

An econometric analysis on the changes of the hinterlands of the ports in Tokyo Bay

Kwak Kyu Seok

Contents

- | | |
|---|--|
| 1. Introduction. | ii) Hinterlands regarding export cargo. |
| 2. Defining the ranges of the hinterlands of the ports. | 3. Elements affecting the range of the hinterland. |
| 1) Outline of the data. | 1) Historical background. |
| 2) Range of the hinterland of Tokyo Bay. | 2) The challenge of the periphery. |
| 3) Changing patterns of the hinterland of each port. | 3) Diversification of handling cargo. |
| i) Hinterlands regarding import cargo. | 4) Technical innovation. |
| | 4. Conclusion. |

1. Introduction

Since World War II there have been significant changes in the circumstances affecting competition among Tokyo Bay ports for import and export cargo. Such changes have shifted the hinterlands of the ports severely. Leading factors affecting Tokyo Bay's interport competition for import and export cargo may be classified as follows:

- Historical factors

- Economic factors
- Technical factors

The Research about the hinterland of the port is found frequently in geographical literature, but quantitative analyses of the circulation of traffic to and from ports are few.

Donald J. Patton⁽¹⁾ presented the hinterland maps of the origin and destination for port traffic of a general cargo nature for New York, Philadelphia, Baltimore, and New Orleans, which were the leading cargo ports in the eastern half of the United States. He clarified the relative port ability of the four leading ports, based on the import and export traffic volumes of the continent, and presented us the relative importance of factors contributing to the hinterland patterns. But he focused on a restricted phase of total port traffic, that is, general cargo traffic.

James B. Kenyon⁽²⁾ analyzed the shifting magnitudes and composition of general cargo freight among selected United States ports in terms of the extent and makeup of their domestic hinterlands, their overseas trade orientation, and the economic characteristics of port metropolis itself. He, also, picked up some of the changing conditions and practices that seemed to hold special significance to the competitive power among American ports. However, his analysis was restricted to general cargo freight and it was not very helpful to the port managers or planners who would forecast the stable growth level of the port as a whole.

Howard L. Green⁽³⁾ defined and analyzed the hinterland boundaries in southern New England between New York and Boston. As his analysis was focused on non-sea trade, that is, commuter traffic, rail passenger flow, daily newspapers, telephone calls and so forth. It was nothing but a indirect reference to the port managers.

In this study, I analyze the influential relations between the competitive power of the port and the range of its hinterland, thereby clarify the leading factors affecting the competitive power of the port. I believe that the results of this analysis are helpful to port managers who seek the stable growth of their ports.

The changes in the competitive power of the port are, mainly, resulted from the effort to find ways and means of providing services what will induce maritime interests and shippers in the hinterland to use it in preference to another port.⁽⁴⁾ The competitive power of the port may be changed by the following elements: historical background, the challenge of the periphery, diversification of handling cargo, technical

innovation, and promotion of efficiency in port management. To analyze the influence of the above elements upon the range of the hinterland, the data of the surveys on the incoming and outgoing cargo by the overland transport by the Ministry of Transport of Japan are used. The ports selected for analysis are Tokyo, Yokohama, and Kawasaki. They locate near in the same Tokyo Bay and Tokyo Metropolitan Area. For that reason, it is considered that the interport competition for import and export cargo may be severer than any other ports of Japan. The terms import and export in this paper do not refer only to the foreign trade. They refer simply to commodities arriving at the port or departing from the port by sea, regardless of whether its foreland is in Japan or foreign country.

Chapter 2 gives the definition of the ranges of the hinterlands of the ports and in chapter 3 elements affecting the range of the hinterland are analyzed. In chapter 4, conclusion is described.

2. Defining the ranges of the hinterlands of the ports

1) Outline of the data

I used the data of the surveys executed by the Ministry of Transportation of Japan to define the ranges of the hinterlands of the ports. These surveys were put into practice to clarify the situation of the cargo flow between the ports and their hinterlands. The surveys were held four times, that is 1954, 1967, 1977, 1982 and each survey was carried for one month.

