

An application of input-output analysis in analyzing the impacts of final demands changes on the total outputs of Japanese energy sectors: A further study

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Abstract. The purpose of this study is to continue the previous study which discussed the impacts of final demands changes on the total outputs of Japanese energy sectors. More specifically, this study aims to conduct a deeper analysis regarding these impacts. This study employs a demand-pull Input-Output (IO) quantity model, one of the calculation instruments in IO analysis, as a tool of analysis. This study focuses on two sectors, namely (1) petroleum refinery products, and (2) non-ferrous metals. Two conditions are considered in the analysis part, namely (1) “whole sector change”, and (2) “pure change”. The results show that in both conditions, both discussed sectors have similar patterns. The results also explain that, in both conditions, the biggest positive impact for the sector of petroleum refinery products is given by scenario 4, the modification of consumption expenditures of private.

1. Introduction

In this day and age, human dependence on energy can be easily observed. The simplest evidence is human needs energy when he or she does the activities. This dependency can also be seen in broader aspects. For example, the government usually considers the availability of energy sources when new economic policies must be made. Besides, countries also consider this availability before executing the economic activities such as an international trade. Therefore, based on these facts, one can argue that energy is also economically important.

Many previous studies discussed the energy topic. For example, [1] described the connections between the prices of oil and Euro area's inflation. [2] investigated the effect of oil price shocks on the economic growth of some Middle East and North Africa (MENA) countries. [3] analyzed the relationship between the changes of price of oil and real Gross Domestic Product (GDP) which the focus was the economy of US. Besides, [4] analyzed the ways to increase the total outputs of Japanese energy sectors in the future. He used Input-Output (IO) analysis and some scenarios of final demands change in his study.

The study analyzes the impacts of final demands changes on the total outputs of energy sectors of specific country, viewed from above previous studies, however, is still thin. This analysis is important because it will describe the characteristics of these sectors when the changes of national economy condition happen. Further, it can give the understanding regarding the improvements needed for enhancing the sectors. This study is conducted in order to fulfill the gap.

The purpose of this study is to continue the previous study which discussed the impacts of final demands changes on the total outputs of Japanese energy sectors. More specifically, this study aims to conduct a deeper analysis regarding these impacts. This study employs IO approach as a tool of analysis.



2. Methodology

The methodology of this study is similar with the one used in a previous study, the study conducted by [4], and described as follows. The first step is to explain the data used. This study uses an aggregated IO table of Japan for 2005. This table consists of 89 industrial sectors. These industries are described in Appendix.

The second step is to describe Japanese energy sectors used. Table 1 shows these sectors. As with a previous study, this study also focuses on two sectors. These sectors are (1) petroleum refinery products, and (2) non-ferrous metals.

The third step is to conduct the calculation in order to know the impacts of final demand changes on the total outputs of analyzed sectors. A demand-pull IO quantity model, one of the calculation instruments in IO analysis, is used in this calculation. [5] explained that following equation is a representation of this model:

$$\mathbf{x}^1 = \mathbf{L}^0 \mathbf{f}^1 \quad (1)$$

where \mathbf{x} , \mathbf{L} , and \mathbf{f} are matrices of total outputs of sectors, Leontief inverse, and final demands of sectors, respectively. 0 and 1 describe initial and future periods, respectively. An initial period in this study is 2005. Table 2 explains the scenarios of final demands modification used. These scenarios, compared with previous ones, are slightly different. The difference can be seen on the existence of scenario 4, the change of consumption expenditures of private. Simultaneously, the deeper understanding regarding the impacts is obtained through this extension.

The conditions of “whole sector change” and “pure change” are considered in above calculation. The former situation explains the condition which the changes of final demands are addressed to all Japanese industrial sectors while the latter one only focuses on the discussed sectors. In this study, the former one will be called “condition A” while the term of “condition B” is used to explain the latter condition. The analysis regarding above impacts is discussed on the next step. Conclusions of this study and suggestions for further researches are described on the final step.

Table 1. Japanese energy sectors used in this study.

No.	Sector Number	Sector Name
1	6	Metallic ores
2	7	Non-metallic ores
3	8	Coal mining, crude petroleum and natural gas
4	26	Final chemical products, n.e.c. ^a
5	27	Petroleum refinery products
6	28	Coal products
7	36	Pig iron and crude steel
8	37	Steel products
9	38	Steel castings and forgings, and other steel products
10	39	Non-ferrous metals
11	40	Non-ferrous metal products
12	41	Metal products for construction and architecture
13	42	Other metal products

^a Not elsewhere classified.

