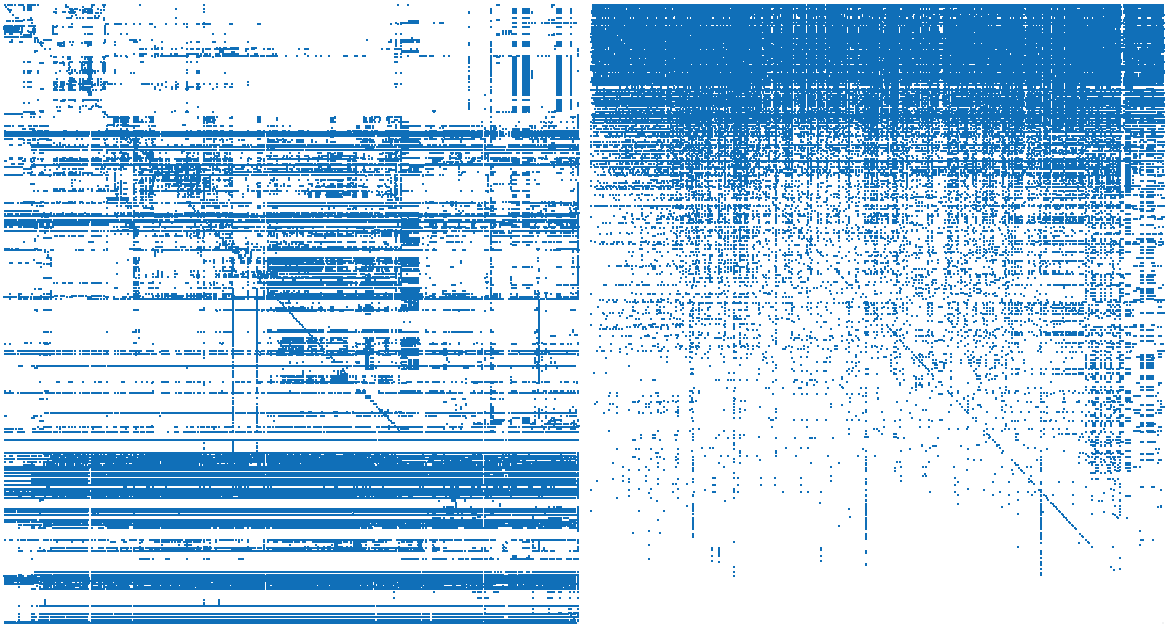

Figure 4: Original and triangulated input–output incidence matrices for 2000–2005 Japan (395 sectors).

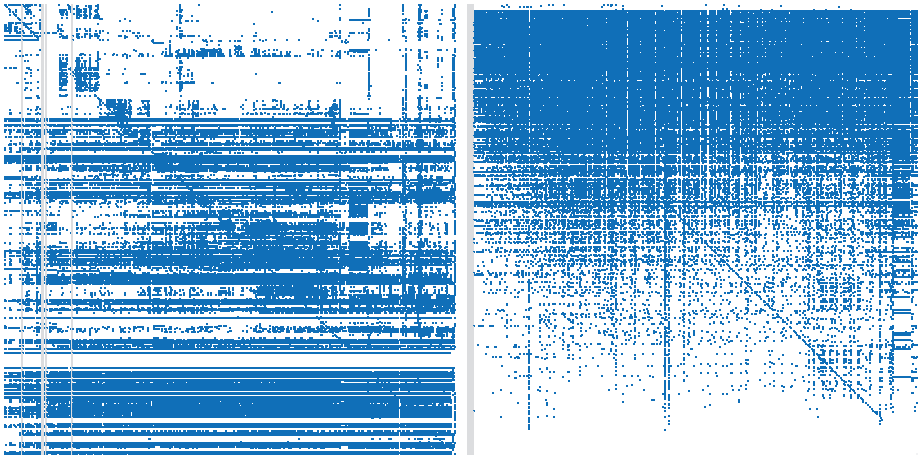

Figure 5: Original and triangulated input–output incidence matrices for 2000–2005 Korea (350 sectors).

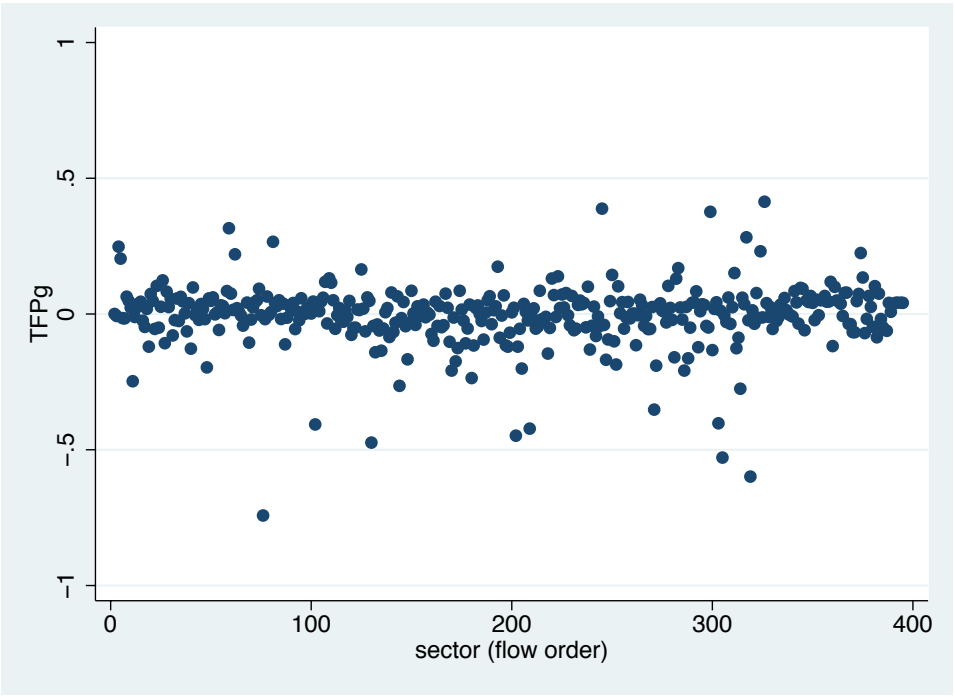

Figure 6: Productivity growths (2000–2005 Japan).

