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Abstract. The purpose of this study is to determine the ranks of Indonesian and Japanese industrial sectors from the economic point of view. The analysis period of this study is 2005. This study employs one of the well-known analysis tools in the economic topic, the Input-Output (IO) analysis. More specifically, this study uses the analysis methods in the IO analysis, backward and forward linkages, in order to achieve the purpose. The results of calculations show that the orders of the ranks depend on the method used. Nevertheless, from the results, one can say that the manufacturing industry was a leading sector in the Indonesian economy on the analysis period. On the other hand, for the Japanese case, the sector which had the beneficial effects in the Japanese economy on the analysis period was the transport.

1. Introduction

An analysis of the industrial sectors of one country will continually give the insights about their characteristics. These insights will be the triggers in order to improve the sectors. Further, the improvement actions for the industries might increase the macroeconomics conditions of the country.

The examples of previous studies which focuses on the analysis are [1], [2], [3], [4], [5], and [6]. To the best of my knowledge, after learning the studies, the research which the subject is to determine the ranks of the industrial sectors of countries is still needed. The research is required in order to get the understanding about the beneficial sectors in the economic activities of focused countries. This study tries to fulfill the need.

The purpose of this study is to determine the ranks of Indonesian and Japanese industrial sectors from the economic point of view. The analysis period of this study is 2005. This study employs one of the well-known analysis tools in the economic discussion, the Input-Output (IO) analysis, in order to achieve the purpose. One thing that all readers should notice is that this study focuses on the observation rather than the comparison for the conditions of Indonesian and Japanese industrial sectors.

2. Methodology

The methodology of this study is described as follows. The first step is to explain the data sources. The data sources of this study are 2005 Indonesian and Japanese IO tables. The table of Indonesia is obtained from [7] while the Japanese one is acquired from [8]. The second step is to describe the industrial sectors of Indonesia and Japan used in this study. Tables 1 and 2 elaborate these sectors for the cases of Indonesia and Japan, respectively.

Table 1. Indonesian industrial sectors used in this study.

Sector Number	Sector Name
1	Agriculture, livestock, forestry, and fishery
2	Mining and quarrying
3	Manufacturing industry
4	Electricity, gas, and water supply
5	Construction
6	Trade, hotel, and restaurant
7	Transport and communication
8	Financial, real estate, and business services
9	Services

Table 2. Japanese industrial sectors used in this study.

Sector Number	Sector Name
1	Agriculture, forestry, and fishery
2	Mining
3	Manufacturing
4	Construction
5	Electricity, gas, and water supply
6	Commerce
7	Finance and insurance
8	Real estate
9	Transport
10	Information and communications
11	Public administration
12	Services
13	Activities not elsewhere classified

The third step is to conduct the calculations in order to determine the ranks of the industries of analyzed countries on the analysis period. The methods of backward and forward linkages, the analysis devices in the IO analysis, are employed in the calculations. Both linkages describe the relationship between a specific industrial sector and other industries. More specifically, the backward linkage focuses on the demands of the particular industry from other industrial sectors. These demands appear as a consequence of the industry as a purchaser in the economy. On the other hand, the forward linkage explains the consequence of the industrial sector as a seller.

The methods are suitable for determining the ranks of industrial sectors on the specific time period. [9] reaffirm this argument through the following statement:

"*Measures have been proposed to quantify such backward and forward linkages, or economic "connectedness." Comparisons of the strengths of backward and forward linkages for the sectors in a single economy provide one mechanism for identifying "key" or "leading" sectors in that economy (those sectors that are most connected and therefore, in some sense, most "important") and for grouping sectors into spatial clusters.*"

One can say that if the backward linkage value of sector *a* is higher than that of sector *b*, then sector *a* gives more beneficial effect because of the higher capability of the sector in attracting the economy through its demands. The similar argument which uses the supplier's point of view can be applied in analyzing the forward linkage values of two or more industries.