(Source: [6] with slight modifications)

Table 2. The scenarios of final demands modification used in this study.

Component of Final Demand	Scenario			
	1	2	3	4
	Exports Modification	Imports Modification	The Modification of Consumption Expenditures of Outside Households	The Modification of Consumption Expenditures of Private
Exports	Increase 30%	Constant	Constant	Constant
Imports	Constant	Increase 30%	Constant	Constant
Consumption expenditures of outside households	Constant	Constant	Increase 30%	Constant
Consumption expenditures of private	Constant	Constant	Constant	Increase 30%

3. Results and analysis

Table 3 describes the total outputs of discussed sectors for each scenario on condition A. Figures 1 and 2 explain in more details the dynamics happen on these total outputs on this condition. Based on these results, one can argue that, on this condition, the biggest positive impact on the total output of petroleum refinery products sector is given by scenario 4, the modification of consumption expenditures of private. Meanwhile, scenario 1, the exports modification, has the biggest positive effect on the total output of non-ferrous metals sector. On the contrary, the negative impact is given by scenario 2, the change of imports.

On the other hand, Table 4 describes the total outputs of analyzed sectors for each scenario on condition B. Figures 3 and 4 explain in more details the dynamics happen on these total outputs on this condition. Based on these results, one can say that, on this condition, the biggest positive impact on the total output of petroleum refinery products sector is given by scenario 4, the modification of consumption expenditures of private. Meanwhile, scenario 1, the change of exports, has the biggest positive effect on the total output of non-ferrous metals sector. On the contrary, the negative impact is given by scenario 2, the imports change.

Above phenomena show that, in both conditions, both discussed sectors have similar patterns, namely these industries receive the positive impacts from scenarios 1, 3, and 4 while the opposite impact is obtained from scenario 2. This negative impact also appeared in the previous study. Above phenomena also explain that, in both conditions, the biggest positive impact for the sector of petroleum refinery products is given by scenario 4, the modification of consumption expenditures of private. This is a new finding compared with a previous study. Based on these results, one can argue that the effective ways to increase the total output of this sector in the future are to open greater opportunities for private sectors in processing products of this industry, and to restrict import activities regarding these products.

Table 3. Total outputs of discussed sectors for each scenario on condition A (100 million Yen).

Sector Number	Sector Name	X_t	X_{t+1} , Scenario 1	X_{t+1} , Scenario 2	X_{t+1} , Scenario 3	X_{t+1} , Scenario 4
27	Petroleum refinery products	156,740.17	170,203.33	138,594.26	158,126.05	193,243.18
39	Non-ferrous metals	21,527.12	29,139.76	11,014.71	21,820.99	24,959.84

