The dynamics of the total output of the Japanese fisheries sector: An analysis using input-output approach

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Abstract. The purpose of this study is to investigate the dynamics of the total output of the fisheries industry when the changes of the final demand occur. This study focuses on the case of Japan. This study employs a demand-pull Input-Output (IO) quantity model, one of the calculation instruments in the IO analysis, as an analysis tool. Two conditions are included in calculations and analysis parts, namely (1) "whole sector change", and (2) "pure change". An initial period in this study is 2005. The results show that, in both conditions, the analyzed sector has similar patterns, namely this industry obtains the positive impacts from scenarios 1, 3, and 4 while the negative impact is received from scenario 2. The results also expose that, in both conditions, the biggest positive impact for the discussed sector is given by scenario 4, the modification of the consumption expenditures of the private.

1. Introduction

[1] exposed the importance of the fishery industry in the society through the following explanation:

"*To those involved in fisheries, the importance of the industry to the economy is obvious: (i) exports of fish and fish products earn foreign exchange which helps provide the resources needed to pay for crucial imports; (ii) it provides employment for a substantial number of people; (iii) the catch of commercial and artisanal fishers provide an important source of food for the community; and (iv) the fish, shellfish, seaweed and other aquatic resources collected by families are a crucial part of their livelihood.*"

On the other hand, [2], through the following description, mentioned the values of fish:

"*Historically, economic values of fish have been viewed solely in the context of commercial harvest. However in recent years, others aspects of value are being recognised both in the UK and abroad. Recreational fisheries, principally angling, can have significant economic importance and social benefits while fish can be valued for their own existence as part of the native fauna, regardless of their exploitation.*"

Meanwhile, [3] described the role of fisheries in the society through the following statements:

"*Around 140 million tonnes of fish and seafood per year are used for human consumption. Set against the global production of cereals of around 2.2 billion tonnes, that figure is comparatively low. Owing to its unique combination of nutrients, fish makes a major contribution to a healthy diet. It supplies proteins, healthy fatty acids, vitamins and other elements essential for health such as iodine and selenium. Furthermore, in developing countries fish is often the only affordable and relatively easily available source of animal protein. In some regions on Earth fish can provide up to 50 per cent of the total animal protein in people's diets. This is the case, for example, in Bangladesh, Cambodia and Ghana.*"

The following exposure, which was given by [4], reaffirms the role:

"*Directly and indirectly, fisheries provide employment for hundreds of millions of people. The vast majority of these people are in developing countries where the sector often plays a key role in preventing and reducing poverty; it is likely that millions more people are involved in fishing activities than appear in official statistics.*"

Therefore, based on above facts, one can say that, from an economic point of view, the fishery is an essential part in the society.

Many previous studies discussed the fishery topic. For example, [5] addressed the fish behavior at the mouth of a midwater trawl in two temperate reservoirs. They employed a SIMRAD EK60 (38 kHz) split-beam echosounder with the transducer deployed at the water surface, attached to the surface trawl headrope, in their study in monitoring fish distribution and behavior. [6] assessed the impacts of lure color on catch-per-unit-effort (CPUE), size selectivity and hooking injury of largemouth bass, *Micropterus salmoides*, by employing artificial 12.7 cm unscented soft-plastic worms. Their study exposed that while different lure colors might capture the imagination and wallet of the angler, they do not influence CPUE or hooking injury in bass but appear to have a little impact on the size of the captured fish. [7] conducted the estimations of (1) catches for all marine fishing sectors, (2) the effort of fishing in the major Italian fishing fleets, and (3) the catch per unit of the effort from 1950 to 2010. [8] did the comparison of the estimated life history parameters for *Hyporthodus octofasciatus* from the south-eastern Indian Ocean with the one from the western central Pacific Ocean.