This study uses two forms for each linkage, namely "direct" and "total". These forms can be seen on both demand-side and supply-side IO models. [10] propose the concepts of the former form on both models. To summarize, this form only indicates the straightforward impacts of the demands and supplies of one specific industry. Further, [9] explain the concept for the backward linkage on the form using the following equation:

$$BL(d)_j = \sum_{i=1}^{n} a_{ij} \tag{1}$$

where $BL(d)_j$, a_{ij}, and *n* are the direct backward linkage of sector *j*, the direct input coefficient, and the number of industrial sectors, respectively. On the other hand, [11] describes the concept for the forward linkage on the form through the following equation:

$$F(d)_i = \sum_{j=1}^{n} a_{ij} \tag{2}$$

where $F(d)_i$ is the direct forward linkage of sector *i*. Both equations use the demand-driven IO model as the reference. The using of row sums in explaining the direct forward linkage of the specific sector in the model is also revealed by [9].

The insight of the "total" form for the backward linkage in the demand-driven IO model is proposed by Rasmussen (1957) in [9] while [9] describes the one for the forward linkage. To summarize, this form explains the straightforward and indirect effects of the demands and supplies of one particular industry. [9] explore the former insight by using the following equation:

$$BL(t)_j = \sum_{i=1}^{n} l_{ij} \tag{3}$$

where $BL(t)_j$ and l_{ij} are the total backward linkage of sector *j*, and Leontief inverse or the total requirements matrix, respectively. The latter insight, on the other hand, is explained by [11] by using the following equation:

$$F(d+i)_i = \sum_{j=1}^{n} \alpha_{ij} \tag{4}$$

where $F(d+i)_i$ and α_{ij} are the total forward linkage of sector *i* and Leontief inverse matrix, respectively. As with equations (1) and (2), the reference of equations (3) and (4) is also the demand-driven IO model.

[9] mention that the Ghosh inverse is suggested as a better tool in describing the total forward linkage. As a consequence, the supply-driven IO model is a suitable device for measuring the forward linkage. [9] describe the following equations in representing the linkage using the model:

$$FL(d)_i = \sum_{j=1}^{n} b_{ij} \tag{5}$$

$$FL(t)_i = \sum_{j=1}^{n} g_{ij} \tag{6}$$

where $FL(d)_i$, $FL(t)_i$, b_{ij}, and g_{ij} are the direct forward linkage of sector *i*, the total forward linkage of sector *i*, the coefficients matrix in a supply-driven IO model, and the Ghosh inverse, respectively. In this study, all above equations are used in the calculations step. The next step is to analyze the ranks of Indonesian and Japanese industrial sectors on the analysis period. Conclusions of this study, and suggestions for further researches are described in the final step.

3. Results and analysis

Tables 3 and 4 explain the ranks of Indonesian industrial sectors on the analysis period which are viewed from the results of calculations results using direct and total backwards linkages, respectively. On the other hand, tables 5 and 6 describe the ranks which are viewed from the results using direct and total forwards linkages, respectively. Meanwhile, the results using the supply-driven IO model for the Indonesian case are explored in tables 7 and 8. The analysis of the case then focuses on the top five sectors of each result. More specifically, one can argue that the sector number 3, manufacturing industry, was a leading sector in the Indonesian economy in 2005 because it appears as one of the top five sectors in tables 3 – 8. In other words, on the analysis period, the sector had beneficial effects in the Indonesian economy.

Tables 9 and 10 describe the ranks of Japanese industrial sectors on the analysis period which are viewed from the results of calculations using direct and total backwards linkages, respectively. Meanwhile, tables 11 and 12 explore the ranks which are viewed from the results using direct and total forwards linkages, respectively. On the other hand, the results using the supply-driven IO model for the Japanese case are explained in tables 13 and 14. As with the previous case, the top five sectors on each result are viewed in the analysis of the Japanese issue. Based on the analysis, one can say that the sector number 9, transport, was a leading sector in the Japanese economy in 2005 because it appears as one of the top five sectors in almost all tables which explain the ranks. In other words, on the analysis period, the sector had beneficial effects in the Japanese economy.