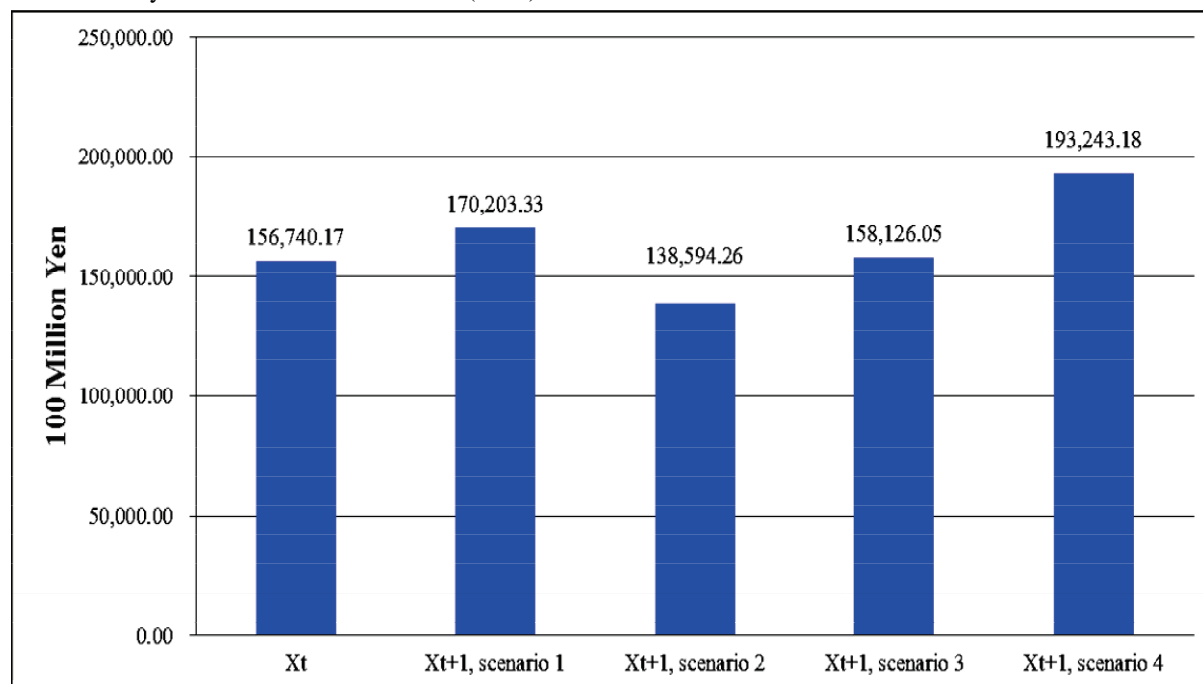


Figure 1. The dynamics happen on the total output of petroleum refinery products sector (condition A).

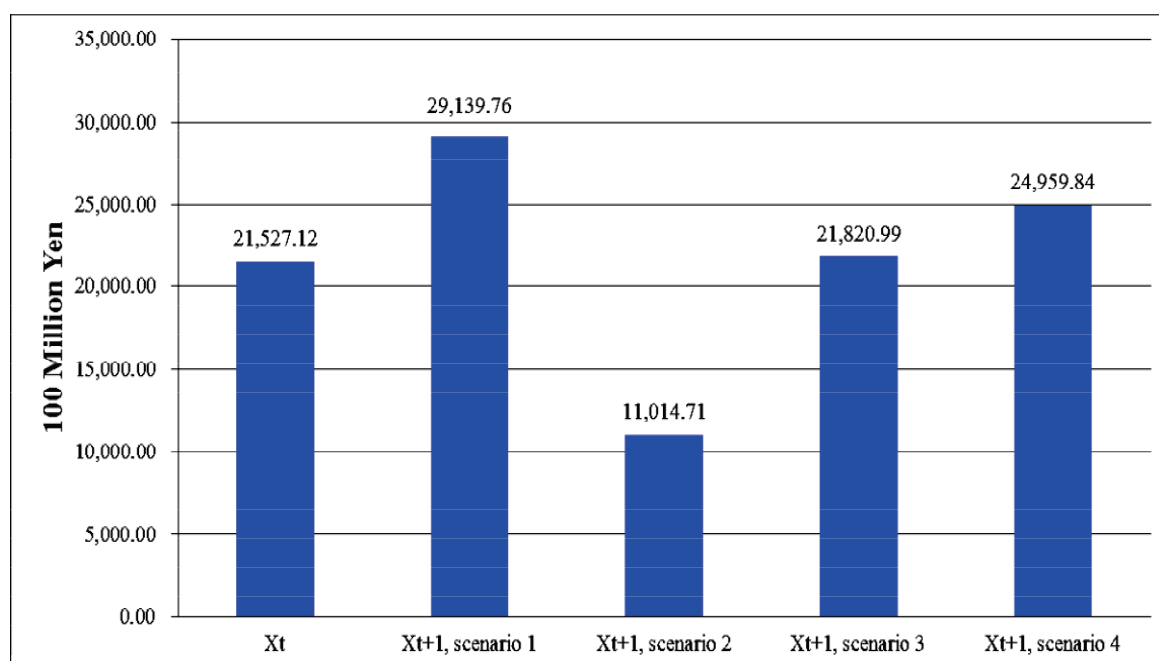


Figure 2. The dynamics happen on the total output of non-ferrous metals sector (condition A).

Table 4. Total outputs of discussed sectors for each scenario on condition B (100 million Yen).

Sector Number	Sector Name	X_t	X_{t+1} , Scenario 1	X_{t+1} , Scenario 2	X_{t+1} , Scenario 3	X_{t+1} , Scenario 4
27	Petroleum refinery products	156,740.17	159,467.79	148,055.30	156,843.72	175,229.98
39	Non-ferrous metals	21,527.12	22,943.73	14,992.47	21,527.36	21,896.06