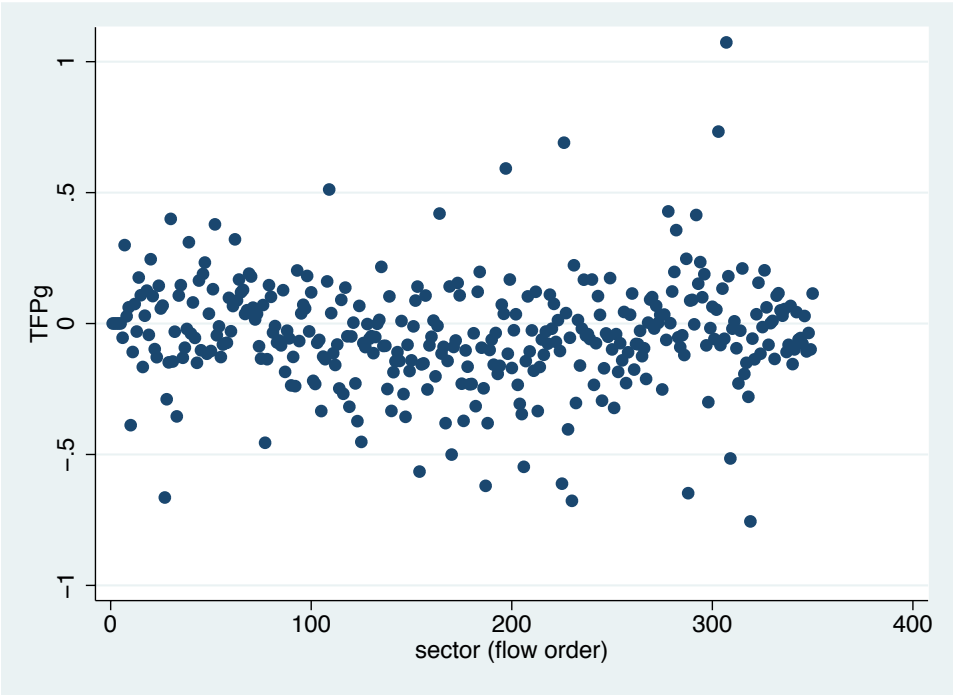

Figure 7: Productivity growths (2000–2005 Korea)

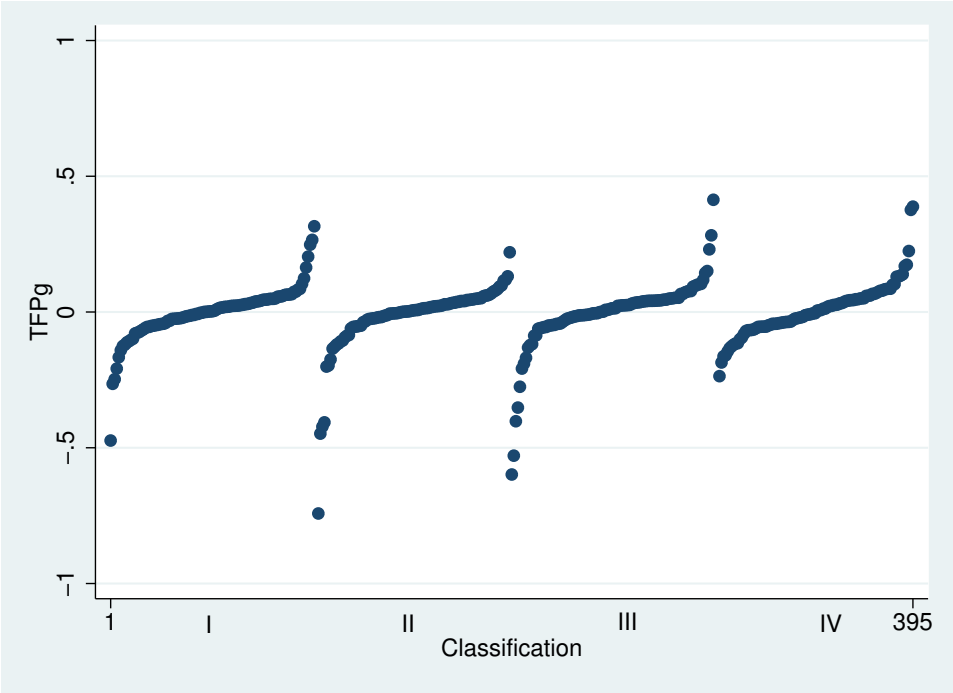

Figure 8: Productivity growth by sector classification (2000–2005 Japan).

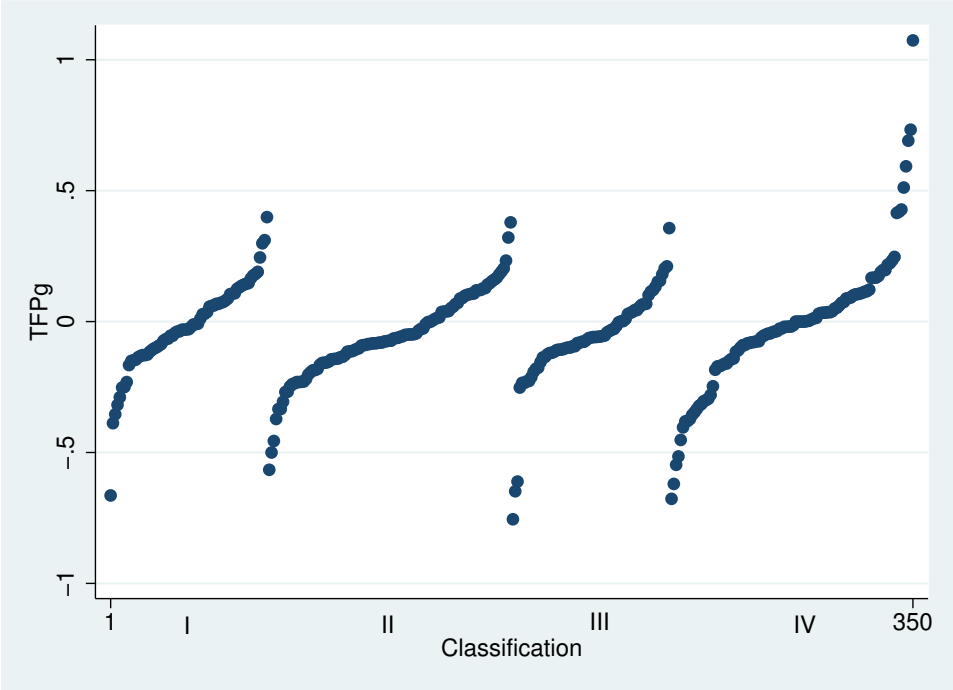

Figure 9: Productivity growth by sector classification (2000–2005 Korea).