2) Range of the hinterland of Tokyo Bay

A hinterland can be described as organized and developed land space which is connected with a port by means of transportation lines. The hinterland receives ships goods through that port. In many cases, an inland area may be the hinterland of several ports.(5)

According to the above definition, the statistics of transport serve us to settle the ranges of the hinterlands of the ports. I settled the range of the hinterland of Tokyo Bay with the areas where the 90% of the cargo of Tokyo Bay (that is, the port of Yokohama, Tokyo, and Kawasaki) was moving to and coming from. The prefectures defined as the hinterland of Tokyo Bay are depicted in Fig. 1.

3) Changing patterns of the hinterland of each port

i) Hinterlands regarding import cargo

More than 90% of the imported cargo through the ports in Tokyo Bay is carried out to the above twelve prefectures, but the share of each prefecture for each port is various. For that reason, the hinterland

of each port becomes different from one another. Here, I am obliged to choose another standard to settle the hinterland of each port.

In practice, it is very difficult to adopt what amount of the share as a standard, and also there is room for criticism for the adopted value. Some reports about the hinterland of the individual port have adopted 10% for the primary hinterland and 1% for the secondary hinterland.⁽⁶⁾ I judged that the secondary hinterland must be defined as the range of the hinterland of the concerned port, and chose the 1% level as the standard.

The ranges of the hinterlands of the ports under study here are arrayed in chronological order (Table 1). It shows that the range of the hinterland of the individual port is changing with the times and is different from one another in the pattern of the change.

ii) Hinterlands regarding export cargo

According to the same method, the hinterlands for each port regarding export cargo are arrayed with the times in table 2. The following comments can be made about this table;

- the changes of the range of the hinterland for export cargo are violent the same as the case of import cargo
- the ranges of the hinterland for each port are quite different from one another
- the ranges of the hinterland for import cargo and those for export cargo are quite different from each other

The changes of the ranges of the hinterlands of the three ports are depicted in chronological order in Fig. 2, 3, and 4.

