Journal of Physics: Conference Series

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To cite this article: Ubaidillah Zuhdi 2017 *J. Phys.: Conf. Ser.* **820** 012030

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The ranks of Japanese industrial sectors: 2005-2011

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Abstract. The purpose of the current study is to expand the previous study which analyzes the industrial sectors ranks of specific countries. More specifically, the study aims to conduct a comparison in terms of the ranks of Japanese industrial sectors on the specific analysis period. The analysis period of the study is 2005-2011. Using the previous study as a reference, the study employs the Input-Output (IO) approach as an analysis instrument. From the results of the study, one can argue that the competitive industries in the Japanese economies in 2005 and 2011 were transport and manufacturing sectors, respectively. Besides, the results also show that, in terms of the movements of calculated values of Japanese industrial sectors, the increasing and decreasing patterns appeared on the analysis period.

1. Introduction

One of the important parts in the economic activities is industrial sectors. One can argue that the importance of industries can be seen from their trade activities in the economy. The importance can also be seen on both macro and micro levels. Therefore, an analysis of industries of one country is an important thing in describing the outlook of its economic situations. Further, the recommendations for enhancing the economic aspects of the country might be generated from the analysis.

The examples of previous studies which focus 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 identify the ranks of the industrial sectors of countries is still needed. The research is required in order to get the understanding about the competitive industries in the economic activities of focused countries. The current study tries to fulfill the gap.

The purpose of the study is to expand the previous study which analyzes the industrial sectors ranks of specific countries. More specifically, the study aims to conduct a comparison in terms of the ranks of Japanese industrial sectors on the specific analysis period. The analysis period of the study is 2005-2011. Using the previous study as a reference, the study employs the Input-Output (IO) approach as an analysis instrument.

2. Methodology

The methodology of this study refers to the previous study which was conducted by [7]. The first step of the methodology is to explain the data sources. The data sources of this study are Japanese IO tables for 2005 and 2011. The former table is obtained from [8] while the latter one is from [9]. The second step is to expose the industrial sectors of Japan used in this study. Table 1 shows the industries. The main difference between 2005 and 2011 Japanese industrial sectors is located on the sector number 9. More specifically, in the former year, the name of the industry is “Transport” while in the latter one is “Transport and postal services”.

The third step is to conduct the calculations in order to identify the ranks of the industrial sectors of Japan on the analyzed years. The methods of backward and forward linkages, the analysis instruments 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

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particular industry on other industrial sectors. These demands appear as a consequence of the industry as a purchaser in the economic activities. On the other hand, the forward linkage describes the consequence of the industrial sector as a seller.

The methods are suitable for identifying the ranks of industrial sectors on the specific time period. [10] affirm this thought 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 imposed in analyzing the forward linkage values of two or more industries.

This study implements two forms for each linkage, namely "direct" and "total". These forms can be seen on both demand-side and supply-side IO models. [11] propose the concepts of the former form on both models. To summarize, this form only describes the straightforward impacts of the demands and supplies of one specific industry. Further, [10] expose the concept of the form on the backward linkage by 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, [12] explains the concept of the form on the forward linkage 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 a base. The using of row sums in describing the direct forward linkage of the particular sector in the model is also described by [10].

The insight of the "total" form on the backward linkage in the demand-driven IO model is proposed by Rasmussen (1957) in [10] while [10] expose this on the forward linkage. To summarize, the form describes the straightforward and indirect effects of the demands and supplies of one particular industry. [10] explain 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 exposed by [12] by using the following equation:

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

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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 equations (3) and (4) also use the demand-driven IO model as a base.

[10] mention that the Ghosh inverse is suggested as a better device in explaining the total forward linkage. As a consequence, the supply-driven IO model is a suitable tool for analyzing the forward linkage. [10] expose the following equations in representing the linkage which uses 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 applied in the calculations step. The next step is to analyze the ranks and movements of Japanese industrial sectors on the analysis period. Conclusions of this study, and suggestions for further researches are exposed on the final step.