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Appendix

Table 2: Productivity growth and quadrant classification (2000–2005 Japan).

sector	TFPg	Column	Row	Category
Office supplies	0.000	31	391	I
Steam and hot water supply	−0.007	56	327	I
Industrial water supply	0.248	65	292	I
Car rental and leasing	0.204	80	392	I
Non-life insurance	−0.015	82	392	I
Building maintenance services	−0.016	82	365	I
Worker dispatching services	0.064	81	351	I
News syndicates and private detective agencies	0.049	74	302	I
Facility service for road transport	0.023	88	392	I
Mobile telecommunication	−0.247	88	388	I
Sewage disposal **	−0.011	86	373	I
Real estate rental service	0.024	89	390	I
Other educational and training institutions (profit-making)	0.039	75	295	I
Hired car and taxi transport	0.045	87	372	I
Real estate agencies and managers	−0.025	86	363	I
Bus transport service	−0.047	88	372	I
Cleaning	0.019	88	366	I
Road freight transport(except@Self-transport by private cars)	−0.120	93	394	I
Public broadcasting	0.074	93	389	I
Consigned freight forwarding	0.049	94	394	I
Gas supply	−0.055	93	377	I
Postal service and mail delivery	0.104	95	390	I
Harbor transport service	−0.050	96	392	I
Private non-profit institutions serving enterprises	0.027	91	355	I
Water supply	0.124	98	389	I
Electricity	−0.108	99	393	I
Judicial, financial and accounting services	0.083	96	373	I
Waste management services (private)	0.026	91	342	I
Petroleum refinery products (inc. greases)	0.056	100	393	I
Railway transport (freight)	−0.079	101	393	I
Information services	−0.023	100	384	I
Newspaper	0.057	99	377	I
Financial service	−0.026	101	389	I
Photographic studios	0.064	98	362	I
Woven fabric apparel	0.046	102	385	I
Tires and inner tubes	0.002	102	385	I
Fixed telecommunication	−0.064	104	390	I
Waste management services (public) **	0.040	90	308	I
Coastal and inland water transport	−0.128	105	394	II
Storage facility service	0.098	107	394	II
Air transport	−0.004	106	383	II
Advertising services	0.013	103	365	I
Civil engineering and construction services	−0.022	92	298	I
Knitted apparel	0.037	109	384	II
Other wearing apparel and clothing accessories	0.019	110	380	II
Repair of motor vehicles	−0.019	115	392	II

Continued.

Sector	TFPg	Column	Row	Category
Goods rental and leasing (except car rental)	−0.197	114	384	II
Railway transport (passengers)	0.058	112	372	II
Retail trade	0.049	117	393	II
Publication	0.061	105	323	II
Other personal services	−0.002	113	363	II
Research institutes for cultural and social science (profit)	0.005	66	151	I
Research institutes for natural sciences (profit)	−0.059	93	260	I
Wholesale trade	0.032	121	394	II
Corrugated card board boxes	0.029	91	248	I
Electric bulbs	0.003	104	306	I
Miscellaneous repairs, n.e.c.	0.085	117	364	II
Private power generation	0.316	82	204	I
Other business services	0.075	122	366	II
Miscellaneous leather products	0.015	121	360	II
Image information production and distribution industry	0.220	119	348	II
Printing, plate making and book binding	0.021	127	371	II
Metallic furniture and fixture	0.008	125	360	II
Watches and clocks	−0.006	121	340	II
Compressed gas and liquefied gas	−0.043	81	178	I
Soap, synthetic detergents and surface active agents	−0.025	115	311	II
Packing service	0.043	104	243	I
Batteries	−0.105	129	326	II
Research and development (intra-enterprise)	−0.020	126	311	II
Repair of construction	0.025	146	390	II
Repair of machine	0.044	148	391	II
Other industrial inorganic chemicals	0.051	116	260	II
Wooden furniture and fixtures	0.093	145	358	II
Other rubber products	−0.005	126	285	II
Cellular phones	−0.742	149	367	II
Rolled and drawn aluminum	−0.019	86	150	I
Plumber's supplies, powder metallurgy products and tools	0.064	129	283	II
Industrial soda chemicals	−0.003	96	175	I
Other pulp, paper and processed paper products	0.007	126	270	II
Other non-ferrous metal products	0.266	88	148	I
Other metal products	0.041	147	324	II
Other paper containers	0.029	98	168	I
Other final chemical products	0.051	150	322	II
Other glass products	−0.019	107	181	II
Other iron or steel products	0.038	81	113	I
Coal products	−0.112	96	148	I
Other ready-made textile products	−0.014	101	159	I
Rolled and drawn copper and copper alloys	0.031	85	118	I
Plastic products	0.018	170	349	II
Coated paper and building (construction) paper	0.040	111	174	II
Other industrial organic chemicals	−0.055	119	194	II
Research institutes for natural science (pubic) **	0.009	90	121	I
Motor vehicle parts and accessories	−0.023	154	285	II
Lead and zinc (inc. regenerated lead)	0.058	86	111	I
Other fabricated textile products	0.001	119	183	II

Continued.

Sector	TFPg	Column	Row	Category
Coal mining , crude petroleum and natural gas	0.000	96	129	I
Ropes and nets	0.023	96	127	I
Cold-finished steel	0.019	97	128	I
Activities not elsewhere classified	0.002	196	393	II
Miscellaneous ceramic, stone and clay products	0.046	147	236	II
Magnetic tapes and discs	−0.406	121	171	II
Hot rolled steel	0.034	98	122	I
Miscellaneous manufacturing products	0.010	181	324	II
Bolts, nuts, rivets and springs	0.046	132	194	II
Plastic footwear	0.061	108	140	II
Rubber footwear	0.119	109	141	II
Metal containers, fabricated plate and sheet metal	−0.035	135	197	II
Other wooden products	0.131	160	257	II
Paint and varnishes	0.115	125	172	II
Iron and steel shearing and slitting	0.050	83	88	I
Timber	−0.055	81	84	I
Gelatin and adhesives	−0.005	123	163	II
Leather footwear	0.022	98	113	I
Coated steel	−0.024	101	118	I
Paper	−0.029	116	143	II
Machinists' precision tools	0.013	132	175	II
Health and hygiene (profit-making)	−0.011	94	100	I
Cast and forged steel	0.048	85	84	I
Special forest products (inc. hunting)	−0.076	66	56	I
Oil and fat industrial chemicals	−0.051	92	93	I
Pottery, china and earthenware	−0.050	119	138	II
Salt	0.017	80	72	I
Abrasive	0.014	126	148	II
Corrugated cardboard	0.164	84	77	I
Hen eggs	0.020	61	46	I
Other edible crops	−0.064	49	32	VI
Steel pipes and tubes	0.061	98	97	I
Jewelry and adornments	0.049	174	243	II
Plywood	−0.473	86	77	I
Methane derivatives	−0.044	84	73	I
Starch	−0.141	77	63	I
Research institutes for cultural and social science *	−0.039	56	37	VI
Inorganic pigment	−0.061	112	111	II
Aliphatic intermediates	−0.135	109	105	II
Non-ferrous metal castings and forgings	−0.053	123	125	II
Sheet glass and safety glass	0.007	110	103	II
Electric wires and cables	0.022	121	116	II
Carbon and graphite products	−0.085	106	92	II
Other general machines and parts	0.079	143	147	II
Pulses	−0.066	55	31	VI
Woolen fabrics, hemp fabrics and other fabrics	−0.032	84	60	I
Tatami (straw matting) and straw products	0.065	69	42	I
Other non-metallic ores	−0.264	77	50	I
Glass fiber and glass fiber products, n.e.c.	−0.015	106	82	II

Continued.