Meanwhile, [9] conducted the study in order to obtain a deeper understanding of the relationships between *Doryteuthis gahi* immigrations and size distributions during the seasons of fishing, and related wind, temperature, and geostrophic current conditions. The focused area of their study was Falkland Islands. [10] measured the impact of the three types of the underwater lighting on observable rockfish density and behavior by utilizing an underwater stereo camera. [11] explored the crisis involving the Europe Union (EU), Iceland, Norway, and the Faroe Islands regarding the relative allocation and size of Total Allowable Catches (TACs) in the mackerel fishery in the Northeast Atlantic. They used simple non-cooperative and cooperative game theory in their study. [12] evaluated the assumption which is used by stock assessment scientists and fishery managers in their works. They compared industry-generated reports of landed catch to independent observer estimates in their study. [13] developed a method to objectively measure and characterize the location and size of the patterns of discoloration which are currently appeared in the fillets of commercially harvested yellowtail flounder (*Limanda ferruginea*) on the east coast of Canada. Further, they developed the program of image processing to analyze the patterns of the fillet discoloration in order to achieve the goal of their study.

The study analyzes the fishery sector of the specific Asian country, from above literatures, however, is still limited. On the other hand, the readers are provided the previous studies discussed the other industrial sectors of Asian countries. For example, [14] forecasted the influences of the Information and Communication Technology (ICT) on the structural changes of the national economics of Japan. They used Input-Output (IO) and statistical approaches as analysis instruments. [15] analyzed the role of ICT sectors on the Japanese national economy using simple household income multiplier, one of the analysis devices in the IO analysis. The analysis period of his study was from 1995-2005. On the other hand, using this multiplier, [16] analyzed this role on the Indonesian national economy. The period of the analysis of his study was from 1990-2005. [17] inquired the influences of Gross Domestic Product (GDP) and ICT on the changes of the structures of Indonesian industrial sectors from 1990-2005. They used the statistical instrument in analyzing these influences, namely the Constrained Multivariate Regression (CMR) model. [18] exposed the impacts of the modifications of final demands on the total outputs of Indonesian ICT sectors by employing the IO analysis as an analysis device. [19] employed a simple output multipliers method in order to obtain the other perspective regarding the role of ICT sectors in the Indonesian national economy from 1990-2005. The study analyzed the other perspective regarding this role for the case of Japan was conducted by [20]. His analysis focused on the period between 1995 and 2005. Besides, [21] did the comparison between Indonesia and Japan regarding the role by using the Structural Decomposition Analysis (SDA).

Meanwhile, [22] analyzed the dynamics of Indonesian creative industries. More specifically, the purposes of his study were (1) to obtain the other perspective about the role of creative industry sectors in the Indonesian national economy, and (2) to inquire the strategies to improve these industries. He employed the

IO analysis in order to achieve these goals. His study focused on the analysis period between 1990 and 2005. Besides, [23] conducted a deeper analysis regarding the effects of the changes of final demands on the total outputs of Japanese energy sectors. His study focused on two industries, namely (1) petroleum refinery products, and (2) non-ferrous metals.

The study focuses on the analysis of the fishery sector of the specific Asian country is needed because it will expose the characteristics of the sector. Further, this analysis can also open the chance in observing this sector from an economic point of view. This study is conducted in order to fulfill the gap of the research in the fishery topic.

The purpose of this study is to analyze the dynamics of the fisheries industry of the specific Asian country. This study focuses on the Japanese case. This country is chosen because their rate of fish consuming is high. Using the previous studies as references, this study uses the IO analysis as an analysis instrument. The dynamics are represented by the amendments of the total output of the industry. The trigger of these amendments is the changes of the final demand of the sector.

2. Methodology

The methodology of this study refers to the previous study which was conducted by [23]. The methodology of this study is explained as follows. The first step is to describe the data used. This study uses the aggregated IO table of Japan for 2005. This table consists of 89 sectors. These sectors are exposed in Appendix.

