

The dynamics of the total outputs of Japanese information and communication technology sectors: A further study

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Abstract. The purpose of this study is to continue the previous studies which discussed the impacts of the changes of final demands on the total outputs of the Information and Communication Technology (ICT) sectors of the specific country. More specifically, this study aims to conduct a deeper analysis regarding these impacts. This study focuses on the case of Japan. This study employs a demand-pull Input-Output (IO) quantity model, one of the calculation tools in the IO analysis, as an analysis instrument. 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 discussed sectors have similar patterns, namely these industries receive the positive impacts from scenarios 1, 3, and 4 while the opposite impacts are obtained from scenario 2. This negative impact also appeared in the previous studies. The results also expose that, in both conditions, the biggest positive impacts for analyzed sectors are given by scenario 4, the modification of the consumption expenditures of the private. Compared with the previous studies, these are new findings.

1. Introduction

[1] explained the role of the Information and Communication Technology (ICT) in the society through the following statements:

“ICT technologies are already having a role in driving productivity improvements and innovation in sectors such as financial services, as well as in some aspects of mining, agriculture. They are also transforming the delivery of key government services (including health and education).”

Meanwhile, [2] described the role using the following exposure:

“As we have seen, information and communications technologies help expand economic opportunity by enabling people to enhance their knowledge and skills; identify, apply, and qualify for better-paying jobs; use their disposable income more wisely; manage their own businesses efficiently; and tap into broader markets for their goods and services. ICTs also enhance capacity in industries and institutions of all kinds.”

The following explanation, which was given by [3], confirms the role:

“The role of ICT in the dynamic process of allocation and selection is that it may increase the flexibility of firms and as such their ability to cope with economic shocks, increasing relative productivity and chances of survival. ICT can be a major factor in determining the winners in the competitive process of reallocation and exit.”



Therefore, based on above facts, one can argue that, from an economic point of view, ICT is an important part in the society.

Many previous studies discussed the ICT topic. For example, [4] forecasted the influences of the ICT on the structural changes of Japanese national economies. They applied Input-Output (IO) and statistical approaches as analysis tools. [5] 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 to 2005. On the other hand, using this multiplier, [6] analyzed this role on the Indonesian national economy. The period of the analysis of his study was from 1990 to 2005. [7] investigated the influences of Gross Domestic Product (GDP) and ICT on the changes of the structures of Indonesian industrial sectors on the period between 1990 and 2005. They applied the statistical instrument in analyzing these influences, namely the Constrained Multivariate Regression (CMR) model. [8] described the impacts of the modifications of final demands on the total outputs of Indonesian ICT sectors by employing the IO analysis as an analysis instrument. On the other hand, these impacts on the case of Japan were analyzed by [9] and [10].

The study analyzes the impacts of the changes of final demands on the total outputs of the ICT sectors of the specific country, from above literatures, however, is still limited. This analysis is important because it will expose the characteristics of these sectors when the changes of national economic conditions occur. Further, the analysis can give the insights about the improvements needed for enhancing the industries. This study is conducted in order to fulfill the gap of the research in ICT topic.

The purpose of this study is to continue the previous studies which discussed the impacts of the changes of final demands on the total outputs of the ICT sectors of the specific country. More specifically, this study aims to conduct a deeper analysis regarding these impacts. This study focuses on the case of Japan. This country is chosen because their ICT aspects have developed rapidly. Using the previous studies as references, this study employs the IO approach as an analysis instrument.

2. Methodology

The methodology of this study refers to the previous studies which were conducted by [9] and [10]. The methodology of this study is described as follows. The first step is to expose the data used. This study uses the aggregated IO table of Japan for 2005. This table consists of 89 sectors. These sectors are explained in Appendix.

The second step is to define the Japanese ICT sectors used. These sectors are described in Table 1. The third step is to conduct the calculations in order to observe the impacts of the changes of final demands on the total outputs of discussed sectors. A demand-pull IO quantity model, one of the calculation tools in the IO analysis, is employed in the calculations. [11] explained that the 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 the matrices of the total outputs of sectors, the Leontief inverse, and the final demands of sectors, respectively. 0 and 1 explain initial and future periods, respectively. An initial period in this study is 2005. Table 2 exposes the final demand modification scenarios used. The difference between current and previous studies can be seen on these scenarios. More specifically, the current study has the scenario 4, the modification of the consumption expenditures of the private, while the previous ones did not include this plot.