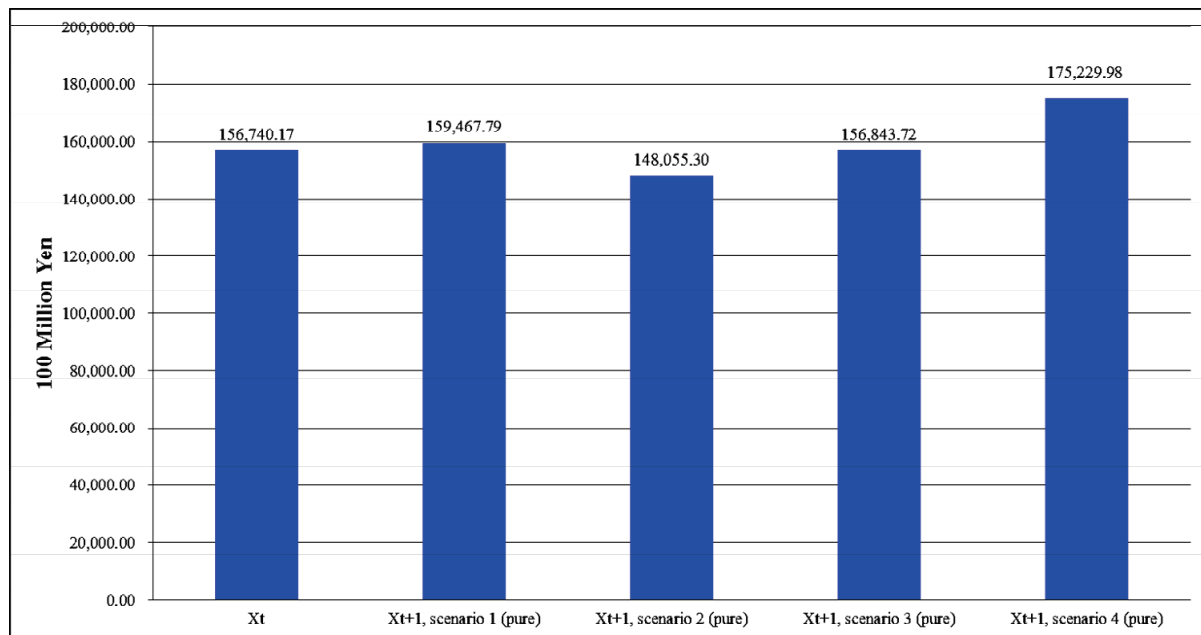


Figure 3. The dynamics happen on the total output of petroleum refinery products sector (condition B).

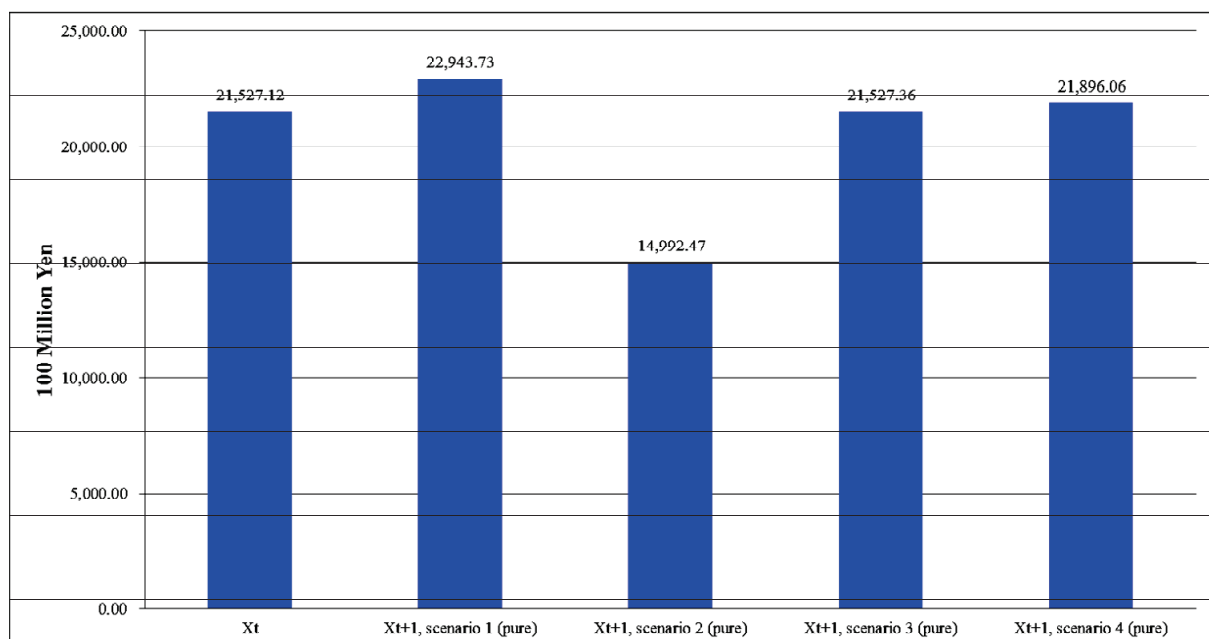


Figure 4. The dynamics happen on the total output of non-ferrous metals sector (condition B).