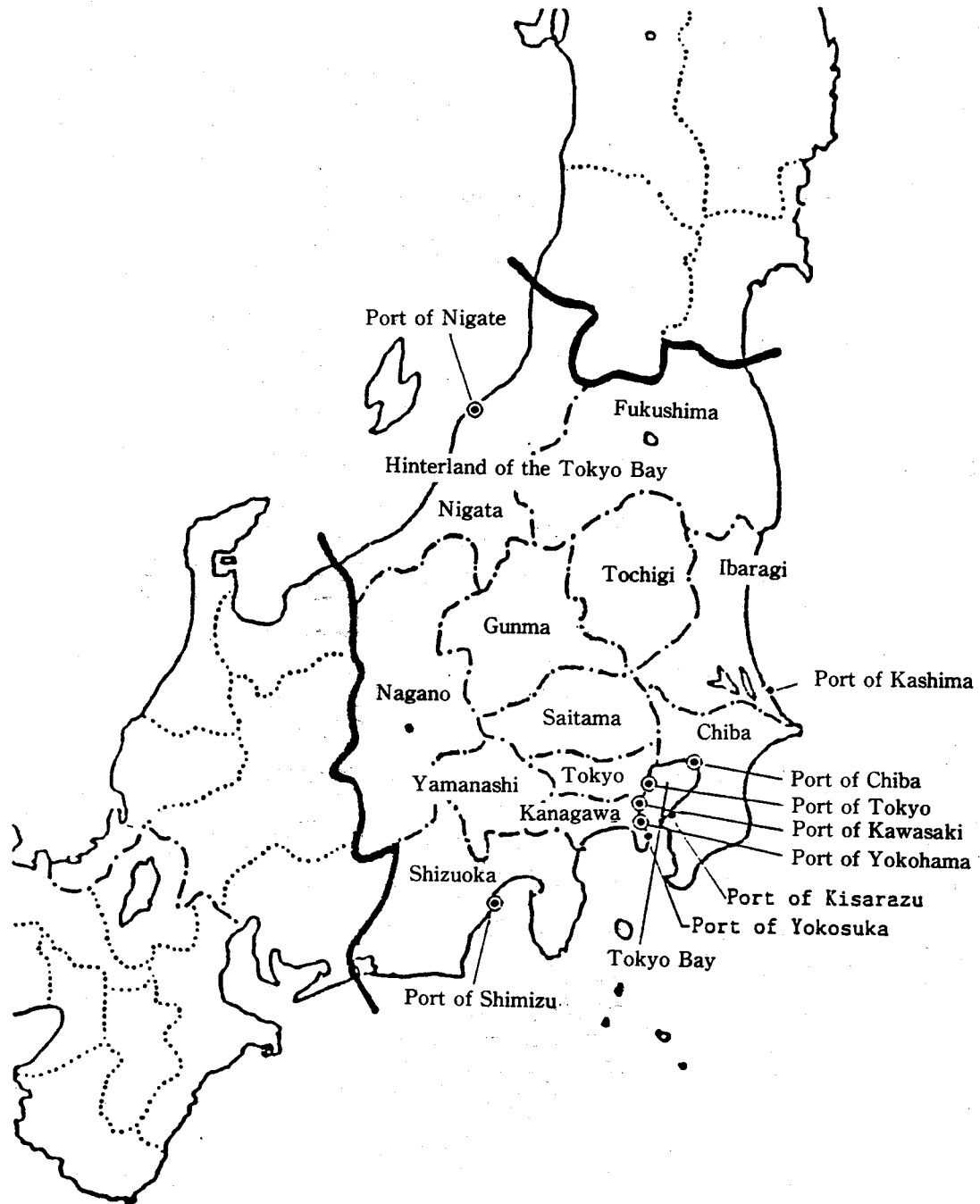


Fig. 1. The range of the hinterland of the Tokyo Bay.

Table 1. The ranges of hinterlands for import cargo

Yokohama

year	Fuku-shima	Iba-ragi	Tochi-gi	Gun-ma	Sai-tama	Chi-ba	To-kyo	Kana-gawa	Ni-gata	Yama-nashi	Naga-no	Shizu-oka
1954	x	x	x	x	x	x	x	x	x		x	x
1967			x		x	x	x	x				x
1977		x					x	x				
1982			x	x	x		x	x				x

Tokyo

year	Fuku-shima	Iba-ragi	Tochi-gi	Gun-ma	Sai-tama	Chi-ba	To-kyo	Kana-gawa	Ni-gata	Yama-nashi	Naga-no	Shizu-oka
1954			x		x	x	x	x				
1967			x	x	x	x	x	x	x			
1977					x	x	x	x				
1982		x	x	x	x	x	x	x				

Kawasaki

year	Fuku-shima	Iba-ragi	Tochi-gi	Gun-ma	Sai-tama	Chi-ba	To-kyo	Kana-gawa	Ni-gata	Yama-nashi	Naga-no	Shizu-oka
1954	x	x	x	x	x	x	x	x	x	x	x	x
1967	x	x	x	x	x	x	x	x			x	x
1977				x			x	x				
1982					x		x	x				

Table 2. The ranges of hinterlands for export cargo

Yokohama												
year	Fuku-shima	Iba-ragi	Tochi-gi	Gun-ma	Sai-tama	Chi-ba	To-kyo	Kana-gawa	Ni-gata	Yama-nashi	Naga-no	Shizu-oka
1954	x	x	x		x		x	x				x
1967		x	x	x	x	x	x	x	x			
1977			x	x	x	x	x	x				
1982		x	x	x	x	x	x	x	x			x

Tokyo												
year	Fuku-shima	Iba-ragi	Tochi-gi	Gun-ma	Sai-tama	Chi-ba	To-kyo	Kana-gawa	Ni-gata	Yama-nashi	Naga-no	Shizu-oka
1954							x	x				
1967						x	x					
1977	x	x	x	x	x	x	x	x				
1982	x	x	x	x	x	x	x	x				