Table 1. Japanese ICT sectors used in this study.

No.	Sector Number	Sector Name
1	72	Communication
2	73	Broadcasting and information services
3	80	Advertising, survey, and information services

(Source: [12])

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: [13], with the slight modifications)

The conditions of “whole sector change” and “pure change” are infused 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 analyzed sectors. In this study, the former situation will be called “condition A” while the term of “condition B” is utilized to explain the latter one. The analysis regarding above impacts is addressed on the next step. Conclusions of this study and suggestions for further researches are exposed on the final step.

3. Results and analysis

Table 3 describes the total outputs of discussed sectors for each scenario on condition A. Figures 1, 2, and 3 explain in more details the dynamics of the total outputs of analyzed sectors on this condition. Based on the results, one can argue that, on this condition, the biggest positive impacts on the total outputs of analyzed sectors are given by scenario 4, the modification of the consumption expenditures of the private. On the contrary, the negative impacts are given by scenario 2, the change of imports.

On the other hand, Table 4 explains the total outputs of discussed sectors for each scenario on condition B. Figures 4, 5, and 6 expose in more details the dynamics of the total outputs of analyzed sectors on this condition. Based on the results, one can say that, on this condition, the biggest positive impacts on the total outputs of analyzed sectors are given by scenario 4, consumption expenditures of the private change. Meanwhile, the negative impacts are given by scenario 2, the modification of imports.

Table 3. The total outputs of discussed sectors 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
72	Communication	163,581.94	167,969.65	158,989.08	165,040.06	200,546.89
73	Broadcasting and information services	295,777.63	305,626.75	285,514.21	297,980.65	335,887.37
80	Advertising, survey, and information services	90,833.06	96,221.67	85,652.04	91,992.82	107,103.75

Table 4. The total outputs of discussed sectors 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
72	Communication	163,581.94	163,875.13	163,204.22	164,013.34	187,385.37
73	Broadcasting and information services	295,777.63	296,856.35	293,299.36	296,092.46	310,074.07
80	Advertising, survey, and information services	90,833.06	91,239.76	90,088.38	90,855.02	91,932.59

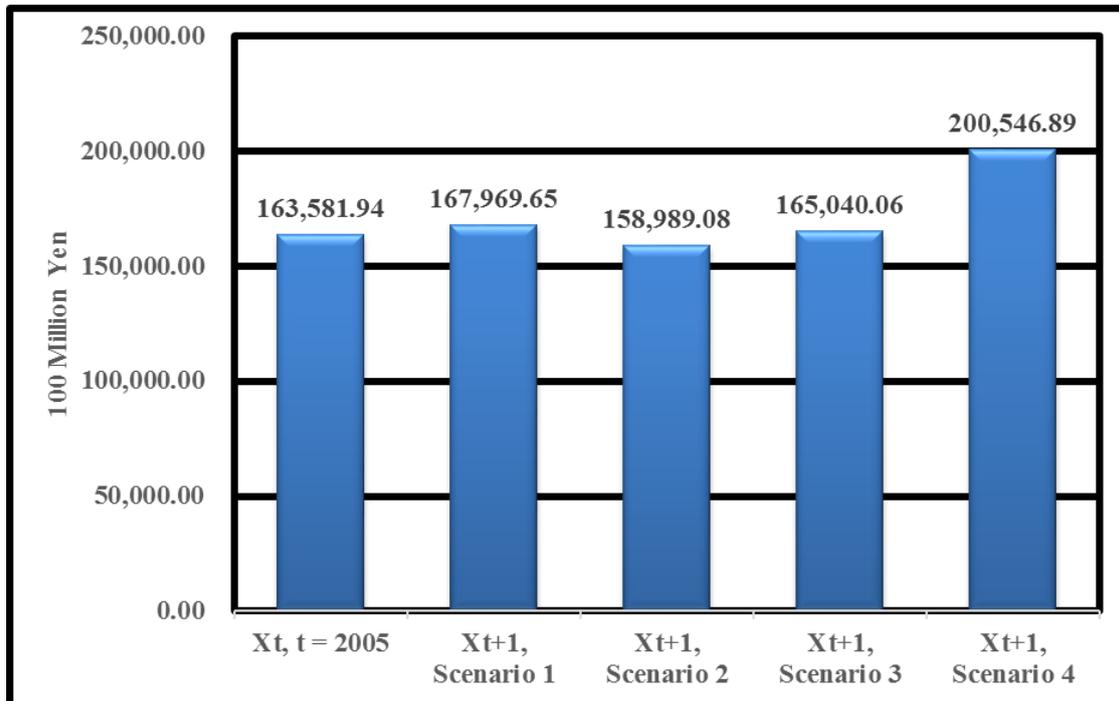


Figure 1. The dynamics of the total output of the communication sector (condition A).