Table 1. 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 and postal services
10	Information and communications
11	Public administration
12	Services
13	Activities not elsewhere classified

3. Results and analysis

Tables 2 and 3 describe the ranks of Japanese industrial sectors on the analyzed years which the results in the tables are based on the calculations using equation (1). From the tables, the sector which had the highest different on the calculated values during the analysis period was sector 13. Figure 1 shows the calculated values movement of the sector during the period of analysis. Based on the figure, one can argue that, from 2005 through 2011, the sector had a decreasing pattern.

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Table 2. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (1), 2005.

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 3. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (1), 2011.

Sector Number	Sector Name	Calculated Value
5	Electricity, gas, and water supply	0.730
3	Manufacturing	0.715
13	Activities not elsewhere classified	0.601
2	Mining	0.553
4	Construction	0.548
1	Agriculture, forestry, and fishery	0.515
9	Transport and postal services	0.497
10	Information and communications	0.474
12	Services	0.384
7	Finance and insurance	0.342
11	Public administration	0.317
6	Commerce	0.315
8	Real estate	0.194

(Source: [7])

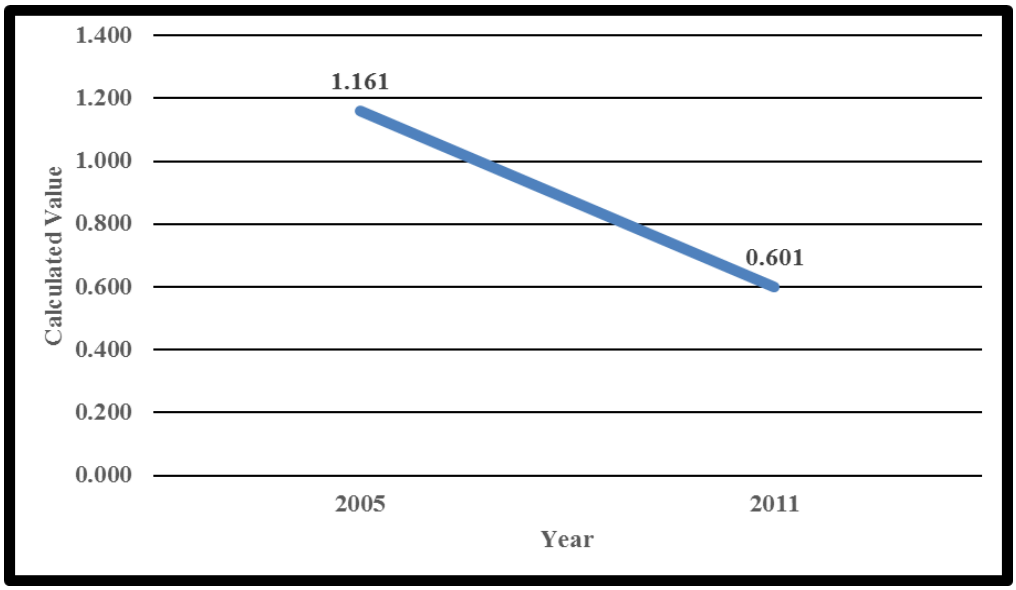

Figure 1. The calculated values movement of sector 13 based on the calculations using equation (1), 2005-2011.

On the other hand, tables 4 and 5 explain the ranks of Japanese industrial sectors on the analyzed years which the results in the tables are based on the calculations using equation (2). From the tables, the sector which had the highest different on the calculated values during the analysis period was sector 13. Figure 2 shows the calculated values movement of the sector during the period of analysis. Based on the figure, one can say that, from 2005 through 2011, the sector had a decreasing pattern.

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Table 4. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (2), 2005.

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 5. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (2), 2011.