Sector	TFPg	Column	Row	Category
Chemical fertilizer	0.044	113	90	II
Flowers and plants	−0.045	75	46	I
Thermoplastics resins	−0.167	101	74	I
Plasticizers	−0.033	84	55	I
Other livestock	0.085	71	42	I
Cast and forged materials (iron)	0.002	133	114	II
Bedding	−0.040	91	62	I
Electric lighting fixtures and apparatus	0.029	128	107	II
Fiber yarns	−0.007	96	64	I
Grain milling	0.002	74	42	I
Cotton and staple fiber fabrics	0.035	80	47	I
Potatoes and sweet potatoes	−0.012	63	32	VI
Wiring devices and supplies	0.005	130	98	II
Sugar	−0.002	84	47	I
Materials for ceramics	−0.074	102	64	I
Petrochemical aromatic products (except synthetic resin)	−0.098	85	47	I
Slaughtering and meat processing	0.046	77	40	I
Other inedible crops	−0.043	67	32	VI
Bearings	0.029	116	77	II
Other resins	−0.048	96	56	I
Research institutes for natural sciences (private, non-profit) *	−0.041	68	32	VI
Ocean transport	0.075	103	61	I
Silk and artificial silk fabrics	0.023	81	41	I
Synthetic dyes	−0.102	101	58	I
High function resins	−0.208	98	55	I
Thermo-setting resins	−0.013	106	62	II
Other electrical devices and parts	−0.175	131	86	II
Flour and other grain milled products	−0.125	85	43	I
Animal oils and fats	0.086	80	39	VI
Aluminum (inc. regenerated aluminum)	0.016	83	41	I
Dextrose, syrup and isomerized sugar	−0.025	80	37	VI
Cyclic intermediates	−0.108	105	57	II
Vegetables	−0.053	78	34	VI
Analytical instruments, testing machine, measuring instruments	0.035	151	96	II
Logs	−0.236	76	32	VI
Rice	−0.116	72	29	VI
Frozen fish and shellfish	0.023	81	35	VI
Fabricated textiles for medical use	0.032	68	26	VI
Vegetable oils and meal	0.000	110	56	II
Paperboard	−0.026	110	56	II
Fruits	−0.094	73	29	VI
Copper	0.005	78	31	VI
Manufactured ice	0.051	65	23	VI
Audio and video records, other information recording media	0.066	95	42	I
Electrical equipment for internal combustion engines	−0.038	131	69	II
Other non-ferrous metals	0.014	170	104	II
Rotating electrical equipment	0.029	129	65	II
Agricultural chemicals	0.174	95	39	VI
Semiconductor devices	−0.087	126	61	II

Continued.

Sector	TFPg	Column	Row	Category
Metal products for architecture	−0.006	124	59	II
Electric measuring instruments	0.069	128	61	II
Paper textile for medical use	−0.115	107	45	II
Other electronic components	−0.120	155	81	II
Cement	−0.069	103	42	I
Research institutes for cultural and social science (public) **	0.006	65	20	VI
Printing ink	0.023	105	43	II
Liquid crystal element	−0.448	117	51	II
Fowls and broilers	−0.120	57	16	VI
Leather and fur skins	−0.055	90	33	VI
Photographic sensitive materials	−0.201	108	44	II
Internal combustion engines for motor vehicles and parts	0.037	134	62	II
Other services relating to communication	0.008	76	25	VI
Dairy farm products	−0.024	104	41	I
Integrated circuits	−0.422	130	58	II
Pumps and compressors	−0.011	133	60	II
Other general industrial machinery and equipment	0.021	140	65	II
Medicaments	−0.054	137	62	II
Synthetic fibers	−0.047	101	38	VI
Beef cattle	0.086	74	23	VI
Fisheries	−0.020	93	33	VI
Transformers and reactors	−0.023	124	52	II
Carpets and floor mats	−0.010	88	30	VI
Synthetic rubber	−0.146	100	36	VI
Gas and oil appliances and heating and cooking apparatus	−0.051	134	57	II
Petrochemical basic products	0.131	89	29	VI
Cable broadcasting	0.070	86	27	VI
Clay refractories	−0.011	109	39	III
Wooden chips	0.139	65	17	VI
Bottled or canned vegetables and fruits	0.022	90	28	VI
Feeds	0.072	108	37	III
Other structural clay products	0.025	107	36	III
Other foods	0.077	112	38	III
Hogs	−0.005	73	19	VI
Condiments and seasonings	−0.042	115	39	III
Inland water Culture	0.067	85	23	VI
Tea and roasted coffee	−0.059	92	26	VI
Marine culture	−0.054	93	26	VI
Relay switches and switchboards	0.034	142	50	II
Dairy cattle farming	0.050	81	20	VI
Cast iron pipes and tubes	0.036	91	24	VI
Other electrical devices and parts	0.040	143	49	II
Preserved agricultural foodstuffs (other than bottled or canned)	−0.049	99	27	VI
Bottled or canned seafood	0.100	88	22	VI
Other processed seafood	−0.131	105	29	III
Rayon and acetate	−0.043	89	22	VI
Seeds and seedlings	0.028	77	17	VI
Crops for feed and forage	−0.081	59	11	VI
Wheat, barley and the like	−0.009	60	11	VI

Continued.