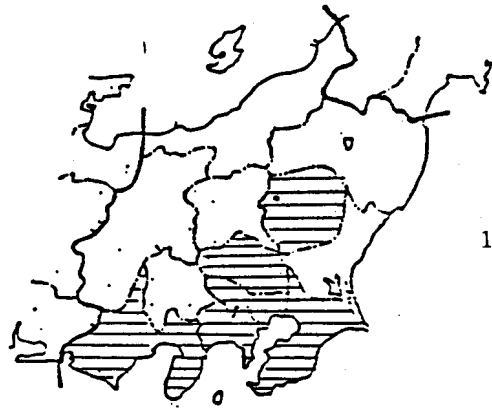
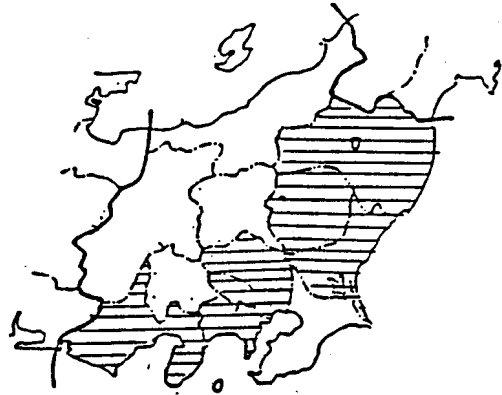
Kawasaki												
year	Fuku-shima	Iba-ragi	Tochi-gi	Gun-ma	Sai-tama	Chi-ba	To-kyo	Kana-gawa	Ni-gata	Yama-nashi	Naga-no	Shizu-oka
1954		x	x		x		x	x	x			x
1967	x		x		x	x	x	x				
1977			x				x	x				
1982			x				x	x				