Sector Number	Sector Name	Calculated Value
3	Manufacturing	2.769
5	Electricity, gas, and water supply	2.625
4	Construction	2.268
1	Agriculture, forestry, and fishery	2.210
2	Mining	2.181
13	Activities not elsewhere classified	2.160
9	Transport and postal services	2.077
10	Information and communications	1.935
12	Services	1.840
11	Public administration	1.664
7	Finance and insurance	1.658
6	Commerce	1.627
8	Real estate	1.361

(Source: [7])

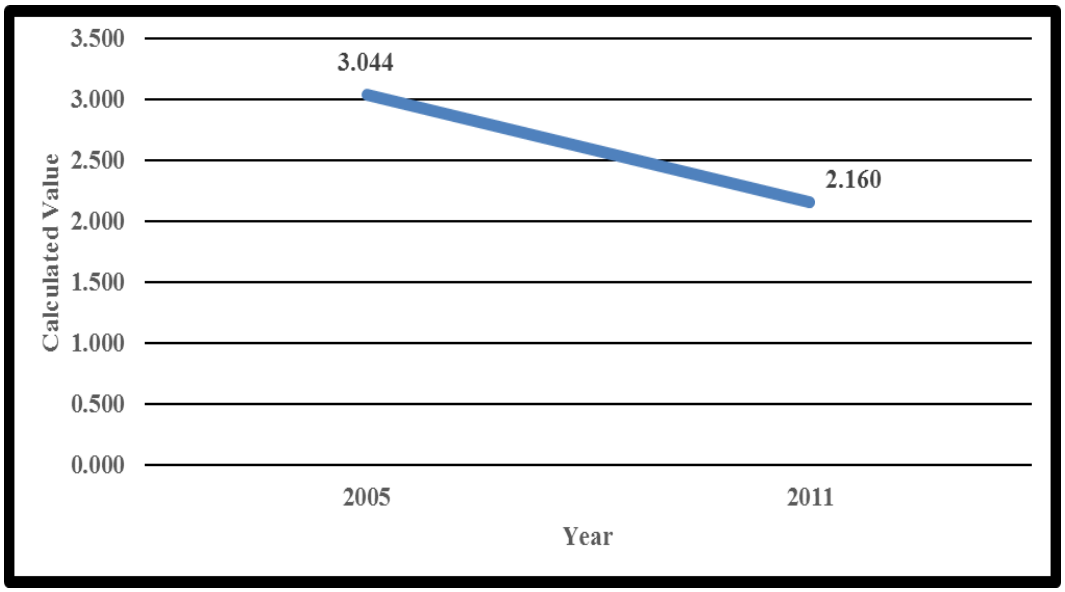

Figure 2. The calculated values movement of sector 13 based on the calculations using equation (2), 2005-2011.

Tables 6 and 7 explain the ranks of Japanese industrial sectors on the analyzed years which the results in the tables are based on the calculations using equation (3). From the tables, the sector which had the highest different on the calculated values during the analysis period was sector 7. Figure 3 shows the calculated values movement of the sector during the period of analysis. Based on the figure, one can say that, from 2005 through 2011, the sector had a decreasing pattern.

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Table 6. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (3), 2005.

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

(Source: [7])

Table 7. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (3), 2011.

Sector Number	Sector Name	Calculated Value
3	Manufacturing	1.664
12	Services	1.197
9	Transport and postal services	0.772
10	Information and communications	0.417
6	Commerce	0.364
2	Mining	0.335
7	Finance and insurance	0.312
5	Electricity, gas, and water supply	0.289
11	Public administration	0.227
8	Real estate	0.203
4	Construction	0.170
1	Agriculture, forestry, and fishery	0.155
13	Activities not elsewhere classified	0.080