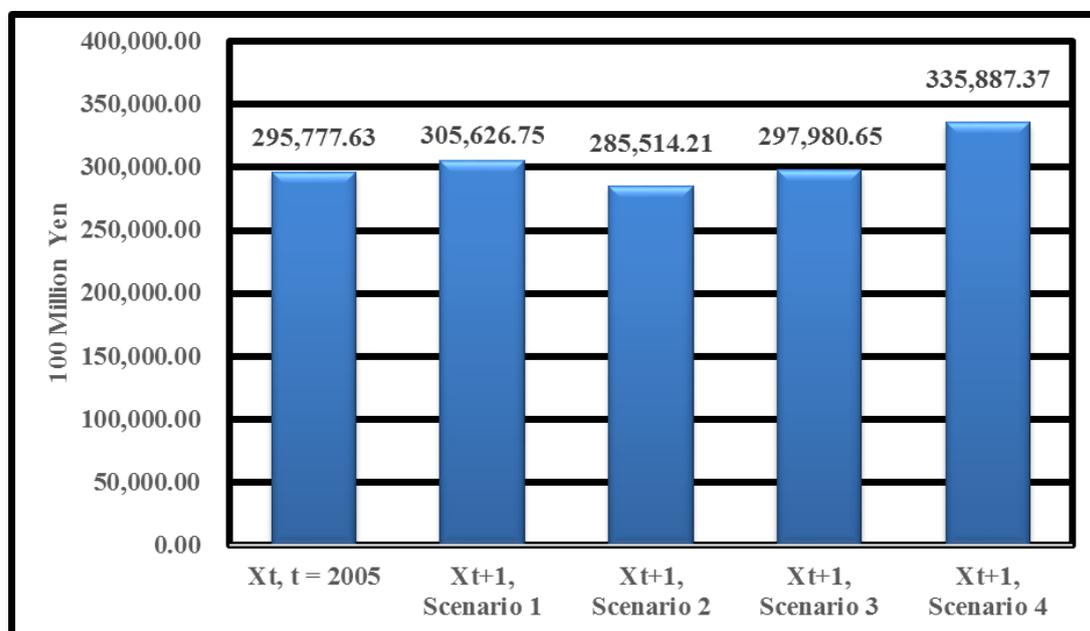


Figure 2. The dynamics of the total output of the broadcasting and information services sector (condition A).