Sector	TFPg	Column	Row	Category
Salted, dried or smoked seafood	−0.043	96	23	VI
Metallic ores	0.388	83	18	VI
Processed meat products	−0.040	98	22	VI
Optical fiber cables	−0.168	117	29	III
Electric audio equipment	−0.093	149	42	II
Organic fertilizers, n.e.c.	0.047	85	17	VI
Musical instruments	0.144	119	29	III
Gravel and quarrying	−0.100	98	21	VI
Crushed stones	−0.186	96	20	VI
Wooden fixtures	0.102	114	26	III
Radio communication equipment (except cellular phones)	0.003	152	41	II
Travel agency and other services relating to transport	0.044	78	14	VI
Fish paste	−0.054	104	22	VI
Cosmetics, toilet preparations and dentifrices	−0.012	105	22	III
Ready mixed concrete	0.044	90	17	VI
Sporting and athletic goods	−0.016	137	33	III
Other photographic and optical instruments	0.001	127	29	III
Performances, theatrical companies	0.002	108	22	III
Bottled or canned meat products	−0.115	92	17	VI
Soft drinks	−0.004	99	19	VI
Cement products	0.053	118	24	III
Agricultural services (except veterinary service)	0.033	99	18	VI
Refrigerators and air conditioning apparatus	−0.043	143	31	III
Retort foods	−0.007	95	16	VI
Noodles	−0.055	109	19	III
Prepared frozen foods	−0.055	103	17	VI
Veterinary service	0.026	79	11	VI
Electron tubes	−0.352	118	20	III
Toys and games	−0.190	140	26	III
Bread	0.031	112	18	III
Applied electronic equipment	0.040	133	23	III
Knitting fabrics	0.012	89	12	VI
Engines	0.008	131	22	III
Yarn and fabric dyeing and finishing	−0.031	112	17	III
Other communication equipment	0.104	143	25	III
Confectionery	0.023	121	19	III
Paving materials	−0.021	92	12	VI
Other liquors	−0.160	98	13	VI
Refined sake	0.130	94	12	VI
Ferro alloys	0.169	85	10	VI
Other amusement and recreation services	0.024	105	14	III
Metal products for construction	−0.021	136	21	III
Radio and television sets	−0.208	128	19	III
Dishes, sushi and lunch boxes	0.026	117	16	III
Pulp	−0.163	104	13	VI
Wired communication equipment	−0.050	153	24	III
Other cleaning, barber shops, beauty shops and public baths	0.042	92	10	VI
Medical instruments	0.043	151	22	III
Beer	0.083	94	10	VI

Continued.

Sector	TFPg	Column	Row	Category
Household electric appliances (except air-conditioners)	−0.122	154	22	III
Conveyors	0.010	139	18	III
Repair of ships	0.036	142	18	III
Boilers	0.033	124	14	III
Camera	−0.044	116	12	III
Turbines	−0.050	122	13	III
Whiskey and brandy	0.376	91	8	VI
Crops for beverages	−0.133	50	3	VI
Port and water traffic control **	0.019	87	7	VI
Crude steel (electric furnaces)	0.043	96	8	VI
Video recording and playback equipment	−0.402	137	14	III
Services relating to water transport	0.013	90	7	VI
Personal Computers	−0.529	126	11	III
Bicycles	−0.004	114	9	III
Crude steel (converters)	−0.030	100	7	VI
Beauty shops	0.061	91	6	VI
Health and hygiene (public) **	−0.036	91	6	VI
Stationery	0.026	133	10	III
Pig iron	0.151	186	17	III
Repair of aircrafts	−0.126	63	3	VI
Electronic computing equipment (accessory equipment)	−0.087	137	10	III
Household air-conditioners	−0.275	151	11	III
Private broadcasting	0.060	95	5	VI
Internal combustion engines for vessels	0.036	118	7	III
Motor vehicle bodies	0.283	125	7	III
Sugar crops	−0.023	58	2	VI
Electronic computing equipment (except personal computers)	−0.598	127	7	III
Other transport equipment	0.013	140	8	III
Machinery for service industry	−0.036	131	7	III
Professional and scientific instruments	0.077	120	6	III
Other office machines	−0.015	134	7	III
Aircrafts	0.231	124	6	III
Chemical machinery	−0.013	137	7	III
Ordnance	0.413	125	5	III
Silviculture	0.040	91	3	VI
Textile machinery	−0.010	149	6	III
Copy machine	0.025	133	5	III
Industrial robots	−0.055	124	4	III
Food processing machinery and equipment	0.014	125	4	III
Metal molds	−0.025	128	4	III
Other special machinery for industrial use	−0.012	150	5	III
Metal processing machinery	0.035	131	4	III
Metal machine tools	0.023	131	4	III
Airport and air traffic control (industrial)	0.059	85	2	VI
Repair of rolling stock	0.014	118	3	III
Machinery for agricultural use	−0.001	144	4	III
Semiconductor making equipment	−0.004	144	4	III
Machinery and equipment for construction and mining	−0.009	145	4	III
Two-wheel motor vehicles	0.085	99	2	VI

Continued.

Sector	TFPg	Column	Row	Category
Medical service (medical corporations, etc.)	0.043	157	4	III
Tobacco	−0.035	104	2	VI
Rolling stock	0.096	141	3	III
Services relating to air transport	0.093	110	2	III
Ships (except steel ships)	−0.059	145	3	III
Eating and drinking places for pleasures	0.051	149	3	III
General eating and drinking places (except coffee shops)	0.044	149	3	III
Electric power facilities construction	0.066	151	3	III
Public construction of rivers, drainages and others	0.041	157	3	III
Passenger motor cars	−0.023	123	2	III
Accommodations	0.053	161	3	III
Trucks, buses and other cars	−0.005	125	2	III
Airport and air traffic control (public) **	0.051	89	1	VI
Coffee shops	0.052	143	2	III
Telecommunication facilities construction	0.067	145	2	III
Railway construction	0.046	149	2	III
Other civil engineering and construction	0.046	154	2	III
Ceremonial occasions	0.119	155	2	III
Steel ships	−0.118	158	2	III
Supplementary tutorial schools, etc.	0.100	113	1	III
Public administration (local) **	0.050	127	1	III
Agricultural public construction	0.049	144	1	III
Public construction of roads	0.038	157	1	III
Public administration (central) **	−0.007	220	1	III
Nuclear fuels	0.078	53	0	VI
School lunch (private) *	0.079	56	0	VI
Social insurance (public) **	−0.036	70	0	VI
Social insurance (private, non-profit) *	−0.037	70	0	VI
School lunch (public) **	−0.067	75	0	VI
Movie theaters	−0.067	76	0	VI
Social education (private, non-profit) *	0.047	78	0	VI
Barber shops	0.074	86	0	VI
Life insurance	0.225	88	0	VI
House rent	0.134	91	0	VI
Other educational and training institutions (public) **	−0.070	92	0	VI
Social education (public) **	−0.018	93	0	VI
Public baths	0.067	95	0	VI
Amusement and recreation facilities	0.026	102	0	VI
Private non-profit institutions serving households, n.e.c. *	−0.047	105	0	III
Stadiums and companies of bicycle, etc.	0.103	105	0	VI
School education (public) **	−0.086	109	0	III
School education (private) *	0.075	110	0	III
Sport facility service, public gardens and amusement parks	−0.018	117	0	III
Social welfare (public) **	−0.048	143	0	III
Social welfare (profit-making)	−0.058	143	0	III
Social welfare (private, non-profit) *	−0.062	144	0	III
Non-residential construction (wooden)	0.041	154	0	III
Medical service (public)	0.008	154	0	III
Nursing care (In-home)		154	0	III

Continued.