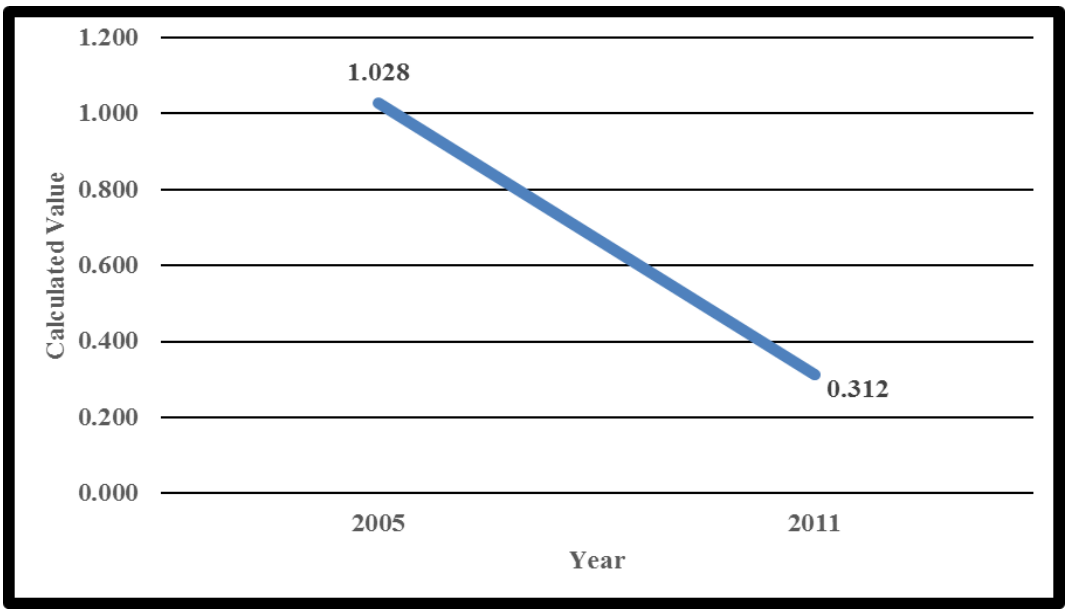

Figure 3. The calculated values movement of sector 7 based on the calculations using equation (3), 2005-2011.

Tables 8 and 9 expose the ranks of Japanese industrial sectors on the analyzed years which the results in the tables are based on the calculations using equation (4). From the tables, the sector which had the highest different on the calculated values during the analysis period was sector 7. Figure 4 shows the calculated values movement of the sector during the period of analysis. Based on the figure, one can argue that, from 2005 through 2011, the sector had a decreasing pattern.

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Table 8. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (4), 2005.

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 9. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (4), 2011.

Sector Number	Sector Name	Calculated Value
3	Manufacturing	5.629
12	Services	3.379
9	Transport and postal services	2.455
6	Commerce	1.871
10	Information and communications	1.767
2	Mining	1.763
5	Electricity, gas, and water supply	1.582
7	Finance and insurance	1.521
8	Real estate	1.363
1	Agriculture, forestry, and fishery	1.336
4	Construction	1.297
11	Public administration	1.261
13	Activities not elsewhere classified	1.151

(Source: [7])

