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Construction steps of 4 × 4 I - O table including the defense sector

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Summary

An attempt to make I‐O tables with the defense sector independent from other sectors will be made. Methods in order to make 4× 4 Industrial I‐O tables consisting of each sector including the primary industry, the secondary industry, the tertiary industry, and the defense sector, will be proposed.

The number 1 significance is that if industrial I‐O tables (using the extension table) including the defense sector are made every year, a times series analysis will be made possible, and it will lead to various economic model analyses.

The second significance is that concerning many economic empirical studies including econometrics, because the process of the researchers remain unclear, an effort to clarify the process in the working paper is made. Although the steps are mentioned, many difficulties accompany the actual making process.

Key words

4× 4 I‐O tables
Construction step
defense sector
time series analysis
the ban of weapon exports

1. The significance of making the I - O table including the defense sector

Ueno,E(2015) is a preceding study of defense analysis using the industrial I‐O table in Japan.[(1)] However, there are no proper analyses using the economic model. A big reason for this is that there are no industrial I‐O tables that explicitly show the defense sector.

Therefore, an attempt to make I‐O tables with the defense sector independent from other sectors will be made. Methods in order to make 4× 4 Industrial I‐O tables consisting of each sector including the primary industry, the secondary industry, the tertiary industry, and the defense sector, will be proposed.

The significance of the above are as follows:

The number 1 significance is that if industrial I‐O tables (using the extension table) including the defense sector are made every year, a times series analysis will be made possible, and it will lead to various economic model analyses. Writers have made their own original MAIDO models(Mizuno,K, Doi,T, Ando S, Omata,J, and G.Igusa（2016）) and MAI models (Mizuno,K Ando S, and G.Igusa（2016）)until now, and using such models, a new economic model analysis

of defense that has never been accomplished before can be conducted.

The second significance is that concerning many economic empirical studies including econometrics, because the process of the researchers remain unclear, an effort to clarify the process in the working paper is made. Although the steps are mentioned, many difficulties accompany the actual making process. There is no choice but to trust in the data created by researchers. Therefore, by recording the process in detail on the working paper, the processing of data used in empirical analyses will be clear to all readers.

In creating the defense sector, although the process is made extremely difficult as information is limited to defense yearbook data, industrial I - O tables, and weapon dealings data from UN statistics, there will be no development if the first step is not made. This paper will serve as the first step.

2 . Actual production steps

First, a 3×3 industrial I - O table will be made with agricultural/forestry/fishery industry, industry, and other (including mining, construction, tertiary industry, and activities not classified elsewhere) in the columns and rows. After this, the defense industry taken from industry and public administration defense taken from the "other" sector will be made, and together with the agricultural/forestry/fishery industry, industry(excluding defense industry), and "other(excluding public administration defense)", a 5×5 industrial I - O table will be made. Afterwards, by integrating the defense industry and public administration defense, a 4×4 industrial I - O table with agricultural/forestry/fishery industry, industry (excluding defense), defense, and tertiary(excluding public administration defense) will be made.

【Step 1】 Making a 3×3 industrial I - O table

A industrial I - O table integrated with 3 sectors including "agricultural/forestry/fishery industry", "industry (Manufacturing industry)", and "other" will be made.

* "Other" includes the mining industry, construction industry, and other activities not classified elsewhere.

Calculate the total of the rows.

Table 1

	Agricultural, forestry, and fishery industry	Industry	Other	Domestic final demand	Domestic demand	Export	Import	Total final demand	Gross production
Rice	Add the row of agricultural/forestry/fishery industry.	Add the row of manufacturing industry excluding the mining industry.	Add the row of mining/construction/activities not classified elsewhere.						
....									

….									
Activities not classified elsewhere									
Total of intermediate sectors									
Added value									
Gross production									

Calculate the total of the columns.

Table 2

	Agricultural, forestry, and fishery industry	Industry	Other	Intermediate demand	Domestic final demand	Domestic demand	Export	Import	Total final demand	Gross production
Agricultural, forestry, and fishery industry	Add the column of agricultural/ forestry/fishery industry.									
Industry	Add the column of manufacturing industry excluding the mining.	①								
Other	Add the column of mining/construction/activities not classified elsewhere.									
Total of intermediate sectors										
Added value										
Gross production										

【Step 2】 Make the defense yearbook data available for use in the industrial I - O tables.

The defense yearbook data is recorded according to the fiscal year. In order to adjust to the industrial I - O table which is calculated according to the calendar year, the fiscal year data must be changed into calendar year data. Multiply the fiscal year data by three quarters and add one quarter of the previous fiscal year.

Data：

Table：Status of defense production in the domestic industrial production

Table：Ratio of defense production amount in the domestic industrial production amount

（p455 in the case of the 2015 Defense yearbook ）

【Step 3】 Make a 5×5 industrial I－O table

Make a provisional 4×4 industrial I－O table. In the row, exclude public administration defense from Other. “Public administration defense” corresponds to the supply made from the government to the defense industry and “other” sectors(non personnel expenses).