The second step is to define the Japanese fishery sector used. This sector is explained in Table 1. The third step is to conduct the calculations in order to observe the impacts of the changes of the final demand on the total output of the analyzed sector. A demand-pull IO quantity model, one of the calculation instruments in the IO analysis, is employed in the calculations. [24] explained that the following equation is a representation of this model:

$$\mathbf{x}^1 = \mathbf{L}^0\mathbf{f}^1 \tag{1}$$

where **x**, **L**, and **f** are the matrices of the total outputs of sectors, the Leontief inverse, and the 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 final demand modification scenarios used.

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

3. Results and analysis

Table 3 describes the total output of the discussed sector for each scenario on condition A. Figure 1 exposes in more details the dynamics of the total output of the sector on this condition. Based on the results, one can argue that, on the condition, the biggest positive impact on the total output of the analyzed sector is given by scenario 4, the change of the consumption expenditures of the private. Meanwhile, the negative impact is delivered by scenario 2, the modification of imports.

Table 1. Japanese fisheries sector used in this study.

Sector Number	Sector Name
5	Fisheries

Table 2. The final demand modification scenarios used in this study.

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

(Source: [23], with the slight modifications)

On the other hand, Table 4 explains the total output of the analyzed sector for each scenario on condition B. Figure 2 describes in more details the dynamics of the total output of the sector on this condition. Based on the results, one can argue say, on the condition, the biggest positive impact on the total output of the analyzed sector is given by scenario 4, consumption expenditures of the private modification. Meanwhile, the negative impact is delivered by scenario 2, the change of imports.

Above phenomena show that, in both conditions, the discussed sector has similar patterns, namely this industry obtains the positive impacts from scenarios 1, 3, and 4 while the opposite impact is received from scenario 2. Above phenomena also describe that, in both conditions, the biggest positive impact for the analyzed sector is given by scenario 4, the change of the consumption expenditures of the private. Based on these results, one can argue that, the effective way to increase the total output of the Japanese fisheries sector in the future are to enhance the rate of private institutions in terms of consuming the products of the industry. Besides, to restrict import activities for these products also will be a good strategy.

The marine ecosystem balance, however, should be noticed by all parties who have relationships with the fishing. Besides, they must realize that the overfishing activity is a cruel thing. The following explanation, which was mentioned by [25], confirms the negative side of this activity:

"*The market for seafood is huge, and expanding rapidly, but wild stocks of fish are declining dramatically due to overfishing, pollution and other human impacts.*"

The importance of the balance should be understood because we, humans, will experience the huge pains when the ecosystem is damaged. In other words, they have to know and conduct the marine ecosystem maintenance activities too. One of the pains is a food shortage phenomenon.

Table 3. The total output of the discussed sector for each scenario on condition A (100 million Yen).

Sector Number	Sector Name	X_t, t = 2005	X_{t+1}, Scenario 1	X_{t+1}, Scenario 2	X_{t+1}, Scenario 3	X_{t+1}, Scenario 4
5	Fisheries	16,101.68	16,349.53	14,168.71	16,775.16	21,561.09