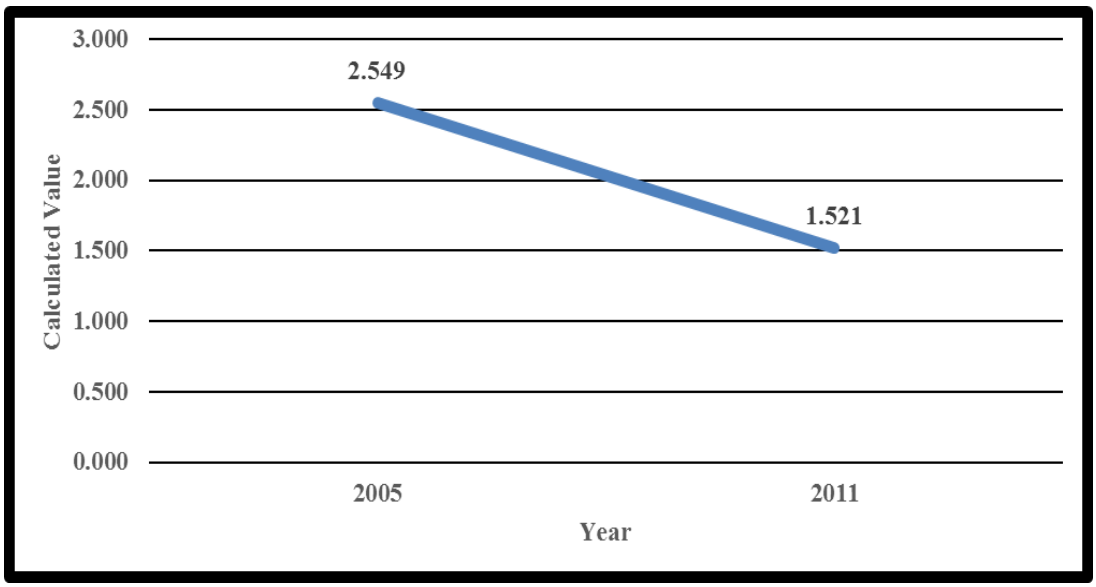

Figure 4. The calculated values movement of sector 7 based on the calculations using equation (4), 2005-2011.

Tables 10 and 11 describe the ranks of Japanese industrial sectors on the analyzed years which the results in the tables are based on the calculations using equation (5). From the tables, the sector which had the highest different on the calculated values during the analysis period was sector 2. Figure 5 exposes the calculated values movement of the sector during the period of analysis. Based on the figure, one can say that, from 2005 through 2011, the sector had an increasing pattern.

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Table 10. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (5), 2005.

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 11. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (5), 2011.

Sector Number	Sector Name	Calculated Value
2	Mining	31.701
13	Activities not elsewhere classified	1.003
1	Agriculture, forestry, and fishery	0.887
5	Electricity, gas, and water supply	0.690
3	Manufacturing	0.668
9	Transport and postal services	0.645
10	Information and communications	0.552
7	Finance and insurance	0.517
6	Commerce	0.378
12	Services	0.360
4	Construction	0.186
8	Real estate	0.167
11	Public administration	0.029

(Source: [7])

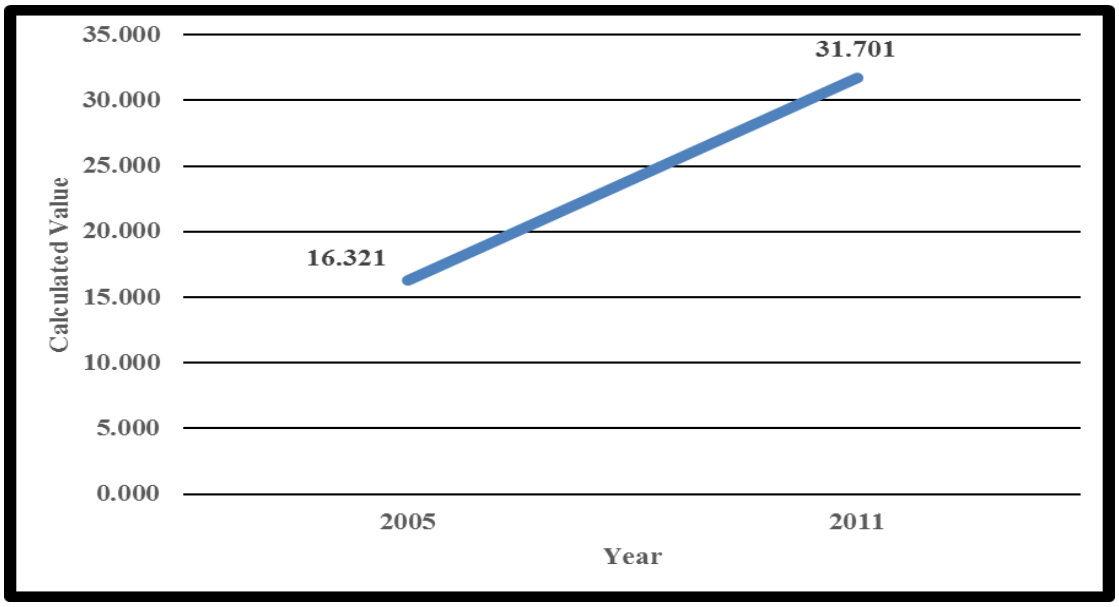

Figure 5. The calculated values movement of sector 2 based on the calculations using equation (5), 2005-2011.