Table 3

	Agricultural, forestry, and fishery industry	Industry	Public service of defense	Other	Intermediate demand	Domestic final demand	Domestic demand	Export	Import	Total final demand	Gross production
Agricultural, forestry, and fishery industry			Input 0.								
Industry		④	② Multiply ① by the annual defense “ratio of defense supply amount in the industry”								

Defense industry	Input 0	⑤ Multiply ④ by the annual defense "ratio of defense supply amount in the industry"	③ Input the annual defense supply amount from the industry of the Ministry of defense								
Other			⑥ Input the supply amount of non-personnel expenses which was separately calculated with the defense yearbook	⑦							
Total of intermediate sectors											
Added value											
Gross production											

② Multiply ① by the "defense supply costs ratio in the industry" of the annual defense.

⑤ Input numbers "defense industry→industry"
defense industry→industry Multiply with 0.007 times the "other industries(excluding defense)→industry" (Ratio of defense orders of Ministry of Defense in the 2013 industry production. From the defense yearbook)

④ Afterwards, subtract the new "defense industry→industry"⑤ from "industry". (As shown in the table below.)

⑥Input numbers “other→public administration defense”
From the defense related budget data, choose the non-personnel expenses and add it to Table 2. Subtract defense industry production amount (yellow) from “non-personnel expenses+food expenses”(Add both as the food expenses are included in industry items.)。
“Other→public administration defense” is complete.

⑦ After the above, subtract the new “other→public administration defense” from “other→other”. (As shown in the table below.)

③ “defense industry(horizontal)→public administration(vertical)”
Input the supply costs from the industry of the Ministry of Defense
② Subtract the above from “industry→defense(public administration)” (As shown in the table below)

Table 4

	Agricultural, forestry, and fishery industry	Industry	Public service of defense	Other (excluding public service of defense)	Intermediate demand	Domestic final demand	Domestic demand	Export	Import	Total final demand	Gross production
Agricultural, forestry, and fishery industry											
Industry (excluding defense industry)		Subtract ⑤ from ④	Subtract ③ from ②								
Defense industry											
Other				Subtract ⑥ from ⑦							
Total of intermediate sectors											
Added value											
Gross production											

【Step4】

Table 5

	Agricultura	Agricultural, forestry	Industry	Public servi	Other (excluding	Intermediate deman	Domestic	Domestic dem	Export	Import	Total final demand

	l, forestry, and fishery industry	, and fishery industry		ce of defense	public service of defense)	d	final demand	and			
Agricultural, forestry, and fishery industry					Total of the column on the left side					(in the column) final domestic demand ＋ exports ＋ imports (shown as minus on the I－O tables)	⑪ (in the column) intermediate demand ＋total final demand
Industry (excluding defense industry)					Total of the column on the left side	b1	⑧ b2	b3	⑨ b4	(in the column) final domestic demand ＋ exports ＋ imports (shown as minus on the I－O tables) b5	⑫ (in the column) intermediate demand ＋total final demand b6
Defense industry					Total of the column on the left side	c1 Input the actual industrial I－O	⑩ c2	c3 Input the UN's small weap	c4 Multiply ⑩ by the ratio	c5(in the column) final domestic demand	⑬ (in the column) intermediate demand ＋total final

						table value of the weapon sector's stock increase/decrease		on exports data after converting it to yen	of ⑧ and ⑨	＋exports＋imports (shown as minus on the I - O tables)	demand c6
Other					Total of the column on the left side					(in the column) final domestic demand＋exports＋imports (shown as minus on the I - O tables)	⑭ (in the column) intermediate demand＋total final demand
Total of intermediate sectors	Total of the upper rows	Total of the upper rows	Total of the upper rows	Total of the upper rows							
Added value	(last step) subtract the row intermediate demand from the	(last step) subtract the row intermediate demand from the row total production	a3 Calculate and input the personnel expenses of defense with the defense yearbook (calculate by subtracting food expenses	a1(last step) subtract the row intermediate demand from the row total							

	row total production		from “personnel/food expenses”)	production
Gross production	Input ⑪	⑫＋⑬	⑮Add the intermediate demand and additional value of this row	Subtract ⑮ from ⑭ a2

Add the intermediate and final demand, and calculate the total production expenses.
Subtract the intermediate demand total from the total production amount of “Agricultural, forestry, and fishery industry” and “industry” as shown in the bottom row, and calculate the added value of each industry.

Follow the instructions within the table. However, the following are some additional points to consider.
a3 Additional value of public administration defense
Actual values of personnel expenses (excluding food expenses) were filled in.
Fill in the defense personnel expenses(calculate by subtracting food expenses from personnel+food expenses) in the vertical additional value costs of public administration defense.
⑮Add the total of the vertical public administration defense and its additional value, and fill the total production amount in the public administration defense on the lower left side.

b 1 ~ b 6 Regarding the final demand of the defense industry
The domestic final demand includes the domestic final demand (increase/decrease of stock) of weapons.
Exports will be calculated by using the exchange rate to convert the annual average and UN statistics of weapon exports.
Imports will be calculated by multiplying the defense industry production by the import ratio regarding industry production.
After calculating the amount of export/import regarding the defense industry, concerning the industry, the final demand and production value will be calculated by subtracting the aforementioned from the industry.