Import cargo

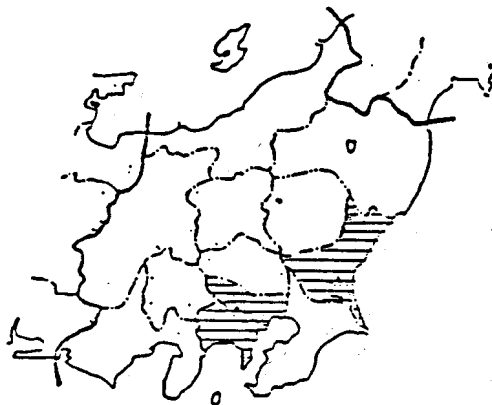
Export cargo



1954



1967



1977



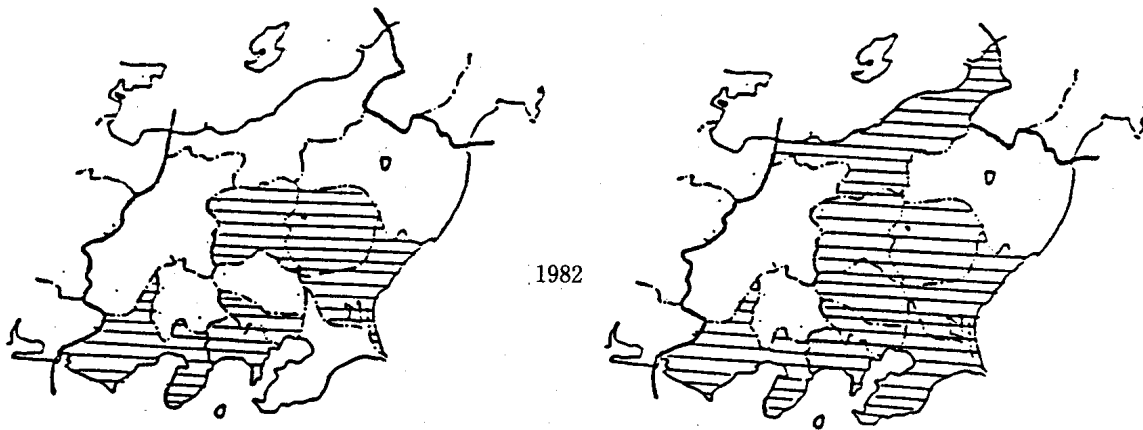
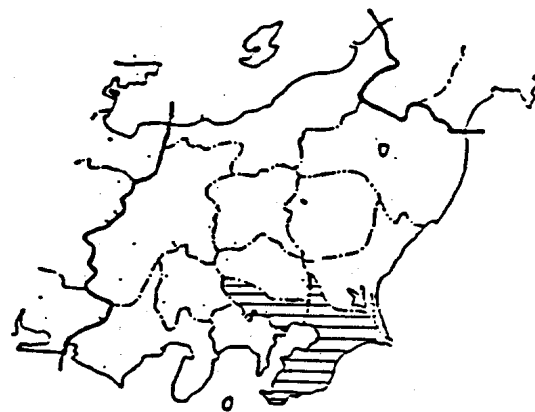
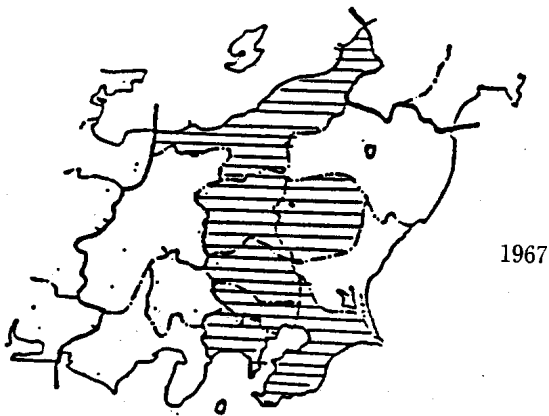
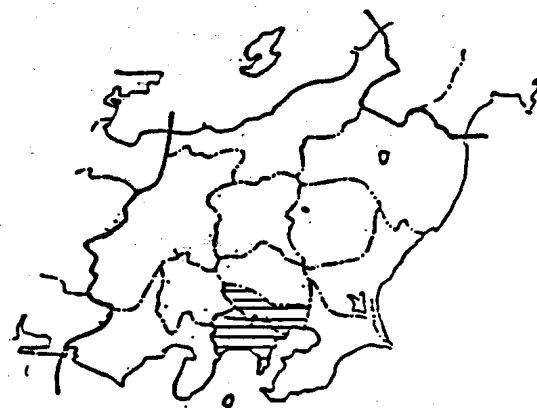
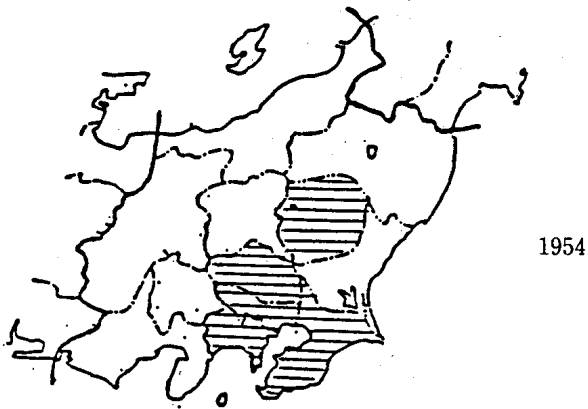