Sector	TFPg	Column	Row	Category
Medical service (non-profit foundations, etc.)	0.040	155	0	III
Residential construction (wooden)	0.042	158	0	III
Nursing care (In-facility)		160	0	III
Residential construction (non-wooden)	0.042	163	0	III
Non-residential construction (non-wooden)	0.041	164	0	III

Table 3: Productivity growth and quadrant classification (2000–2005 Korea).

sector	TFPg	Column	Row	Category
Natural rubber	0.000	0	11	VI
Crude petroleum and Natural gas	0.000	0	9	VI
Bituminous coal	0.000	0	7	VI
Raw sugar	0.000	0	7	VI
Copper ores	0.000	0	3	VI
Office supplies	−0.054	39	334	I
Services related to real estate	0.299	94	319	I
Legal and accounting services	0.028	96	329	I
Business and professional organizations	0.062	98	329	I
Non-life insurance	−0.388	109	343	I
Other financial brokerage institutions	−0.108	110	343	I
Market research and management consultancy	0.075	102	301	I
Services auxiliary to finance and insurance	−0.031	115	343	I
Cleaning and disinfection services	0.176	109	317	I
Supporting air transport activities	0.108	115	324	I
Hydroelectric power generation	−0.166	119	333	I
Other services incidental to transportation	0.030	123	339	I
Computer related services	0.125	121	329	I
Central bank and banking institutions	−0.043	125	343	I
Water supply	0.245	125	340	I
Newspapers	0.105	124	327	I
Cargo handling	−0.098	129	344	I
Telecommunications	−0.128	130	343	I
Renting and subdividing of real estate	0.145	127	330	I
Nuclear power generation	0.057	129	334	I
Postal services	0.068	128	328	I
Railroad freight transport	−0.664	131	337	I
Fire power generation	−0.289	131	334	I
Manufactured gas supply	−0.148	116	279	I
Computer software development and supply	0.399	115	273	I
Warehousing and storage	−0.145	135	342	I
Knitted clothing accessories	−0.031	128	315	I
Liquefied petroleum gas	−0.354	136	343	I
Supporting land transport activities	0.107	131	323	I
Publishing	0.147	134	329	I
Lumber	−0.131	116	265	I
Coastal and inland water transport	−0.092	138	342	I
Education (commercial)	−0.020	132	318	I
Renting of machinery and goods	0.311	139	340	I
Advertising services	−0.038	137	332	I
Sanitary services(commercial)	0.081	133	317	I
Heavy oil	−0.054	140	341	I
Road freight transport	−0.150	141	344	I
Road passenger transport	0.165	139	333	I
Kerosene	−0.102	142	342	I
Misc. business services	0.190	141	333	I
Gasoline and Jet oil	0.233	144	342	II
Light oil	−0.115	147	343	II

Continued.

Sector	TFPg	Column	Row	Category
Business consumption expenditures	0.038	147	342	II
Lubricants	−0.105	146	337	II
Corrugated paper and solid fiber boxes	0.131	124	265	I
Architectural engineering services	0.379	148	339	II
Motor repair services	−0.045	147	334	II
Reproduction of recorded media	−0.010	141	306	I
Industrial gases	−0.128	138	283	I
Railroad passenger transport	−0.080	149	315	II
Textile wearing apparels and Clothing accessories	−0.076	157	339	II
Steam and hot water supply	−0.073	112	205	I
Medical and health services(Private, non-profit)	0.098	150	312	II
Cordage, rope, and fishing nets	−0.029	125	237	I
Wooden containers and Other wooden products	0.067	143	286	II
Handtools	0.321	161	336	II
Wholesale and Retail trade	0.088	163	342	II
Footwear	0.168	148	295	II
Other personal repair services	0.120	153	307	II
Bolts, nuts, screws, rivets, and washers	0.128	146	286	II
Tires and tubes	0.037	156	310	II
Air transport	0.051	165	334	II
Printing	0.191	165	333	II
Office machines and devices	0.180	162	321	II
Misc. primary iron and steel products	0.060	131	234	I
Electric lamps and electric lighting fixtures	0.016	167	329	II
Paper containers	0.037	142	259	I
Batteries	−0.086	164	320	II
Building repairs	−0.134	172	341	II
Rubber products	0.071	172	339	II
Wireless telecommunication and broadcasting apparatuses	−0.456	172	339	II
Plywood	−0.136	140	250	I
Medical and health services(public)	0.147	148	269	II
Medical and health services (commercial)	0.102	170	329	II
Primary plastic products	−0.034	173	328	II
Misc. electric equipment and supplies	−0.010	165	304	II
Textile products and Misc. textile products	−0.073	177	335	II
Electric transformers	−0.065	161	291	II
Pumps and compressors	−0.083	166	302	II
Capacitors and rectifiers, Electric equipment	0.127	176	329	II
Parts of general-purposed machinery and equipment	−0.185	166	301	II
Soap and detergents	−0.028	170	311	II
Other paper products	−0.056	174	321	II
Air-conditioning equipment and refrigeration equipment	−0.236	171	312	II
Line telecommunication apparatuses	−0.127	175	321	II
Motors and generators	−0.239	173	315	II
Fabricated wire products	0.203	173	314	II
Supporting water transport activities	−0.067	130	206	I
Regulators and Measuring and analytical instruments	0.039	177	322	II
Household articles of plastic material	0.072	135	213	I
Steel pipe and tubes, except foundry iron pipe and tubes	0.057	150	245	II

Continued.