4. Conclusions and further researches

This study, as a continuation of a previous study, conducted the deeper analysis regarding the impacts of final demands changes on the total outputs of Japanese energy sectors. This study employed a demand-pull IO quantity model, one of the calculation instruments in IO analysis, as a tool of analysis. This study focused on two sectors, namely (1) petroleum refinery products, and (2) non-ferrous metals. Two conditions were considered in the analysis part, namely (1) “whole sector change”, and (2) “pure change”. An initial period in this study was 2005. The difference between current and previous studies could be seen on the existence of scenario 4, the change of consumption expenditures of private.

The results showed that in both conditions, both discussed sectors had similar patterns, namely these industries obtained the positive impacts from scenarios 1, 3, and 4 while the opposite impact was received from scenario 2. This negative impact also appeared in the previous study. The results also explained that, in both conditions, the biggest positive impact for the sector of petroleum refinery products was given by scenario 4, the modification of consumption expenditures of private. This was a new finding in this topic. Based on these results, the suggestions from this study regarding the effective ways to increase the total output of this sector in the future were to open greater chances for private sectors in processing products of this industry, and to limit import activities regarding these products.

The deeper understanding regarding the impacts of final demands changes on the total outputs of Japanese energy sectors was obtained from this study. However, this study only analyzed specific energy sectors of Japan. In other words, the comprehensive view regarding the impacts on the national economy of Japan did not appear in this study. This view is needed in order to make comprehensive policies for enhancing the economic condition of Japan in the future. Therefore, as a further research, this study proposes the same analysis for other Japanese industrial sectors.

The other suggested further research from this study is to conduct the international comparison on the current topic. This comparison will describe the characteristics of industries of analyzed countries when the final demands changes happen. A good example is to compare developed and developing countries.

References

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Appendix. Japanese Industrial Sectors (89 Sectors)

No.	Sector Name
1	Crop cultivation
2	Livestock
3	Agricultural services
4	Forestry
5	Fisheries
6	Metallic ores
7	Non-metallic ores
8	Coal mining, crude petroleum and natural gas
9	Foods
10	Beverage
11	Feeds and organic fertilizer, n.e.c.
12	Tobacco
13	Textile products
14	Wearing apparel and other textile products
15	Timber and wooden products
16	Furniture and fixtures
17	Pulp, paper, paperboard, building paper
18	Paper products
19	Printing, plate making and book binding
20	Chemical fertilizer
21	Industrial inorganic chemicals
22	Petrochemical basic products and intermediate chemical products
23	Synthetic resins
24	Synthetic fibers
25	Medicaments
26	Final chemical products, n.e.c.
27	Petroleum refinery products
28	Coal products
29	Plastic products
30	Rubber products
31	Leather, fur skins and miscellaneous leather products
32	Glass and glass products
33	Cement and cement products
34	Pottery, china and earthenware
35	Other ceramic, stone and clay products
36	Pig iron and crude steel
37	Steel products
38	Steel castings and forgings, and other steel products
39	Non-ferrous metals
40	Non-ferrous metal products

41	Metal products for construction and architecture
42	Other metal products
43	General industrial machinery
44	Special industrial machinery
45	Other general machines
46	Machinery for office and service industry
47	Electrical appliance
48	Motor vehicles
49	Ships and repair of ships
50	Other transportation equipment and repair of transportation equipment
51	Precision instruments
52	Miscellaneous manufacturing products
53	Building construction
54	Repair of construction
55	Civil engineering
56	Electricity
57	Gas and heat supply
58	Water supply
59	Waste management service
60	Commerce
61	Finance and insurance
62	Real estate agencies and rental services
63	House rent
64	Railway transport
65	Road transport (except transport by private cars)
66	Self-transport by private cars
67	Water transport
68	Air transport
69	Freight forwarding
70	Storage facility service
71	Services relating to transport
72	Communication
73	Broadcasting and information services
74	Public administration
75	Education
76	Research
77	Medical service and health
78	Social security
79	Other public services
80	Advertising, survey and information services
81	Goods rental and leasing services
82	Repair of motor vehicles and machine
83	Other business services
84	Amusement and recreational services
85	Eating and drinking places

86	Accommodations
87	Other personal services
88	Office supplies
89	Activities not elsewhere classified

(Source: [7] with slight modifications)