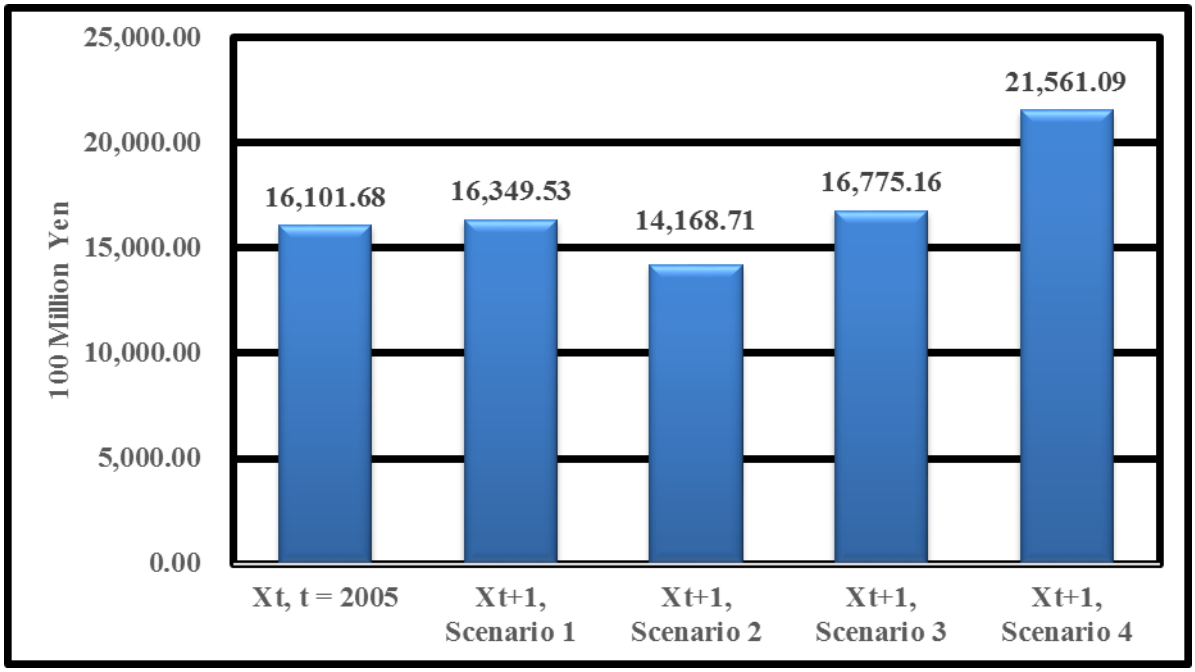

Figure 1. The dynamics of the total output of the Japanese fisheries sector (condition A).

Table 4. The total output of the discussed sector for each scenario on condition B (100 million Yen).

Sector Number	Sector Name	X_t, t = 2005	X_{t+1}, Scenario 1	X_{t+1}, Scenario 2	X_{t+1}, Scenario 3	X_{t+1}, Scenario 4
5	Fisheries	16,101.68	16,230.05	15,091.61	16,162.85	17,260.46