Sector	TFPg	Column	Row	Category
Sanitary services(public)	0.182	132	203	I
Metal cans, barrels, and drums	−0.030	139	219	I
Insulated wires and cables	0.119	180	316	II
Computer and peripheral equipment	−0.219	177	308	II
Boiler, Heating apparatus and cooking appliances	−0.231	172	295	II
Industrial plastic products	−0.073	190	341	II
Misc. machinery and equipment of general purpose	−0.063	184	325	II
Misc. petroleum refinery products	−0.334	143	224	II
Laundry and cleaning services	−0.126	92	117	I
Paints, varnishes, and allied products	−0.136	168	282	II
Treatment and coating of metals and Misc.	0.161	189	333	II
Misc. forest products	0.512	75	85	VI
Adhesives, gelatin and sealants	0.040	157	245	II
Conveyors and conveying equipment	−0.114	173	280	II
Misc. chemical products	−0.158	191	322	II
Motor vehicle engines, chassis, bodies and parts	−0.080	200	333	II
Misc. machinery and equipment of special purpose	−0.248	193	310	II
Research institutes(private, non-profit, commercial)	0.090	163	241	II
Medicaments	−0.268	198	318	II
Other leather products	0.137	98	113	I
Fastening metal products	−0.049	144	198	II
Other nonferrous metal casting and forgings	−0.318	136	181	I
Medical instruments and supplies	−0.049	175	262	II
Metal products for structure	0.004	161	231	II
Basic inorganic chemicals	−0.229	182	273	II
Industrial glass products	−0.372	181	269	II
Steel rods and bars	0.068	140	174	I
Other Inedible crops	−0.452	24	13	VI
Primary copper products	−0.075	144	178	II
Primary aluminium products	−0.090	163	207	II
Other raw paper and paperboard	−0.002	168	215	II
Petrochemical intermediate products and Other	−0.058	181	239	II
Metal forming machine tools	−0.048	162	203	II
Misc. manufacturing products	−0.113	213	303	II
Abrasives	−0.051	153	186	II
Sheet glass and primary glass products	−0.001	147	172	II
Metal furniture	0.014	149	175	II
Raw timber	0.217	52	37	VI
Metal tanks and reservoirs for equipment	−0.086	138	154	I
Internal combustion engines and turbines	−0.085	164	197	II
Misc. non-metallic minerals	−0.250	111	109	I
Misc. nonmetallic minerals products	0.104	147	163	II
Dyes, pigments, and tanning materials	−0.334	161	185	II
Pottery	−0.186	170	198	II
Photographic and optical instruments	−0.144	174	201	II
Synthetic resins	−0.109	172	196	II
Iron foundries and foundry iron pipe and tubes	−0.143	165	182	II
Hot rolled steel plates and sheets	0.010	153	161	II
Metal molds and industrial patterns	−0.269	160	170	II

Continued.

Sector	TFPg	Column	Row	Category
Pulses	−0.356	54	34	VI
Cold rolled steel sheet, strip, and bars	−0.082	156	161	II
Other household electrical appliances	−0.181	168	179	II
Metal cutting type machine tools	−0.141	165	174	II
Other fiber fabrics	−0.011	132	123	I
Other generation	0.088	106	89	I
Other nonferrous metal ingots	0.141	136	124	I
Nonclassifiable activities	−0.566	268	331	II
Misc. electronic components	−0.156	187	195	II
Wood furniture	−0.152	175	176	II
Research and experiment in enterprise	0.107	245	286	II
Bicycles and parts and misc. transportation equipment	−0.252	138	123	I
Lime, gypsum, and plaster products	−0.083	148	136	II
Coated steel plates	−0.050	152	141	II
Metal products for construction	0.011	140	122	I
Household glass products and others	−0.202	149	131	II
Reconstituted and densified wood	−0.008	127	103	I
Coal briquettes	0.420	81	52	VI
Aluminium ingots	−0.115	134	107	I
Asbestos and mineral wool products	−0.089	157	133	II
Wheat	−0.381	34	14	VI
Watches and clocks	−0.142	159	131	II
Research institutes(public)	0.142	203	187	II
Electric resistors and storage batteries	−0.500	161	132	II
Nitrogen compounds	−0.089	121	86	VI
Section steel	−0.065	131	94	I
Other furniture	0.155	177	144	II
Cotton fabrics	0.107	146	108	II
Motorcycles and parts	−0.230	152	114	II
Potatoes	−0.372	53	24	VI
Refractory ceramic products	−0.102	165	127	II
Other audio and visual equipment	−0.165	171	133	II
Printed circuit boards	−0.231	164	125	II
Pesticides and other agricultural chemicals	−0.231	140	99	I
Forgings	−0.037	136	93	I
Oleaginous crops	−0.315	56	25	VI
Printing paper	0.121	154	109	II
Materials for ceramics	0.197	122	74	VI
Semiconductor devices	−0.092	169	116	II
Printing ink	−0.247	134	82	VI
Cotton and hemp	−0.620	30	9	VI
Misc. cereals	−0.380	57	23	VI
Lead and zinc ingots	−0.101	143	87	III
Rails and wires	−0.062	145	88	II
Integrated circuits	−0.157	172	113	II
Thread and other fiber yarns	−0.036	124	69	VI
Electric household audio equipment	−0.193	165	105	II
Other edible crops	−0.161	65	26	VI
Petrochemical basic products	0.072	141	80	VI

Continued.

Sector	TFPg	Column	Row	Category
Electric coils, transformers	0.037	146	84	III
Sand and gravel	0.593	118	61	VI
Synthetic fiber fabrics	−0.115	136	75	VI
Copper ingots	0.168	139	77	VI
Synthetic rubber	−0.170	131	68	VI
Construction and mining machinery	−0.026	162	92	II
Gold and silver ingots	0.036	128	61	VI
Food processing machinery	−0.234	147	74	III
Textile machinery	−0.306	176	96	II
Cultivated medicinal herbs	−0.346	71	25	VI
Unmilled rice	−0.547	86	33	VI
Limestone	−0.143	134	63	VI
Wooden products for construction	0.104	123	54	VI
Recording media and Photographic chemical products	−0.107	157	77	III
Luggage and handbags	−0.026	131	59	VI
Television	−0.180	153	74	III
Cement	0.121	167	82	III
Barley	−0.334	64	20	VI
Coal chemicals	−0.166	118	48	VI
Crude salt	−0.061	100	35	VI
Household laundry equipment	−0.119	155	66	III
Vegetable fats and oils, and processed edible refined oil	−0.031	143	58	III
Fertilizers	−0.077	163	70	III
Other animals	0.110	114	41	VI
Synthetic fiber yarn	−0.020	142	56	VI
Starches	0.075	110	38	VI
Household refrigerators	−0.070	159	64	III
Polished rice	0.013	104	34	VI
Agricultural implements and machinery	−0.105	167	68	III
Digital display	−0.611	168	65	III
Edible forest products	0.691	83	23	VI
Synthetic fibers	0.040	143	51	VI
Horticultural specialties	−0.404	108	33	VI
Refined sugar	−0.054	111	34	VI
Misc. non-ferrous metal ores	−0.677	74	18	VI
Flour and cereal preparations	0.223	119	36	VI
Vegetables	−0.304	111	32	VI
Cotton yarn	0.014	138	44	VI
Silk and hempen fabrics	−0.160	119	34	VI
Malt and yeast	−0.019	100	26	VI
Animal and marine fats and oils	0.167	114	31	VI
Glucose, glucose syrup and maltose	−0.046	119	33	VI
Explosives and fireworks products	−0.041	159	50	III
Agriculture, forestry and fishing related services	−0.059	149	45	III
Crushed and broken stone and Other bulk stones	0.168	126	35	VI
Electron tubes	−0.234	165	51	III
Silk and hempen yarn	−0.075	110	28	VI
Jewelry and plated ware	0.105	132	36	VI
Coke and other coal products	0.033	135	37	VI