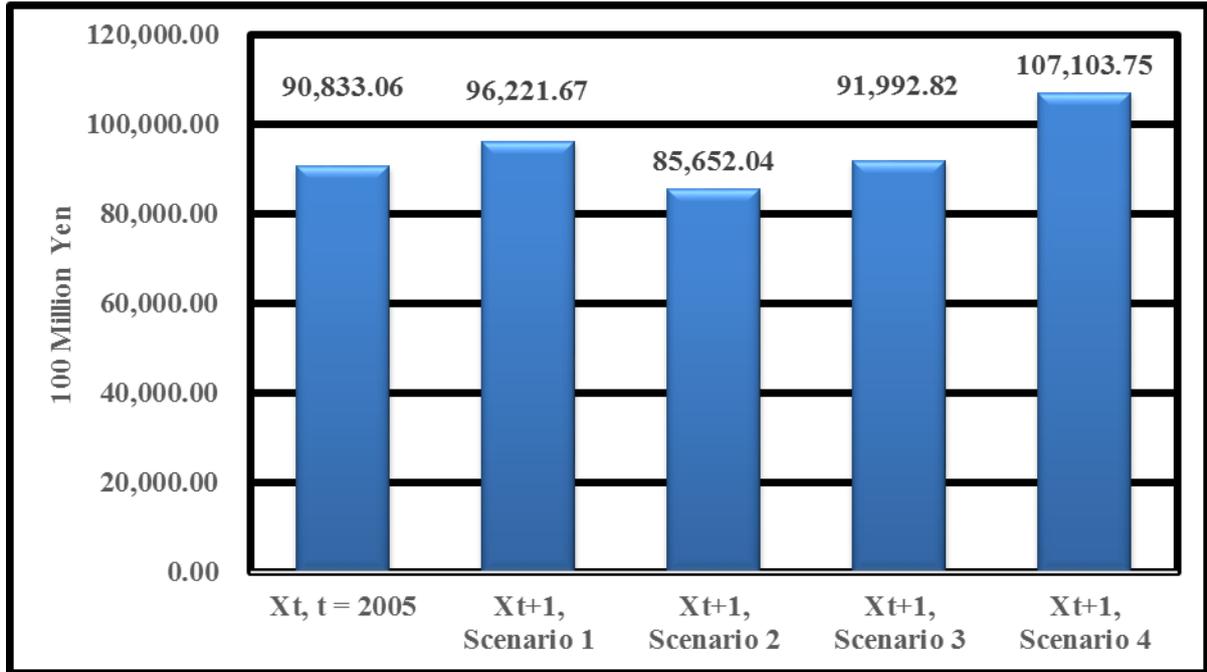


Figure 3. The dynamics of the total output of the advertising, survey, and information services sector (condition A).

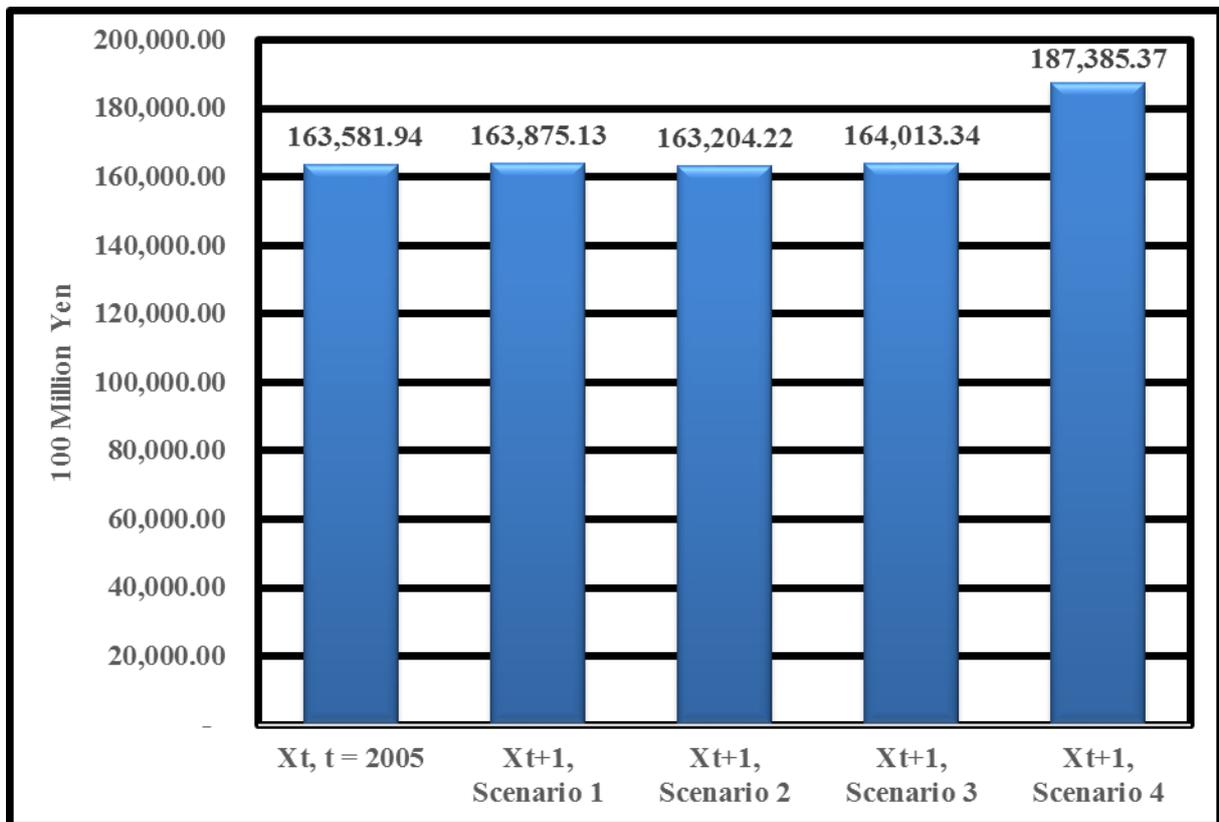


Figure 4. The dynamics of the total output of the communication sector (condition B).