The next process is made in order to avoid double calculations of removed parts.
a2 Subtract the total production amount of public administration defense on the bottom left from the total production amount of “other” on the right side, and input that number in the total production amount of “other” on the bottom left.
a1 Subtract a3 from a1.
Subtract c1 ~ c6 from b1 ~ b6.

【Step 5】

Create “public administration defense” in the columns.

From administration, as there are only numbers in the “activities not classified elsewhere” on the actual industry I－O table, numbers should only be entered in “other” in this case(intermediate dealings). Numbers that are entered here will be the total production amount of the public administration defense on the very bottom in addition to the total production on the very right of the column.

Create defense industry in the rows.

Excluding the agricultural/forestry/fishery industry, the total production amount multiplied by the same ratio of the industry row will also be the row of the defense industry. Subtract the defense industry row from the industry row.
(Table 7)

Table 6

	Agricultural, forestry, and fishery industry	Industry	Defense industry	Public service of defense	Other(excluding public service of defense)	Intermediate demand	Total final demand	Gross production
Agricultural, forestry, and fishery industry		⑯	Input 0					
Industry(excluding defense industry)		⑰	Multiply ⑰w by the ratio of 21 and 22					
Defense industry		⑱	Multiply ⑱ by the ratio of ㉑ and ㉒					
Public service of defense	Input 0	Input 0	Input 0	Input 0	㉓ Input ⑮d1	Input ⑮ d2	Input 0	Input ⑮ d3
Other		⑲	Multiply ⑲ by the ratio of ㉑ and ㉒		Subtract d1 from here	Subtract d2 from here		Subtract d3 from here
Total of intermediate sectors								
Added value		⑳	Multiply ⑳ by the ratio of ㉑ and ㉒					
Gross production		㉑	Input ⑬					

㉒
⑰＋⑱
＋⑲+⑳

Table 7

	Agricultural, forestry, and fishery industry	Industry	Defense industry	Public service of defense	Other(excluding public service of defense)	Intermediate demand	Total final demand	Gross production
Agricultural, forestry, and fishery industry		Subtract the defense industry row on the right from here						
Industry(excluding defense industry)		Subtract the defense industry row on the right from here						
Defense industry		Subtract the defense industry row on the right from here						
Public service of defense		Subtract the defense industry row on the right from here						
Other		Subtract the defense industry row on the right from here						

Total of intermediate sectors		Subtract the defense industry row on the right from here						
Added value		Subtract the defense industry row on the right from here						
Gross production		Subtract the defense industry row on the right from here						

Table 7 completes the 5×5 table.

【Step 6】 Completing the 4× 4 table

Add the defense industry row and the public administration defense column
Add the defense industry column and the public administration defense column

Table 8

	Agricultural, forestry, and fishery industry	Industry	Defense	Defense industry	Public service of defense	Other(excluding public service of defense)	Intermediate demand	Total final demand	Gross production
Agricultural, forestry, and fishery industry			defense industry row＋public administration defense						
Industry (excluding			defense industry row＋						

defense industry)			public administration defense						
Defense	defense industry row＋public administration defense	defense industry row ＋public administration defense	defense industry row＋public administration defense	defense industry column ＋public administration defense	defense industry column＋public administration defense	defense industry column ＋public administration defense	defense industry column ＋public administration defense	defense industry column＋public administration defense	defense industry column ＋public administration defense
Defense industry			defense industry row＋public administration defense						
Public service of defense			defense industry row＋public administration defense						
Other			defense industry row＋public administration defense						
Total of intermediate sectors			defense industry row＋public administration defense						
Added value			defense industry row＋public administr						

			ation defense			
Gross production			defense industry row＋public administration defense			

5×5 is complete after removing the defense industry and the public administration defense from the rows and columns.

	Agricultural, forestry, and fishery industry	Industry	Defense	Other(excluding public service of defense)	Intermediate demand	Total final demand	Gross production
Agricultural, forestry, and fishery industry							
Industry(excluding defense industry)							
Defense							
Other							
Total of intermediate sectors							
Added value							
Gross production							

In addition, the following are points which should be taken into consideration.

First, concerning the the small weapon exports in Japan, although it was entered as a defense item, because military weapons were officially restricted until 2013, on the industrial I－O table, it is entered as industry exports instead of defense.

Second, because there are no data for the increase/decrease of weapon stock for 2001-2003, assuming the number has leveled out and become 0, the space for the three years were set as 0.

Third, concerning the weapon export data, UN's actual data is used instead of the extension table data.

Any abnormalities should be noted.

3 Summary

As the ban of weapon exports has been lifted, Japan's defense industry has been going through a big revolution.

As stated in the beginning, data can be obtained if the industry I－O tables are made. In addition,

this makes the economic model analysis possible. Concerning defense, because the economic model analysis has been falling behind, it is our aim to liven up discussions of industrial I‐O tables related to defense with this working paper as a starting point and to further develop economic analyses based on the aforementioned.

Footnotes

(1) This is an article from the japan Maritime Press.

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