Table 3. The ranks of Indonesian industrial sectors on the analysis period, based on the results of calculations using equation (1).

Sector Number	Sector Name	Calculated Value
4	Electricity, gas, and water supply	0.697
5	Construction	0.642
3	Manufacturing industry	0.626
7	Transport and communication	0.512
9	Services	0.460
6	Trade, hotel, and restaurant	0.407
8	Financial, real estate, and business services	0.320
1	Agriculture, livestock, forestry, and fishery	0.235
2	Mining and quarrying	0.181

Table 4. The ranks of Indonesian industrial sectors on the analysis period, based on the results of calculations using equation (2).

Sector Number	Sector Name	Calculated Value
4	Electricity, gas, and water supply	2.379
5	Construction	2.258
3	Manufacturing industry	2.161
7	Transport and communication	2.026
9	Services	1.919
6	Trade, hotel, and restaurant	1.766
8	Financial, real estate, and business services	1.585
1	Agriculture, livestock, forestry, and fishery	1.440
2	Mining and quarrying	1.295

Table 5. The ranks of Indonesian industrial sectors on the analysis period, based on the results of calculations using equation (3).

Sector Number	Sector Name	Calculated Value
3	Manufacturing industry	1.730
8	Financial, real estate, and business services	0.519
2	Mining and quarrying	0.380
6	Trade, hotel, and restaurant	0.354
7	Transport and communication	0.305
1	Agriculture, livestock, forestry, and fishery	0.256
9	Services	0.221
4	Electricity, gas, and water supply	0.207
5	Construction	0.110

Table 6. The ranks of Indonesian industrial sectors on the analysis period, based on the results of calculations using equation (4).

Sector Number	Sector Name	Calculated Value
3	Manufacturing industry	4.317
8	Financial, real estate, and business services	1.912
2	Mining and quarrying	1.798
1	Agriculture, livestock, forestry, and fishery	1.703
6	Trade, hotel, and restaurant	1.656
7	Transport and communication	1.559
9	Services	1.381
4	Electricity, gas, and water supply	1.320
5	Construction	1.183

Table 7. The ranks of Indonesian industrial sectors on the analysis period, based on the results of calculations using equation (5).

Sector Number	Sector Name	Calculated Value
8	Financial, real estate, and business services	0.803
4	Electricity, gas, and water supply	0.690
2	Mining and quarrying	0.685
1	Agriculture, livestock, forestry, and fishery	0.644
3	Manufacturing industry	0.594
7	Transport and communication	0.496
6	Trade, hotel, and restaurant	0.352
9	Services	0.218
5	Construction	0.086

Table 8. The ranks of Indonesian industrial sectors on the analysis period, based on the results of calculations using equation (6).

Sector Number	Sector Name	Calculated Value
8	Financial, real estate, and business services	2.518
2	Mining and quarrying	2.397
4	Electricity, gas, and water supply	2.393
1	Agriculture, livestock, forestry, and fishery	2.302
3	Manufacturing industry	2.095
7	Transport and communication	1.925
6	Trade, hotel, and restaurant	1.631
9	Services	1.414
5	Construction	1.167

Table 9. The ranks of Japanese industrial sectors on the analysis period, based on the results of calculations using equation (1).

Sector Number	Sector Name	Calculated Value
13	Activities not elsewhere classified	1.161
3	Manufacturing	0.698
2	Mining	0.570
4	Construction	0.538
9	Transport	0.522
5	Electricity, gas, and water supply	0.510
1	Agriculture, forestry, and fishery	0.472
10	Information and communications	0.409
12	Services	0.380
7	Finance and insurance	0.363
6	Commerce	0.315
11	Public administration	0.263
8	Real estate	0.146

Table 10. The ranks of Japanese industrial sectors on the analysis period, based on the results of calculations using equation (2).