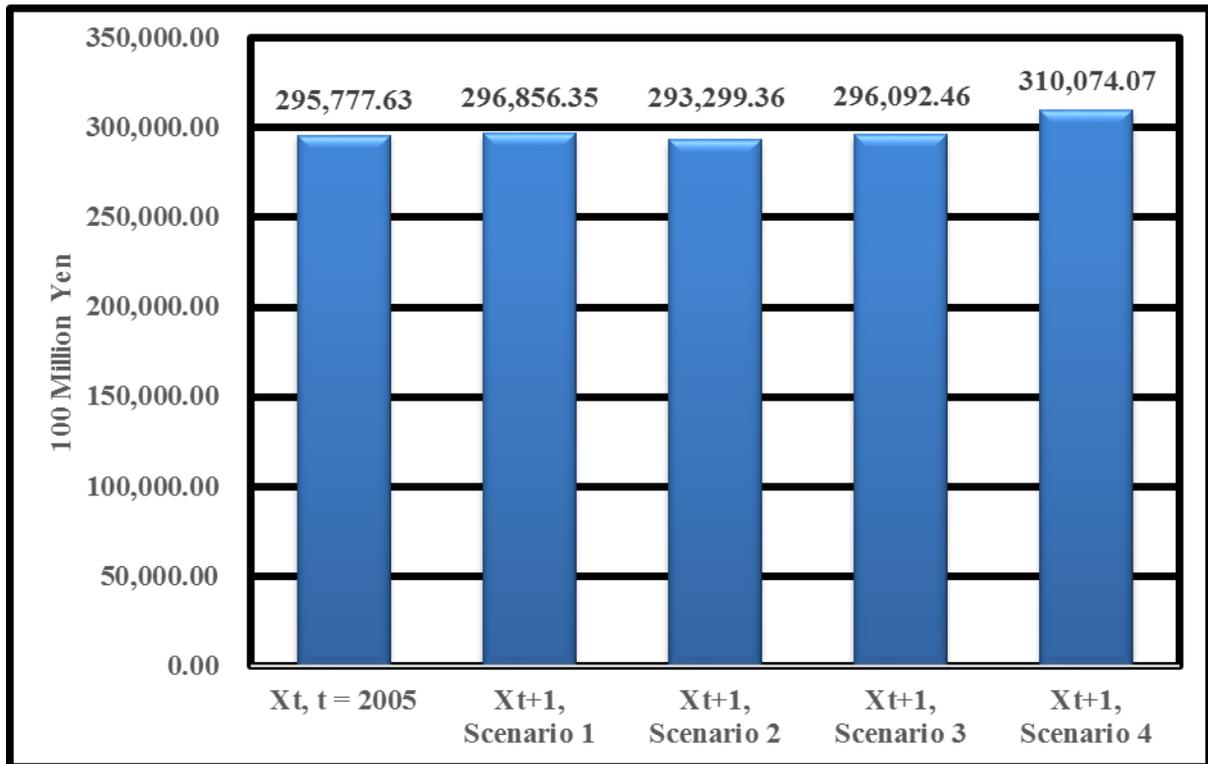


Figure 5. The dynamics of the total output of the broadcasting and information services sector (condition B).