Meanwhile, tables 12 and 13 expose the ranks of Japanese industrial sectors on the analyzed years which the results in the tables are based on the calculations using equation (6). From the tables, the sector which had the highest different on the calculated values during the analysis period was sector 2. Figure 6 explains the calculated values movement of the sector during the period of analysis. Based on the figure, one can argue that, from 2005 through 2011, the sector had an increasing pattern.

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Table 12. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (6), 2005.

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

(Source: [7])

Table 13. The ranks of Japanese industrial sectors which are based on the results of calculations using equation (6), 2011.

Sector Number	Sector Name	Calculated Value
2	Mining	82.632
1	Agriculture, forestry, and fishery	3.276
13	Activities not elsewhere classified	3.072
9	Transport and postal services	2.722
5	Electricity, gas, and water supply	2.597
3	Manufacturing	2.583
10	Information and communications	2.087
7	Finance and insurance	1.970
6	Commerce	1.837
12	Services	1.755
4	Construction	1.358
8	Real estate	1.329
11	Public administration	1.089

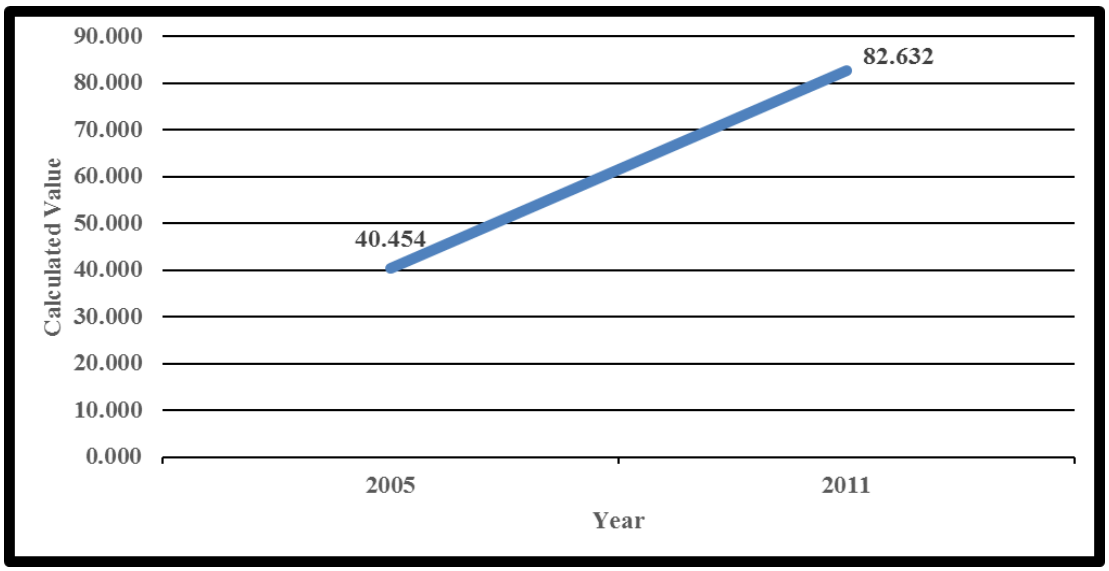

Figure 6. The calculated values movement of sector 2 based on the calculations using equation (6), 2005-2011.

4. Conclusions and further researches

The current study, as a continuation study of the previous one, compares the ranks of Japanese industries by using the analysis methods in the IO analysis, backward and forward linkages, on the analyzed years. From the results of the study, one can argue that the industries which had the beneficial effects in the Japanese economies in 2005 and 2011 were transport and manufacturing sectors, respectively. Besides, the results also show that, in terms of the movements of calculated values of Japanese industrial sectors, the increasing and decreasing patterns appeared on the analysis period.

The suggested further research from the study is to enrich the analyzed industrial sectors for the focused country using the same analysis period. This suggestion is exposed in order to get the deeper insight regarding the economic conditions of Japan on the period, especially about the ranks of its industries. This deeper insight might be useful in determining the focused sectors on its economic activities in the future. The

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other suggested further research is to expand the area of analysis using the same methodology so the industrial sectors ranks of other countries can also be analyzed. The examples are to conduct the analyses for the ASEAN and EU countries.

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