Continued.

Sector	TFPg	Column	Row	Category
Fruits	−0.295	99	22	VI
Leather	−0.171	141	36	VI
Fiber bleaching and dyeing	−0.038	129	31	VI
Regenerated fiber yarn	−0.050	96	20	VI
Ferroalloys	0.174	127	30	VI
Stationery paper and office paper	−0.099	131	31	VI
Polished barley	−0.322	80	15	VI
Knitted fabrics	−0.040	123	28	VI
Slaughtering and meat processing	−0.184	115	25	VI
Pulp	−0.075	113	24	VI
Seeds and seedlings	−0.141	115	24	VI
Cut stone & stone products	0.044	147	34	III
Clay products for construction	−0.227	159	38	III
Regenerated fiber fabrics	−0.110	114	23	VI
Woolen yarn	0.034	131	26	VI
Regenerated cellulose fibers	0.114	104	18	VI
Concrete blocks, bricks, and other concrete products	−0.176	156	32	III
Poultry and birds	−0.078	133	25	VI
Woolen fabrics	−0.079	130	24	VI
Steel ingots and semifinished products	−0.028	155	30	III
Sporting and athletic goods	−0.125	176	36	III
Canned or cured fruits and vegetables	−0.094	159	31	III
Ship repairing and ship parts	−0.212	163	31	III
Asphalts	0.004	138	24	VI
Ginseng products	0.092	110	17	VI
Seasonings	0.101	165	30	III
Poultry slaughtering and processing	−0.019	103	15	VI
Aircraft and parts	0.068	173	30	III
Fishing	0.002	177	30	III
Motion picture, Theatrical producers, bands, and entertainers	0.033	157	25	III
Cosmetics and dentifrices	−0.252	182	31	III
Aquaculture	0.034	140	21	VI
Bean curd and Misc. foodstuffs	−0.063	179	30	III
Salted, dried and smoked seafoods	0.428	133	19	VI
Dairy products	0.001	157	24	III
Pigs	0.122	134	19	VI
Anthracite	0.197	134	19	VI
Misc. processed seafoods	0.357	151	22	III
Soft drinks and Manufactured ice	−0.053	151	22	III
Leather wearing apparels	−0.090	117	14	VI
Coffee and tea	−0.045	135	17	VI
Toys and games	−0.120	172	24	III
Beef cattle	0.247	133	16	VI
Canned seafoods	−0.648	151	19	III
Naphtha	0.088	140	17	VI
Ready mixed concrete	0.090	142	17	VI
Musical instruments	−0.003	167	21	III
Operation of timber tracts	0.415	96	9	VI
Prepared livestock feeds	0.152	173	21	III

Continued.

Sector	TFPg	Column	Row	Category
Soy sauce ad bean paste	0.234	138	15	VI
Frozen fish and seafoods	0.100	136	14	VI
Ethyl alcohol for beverages	0.189	120	11	VI
Dairy farming	−0.083	134	12	VI
Knitted wearing apparels	−0.300	137	12	VI
Bakery and confectionery products	−0.017	195	19	III
Railroad vehicles and parts	0.064	165	14	III
Fur and Fur wearing apparels	−0.059	144	11	III
Newsprint	0.053	133	9	VI
Lead and zinc ores	0.733	101	6	VI
Prepared meat products	−0.082	164	12	III
Noodles	0.133	144	9	III
Other liquors	−0.058	144	9	III
Tobacco products	1.074	114	5	VI
Pig iron	0.181	146	7	III
Iron ores	−0.515	90	3	VI
Broadcasting	−0.020	131	5	VI
Beer	0.009	114	4	VI
Trucks and Motor vehicles with special equipment	−0.094	160	6	III
Misc. amusement and recreation services	−0.228	160	6	III
Blended and distilled sojoo	−0.027	131	4	VI
Other ships	0.211	174	6	III
Pens, pencils, and other artists' materials	−0.192	160	5	III
Trailers and containers	−0.150	142	4	VI
Life insurance	−0.280	107	2	VI
Oceangoing transport	−0.755	146	3	III
Passenger automobiles	−0.057	156	3	III
Public government	−0.137	251	5	III
Library, museum and similar recreation related	0.036	141	2	VI
Sports organizations and sports facility operation	0.156	151	2	III
Buses and vans	−0.115	153	2	III
Barber and beauty shops	−0.014	96	1	VI
Steel ships	0.203	188	2	III
Personal services	0.062	127	1	VI
Accommodation	−0.081	134	1	VI
Library, museum and similar recreation related	0.002	139	1	VI
Restaurants	0.010	190	1	III
Local government	−0.135	257	1	III
Owner-occupied housing	0.107	6	0	VI
Other membership organizations	0.116	117	0	VI
Social work activities(public)	0.050	126	0	VI
Social work activities(other)	0.030	140	0	VI
Communications line construction	0.055	160	0	III
Breakwater, pier, and harbor construction	−0.109	161	0	III
Airport construction	−0.081	161	0	III
Education (private, non-profit)	0.067	165	0	III
Dam, levee, and flood control project construction	−0.155	166	0	III
Land clearing and reclamation, and project construction	−0.099	171	0	III
Electric power plant construction	0.044	173	0	III

Continued.

Sector	TFPg	Column	Row	Category
Railroad construction	−0.061	174	0	III
Water main line and drainage project construction	−0.055	176	0	III
Land leveling and athletic field construction	−0.077	178	0	III
Misc. construction	0.029	181	0	III
Residential building construction	−0.107	185	0	III
Non-residential building construction	−0.036	185	0	III
Road construction	−0.099	188	0	III
Education (public)	0.115	195	0	III