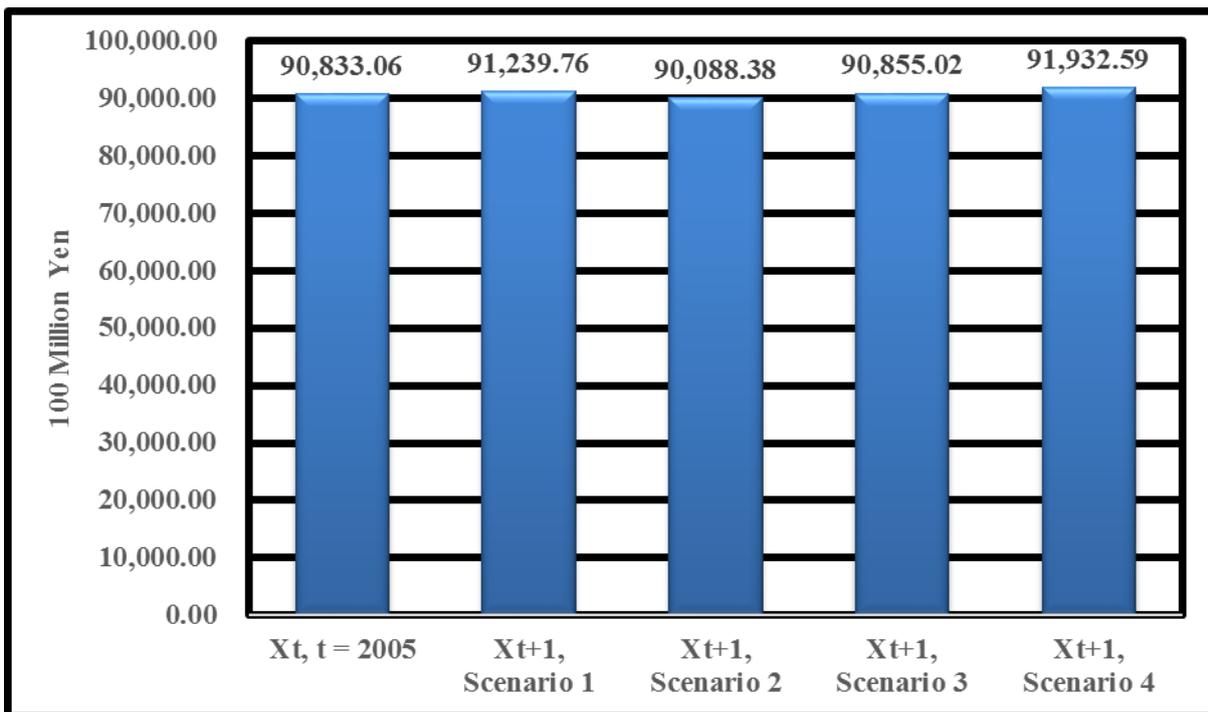


Figure 6. The dynamics of the total output of the advertising, survey, and information services sector (condition B).

Above phenomena show that, in both conditions, the discussed sectors have similar patterns, namely these industries obtain the positive impacts from scenarios 1, 3, and 4 while the opposite impacts are received from scenario 2. This negative impact also appeared in the previous studies. Above phenomena also explain that, in both conditions, the biggest positive impacts for analyzed sectors are given by scenario 4, consumption expenditures of the private modification. Compared with the previous studies, these are new findings. Based on these results, one can argue that the effective way to increase the total outputs of focused sectors in the future are to provide more opportunities and facilities for private sectors in getting the ICT products. Besides, to restrict the import activities regarding these products will also be a good strategy.

4. Conclusions and further researches

This study, as a continuation of previous studies, conducted the deeper analysis regarding the impacts of the modifications of final demands on the total outputs of Japanese ICT sectors. This study employed a demand-pull IO quantity model, one of the calculation tools in the IO analysis, as an analysis instrument. This study focused on three sectors, namely (1) communication, (2) broadcasting and information services, and (3) advertising, survey, and information services. 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 difference between current and previous studies could be observed on the existence of scenario 4, the modification of the consumption expenditures of the private.

The results showed that, in both conditions, the discussed sectors had similar patterns, namely these industries received the positive impacts from scenarios 1, 3, and 4 while the opposite impacts were obtained from scenario 2. This negative impact also appeared in the previous studies. The results also explained that, in both conditions, the biggest positive impacts for analyzed sectors were given by scenario 4, the change of the consumption expenditures of the private. Compared with the previous studies, these were new findings. Based on these outcomes, the suggestions from this study regarding the effective ways to enhance the total outputs of focused sectors in the future were to provide more opportunities and facilities for private sectors in getting the ICT products, and to limit the import activities regarding these commodities.

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

The other suggested further research from this study is to conduct the international comparison on the current discussion. This comparison will describe the characteristics of the ICT industries of analyzed countries when the changes of final demands occur. An interesting example is to compare developed and developing countries. More specifically, a good example is to compare Japan and one of the developing countries, such as Thailand.

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 repairment of ships
50	Other transportation equipment, and the repairment of transportation equipment
51	Precision instruments
52	Miscellaneous manufacturing products
53	Building construction
54	Construction repairment
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	84	Amusement and recreational services
80	Advertising, survey, and information services	85	Eating and drinking places
81	Goods rental and leasing services	86	Accommodations
82	Repairement of motor vehicles and machine	87	Other personal services
83	Other business services	88	Office supplies
		89	Activities not elsewhere classified

(Source: [14], with the slight modifications)

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