Sector Number	Sector Name	Calculated Value
13	Activities not elsewhere classified	3.044
3	Manufacturing	2.649
4	Construction	2.224
2	Mining	2.168
9	Transport	2.081
1	Agriculture, forestry, and fishery	2.071
5	Electricity, gas, and water supply	2.063
12	Services	1.799
10	Information and communications	1.797
7	Finance and insurance	1.669
6	Commerce	1.600
11	Public administration	1.558
8	Real estate	1.279

Table 11. The ranks of Japanese industrial sectors on the analysis period, based on the results of calculations using equation (3).

Sector Number	Sector Name	Calculated Value
3	Manufacturing	1.614
7	Finance and insurance	1.028
12	Services	1.009
9	Transport	0.742
10	Information and communications	0.373
6	Commerce	0.358
11	Public administration	0.280
5	Electricity, gas, and water supply	0.269
2	Mining	0.175
1	Agriculture, forestry, and fishery	0.159
4	Construction	0.157
8	Real estate	0.113
13	Activities not elsewhere classified	0.071

Table 12. The ranks of Japanese industrial sectors on the analysis period, based on the results of calculations using equation (4).

Sector Number	Sector Name	Calculated Value
3	Manufacturing	5.249
12	Services	3.107
7	Finance and insurance	2.549
9	Transport	2.322
6	Commerce	1.828
10	Information and communications	1.751
5	Electricity, gas, and water supply	1.523
2	Mining	1.417
1	Agriculture, forestry, and fishery	1.321
11	Public administration	1.317
4	Construction	1.260
8	Real estate	1.227
13	Activities not elsewhere classified	1.133

Table 13. The ranks of Japanese industrial sectors on the analysis period, based on the results of calculations using equation (5).

Sector Number	Sector Name	Calculated Value
2	Mining	16.321
13	Activities not elsewhere classified	1.167
1	Agriculture, forestry, and fishery	0.825
7	Finance and insurance	0.709
5	Electricity, gas, and water supply	0.677
3	Manufacturing	0.647
9	Transport	0.641
10	Information and communications	0.581
12	Services	0.353
6	Commerce	0.346
4	Construction	0.144
8	Real estate	0.125
11	Public administration	0.029

Table 14. The ranks of Japanese industrial sectors on the analysis period, based on the results of calculations using equation (6).

Sector Number	Sector Name	Calculated Value
2	Mining	40.454
13	Activities not elsewhere classified	3.405
1	Agriculture, forestry, and fishery	3.014
7	Finance and insurance	2.556
9	Transport	2.544
3	Manufacturing	2.449
5	Electricity, gas, and water supply	2.437
10	Information and communications	2.139
12	Services	1.746
6	Commerce	1.735
4	Construction	1.263
8	Real estate	1.247
11	Public administration	1.098

4. Conclusions and further researches

This study determines the ranks of Indonesian and Japanese industries by using the analysis methods in the IO analysis, backward and forward linkages. The analysis period in this study is 2005. The results of calculations show that the orders of the ranks depend on the method used. Nevertheless, from the results, one can say that the manufacturing industry was a leading sector in the Indonesian economy on the analysis period. On the other hand, for the Japanese case, the sector which had the beneficial effects in the Japanese economy on the analysis period was the transport.

The ranks on the specific period can be seen from this study. Nevertheless, the deeper analysis regarding the results of calculations are needed in order to get the comprehensive depiction of the ranks on the period. This study suggests the analysis as a further research.

Another suggested further research from this study is to conduct the international comparison for Indonesia and Japan in the discussed topic. As described in Introduction, this study focuses on the observation rather than the comparison for the industrial sectors conditions of both countries on the specific period. The comparison will be an interesting further research because it can describe the comprehensive economic situations of both countries on the period. The other suggested further research is to expand the analysis period so the movement patterns of the industrial sectors of both countries can be explained.

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