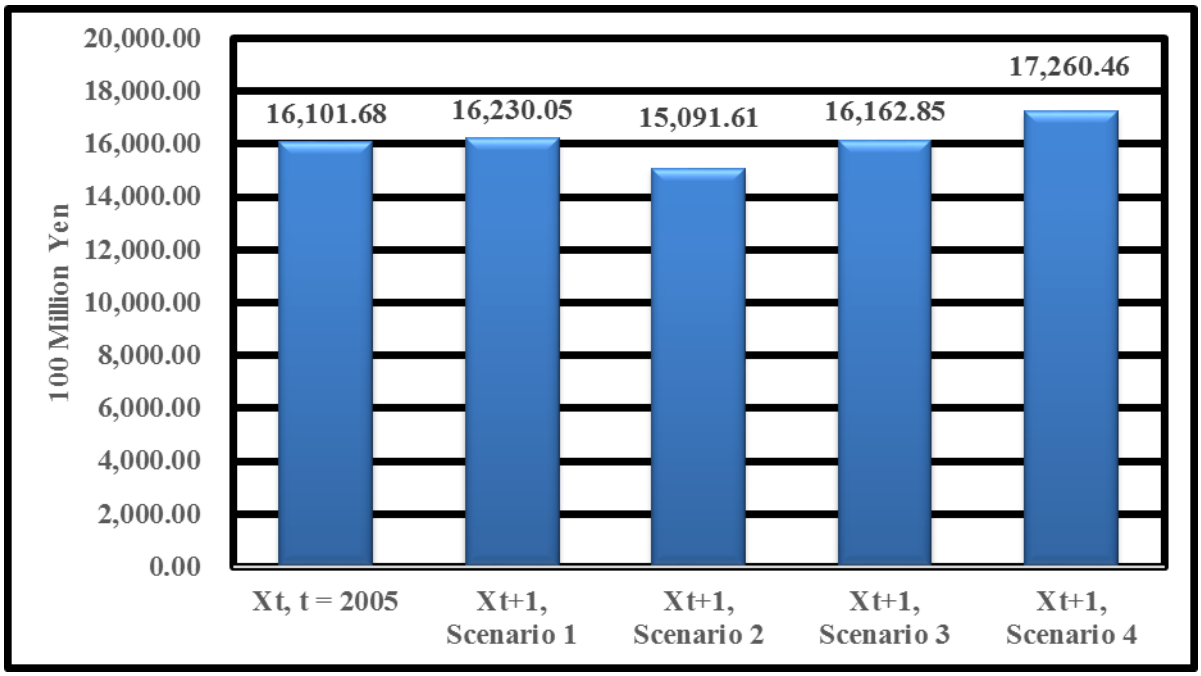

Figure 2. The dynamics of the total output of the Japanese fisheries sector (condition B).

4. Conclusions and further researches

This study examined the dynamics of the total output of the Japanese fisheries industry when the changes of the final demand occurred. This study employed a demand-pull IO quantity model, one of the calculation instruments in the IO analysis, as an analysis tool. Two conditions were included in calculations and analysis parts, namely (1) "whole sector change", and (2) "pure change". An initial period in this study was 2005.

The results showed that, in both conditions, the analyzed sector had similar patterns, namely this industry obtained the positive impacts from scenarios 1, 3, and 4 while the negative impact was received from scenario 2. The results also exposed that, in both conditions, the biggest positive impact for the discussed sector was given by scenario 4, the modification of the consumption expenditures of the private. Based on the results, the suggestions from this study regarding the effective ways to escalate the total output of the fisheries sector of Japan in the future were to increase the rate of private institutions in terms of consuming the products of the industry, and to limit import activities for these outputs.

The dynamics of the total output of the Japanese fisheries sector could be examined from this study. This study, however, did not conduct the deep analysis about how to effectively enhance the output in the future. This analysis is needed in order to concretely map out the steps for achieving the objective. Therefore, as a further research, this study suggests the analysis.

This study also did not execute the investigations in order to know the dynamics of the total outputs of other Japanese sectors. The outcomes of these investigations will be good insights especially in order to know the characteristics of these sectors. Hence, this study also proposes the investigations as a further research.

The role of the fisheries industry on the Japanese economy, however, could not be seen from this study. The information about this role is needed in order to sharpen the strategies for escalating the total output of this industry in the future. Based on this reason, this study recommends the exploration in order to know the role as one of the future researches. This exploration will be more comprehensive if the other data are also included.

The other suggested future research from this study is to execute the international comparison on the current discussion. This comparison will expose the characteristics of the fishery sectors of analyzed countries when the changes of final demands occur. One of the examples is to compare developed and developing countries. More specifically, a good example is to compare Japan and one of the developing countries, such as Indonesia.

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, and building paper
18	Paper products
19	Printing, plate making, and book binding
20	Chemical fertilizer
21	Industrial inorganic chemicals
22	Basic petrochemical 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	Machineries for office and service industry

47	Electrical appliance
48	Motor vehicles
49	Ships, and the repairement of ships
50	Other transportation equipment, and the repairement of transportation equipment
51	Precision instruments
52	Miscellaneous manufacturing products
53	Building construction
54	Construction repairement
55	Civil engineering
56	Electricity
57	Gas and heat supply
58	Water supply
59	Waste management services
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 services
71	Services related to transport
72	Communication
73	Broadcasting and information services
74	Public administration
75	Education
76	Research
77	Medicals services and health
78	Social security
79	Other public services
80	Advertising, survey, and information services
81	Goods rental and leasing services
82	Repairement 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: [26], with the slight modifications)

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