Fig. 2. Change of the hinterland of the port of Yokohama

Import cargo

Export cargo



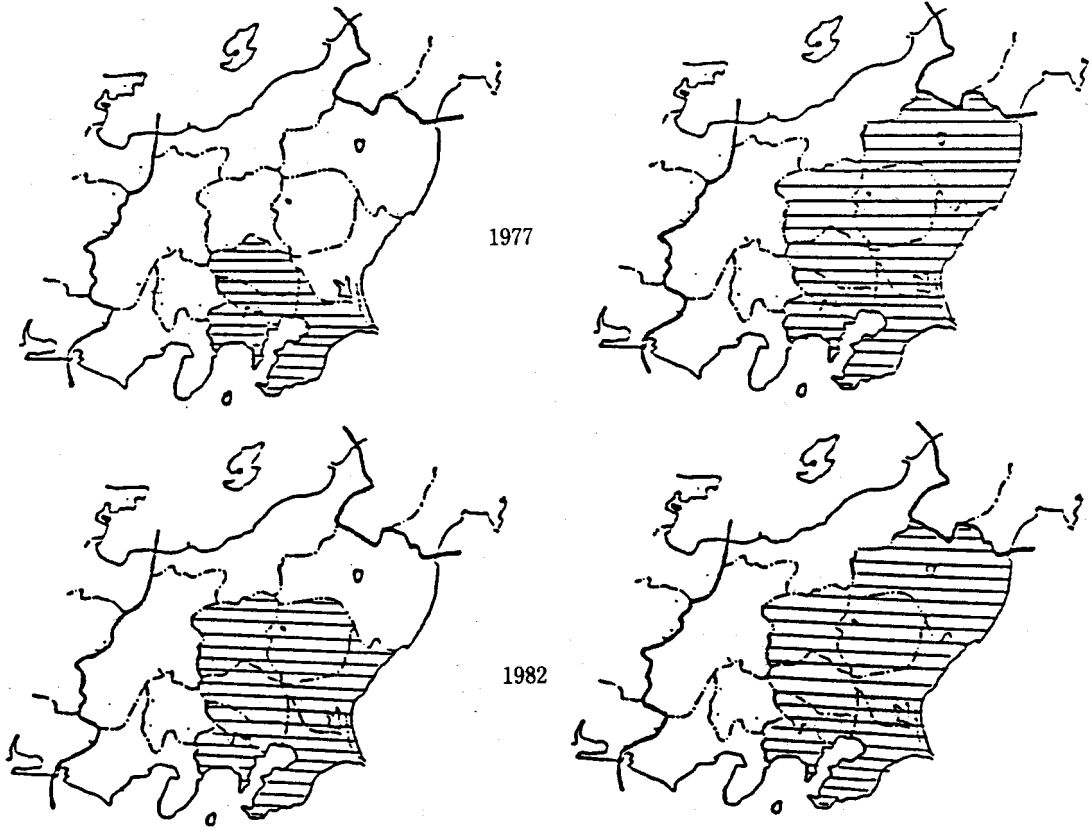
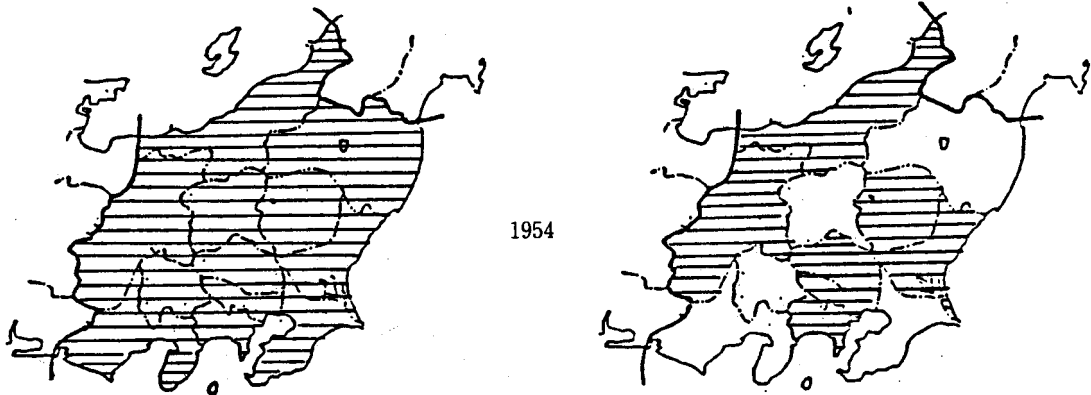


Fig. 3. Change of the hinterland of the port of Tokyo

Import cargo

Export cargo



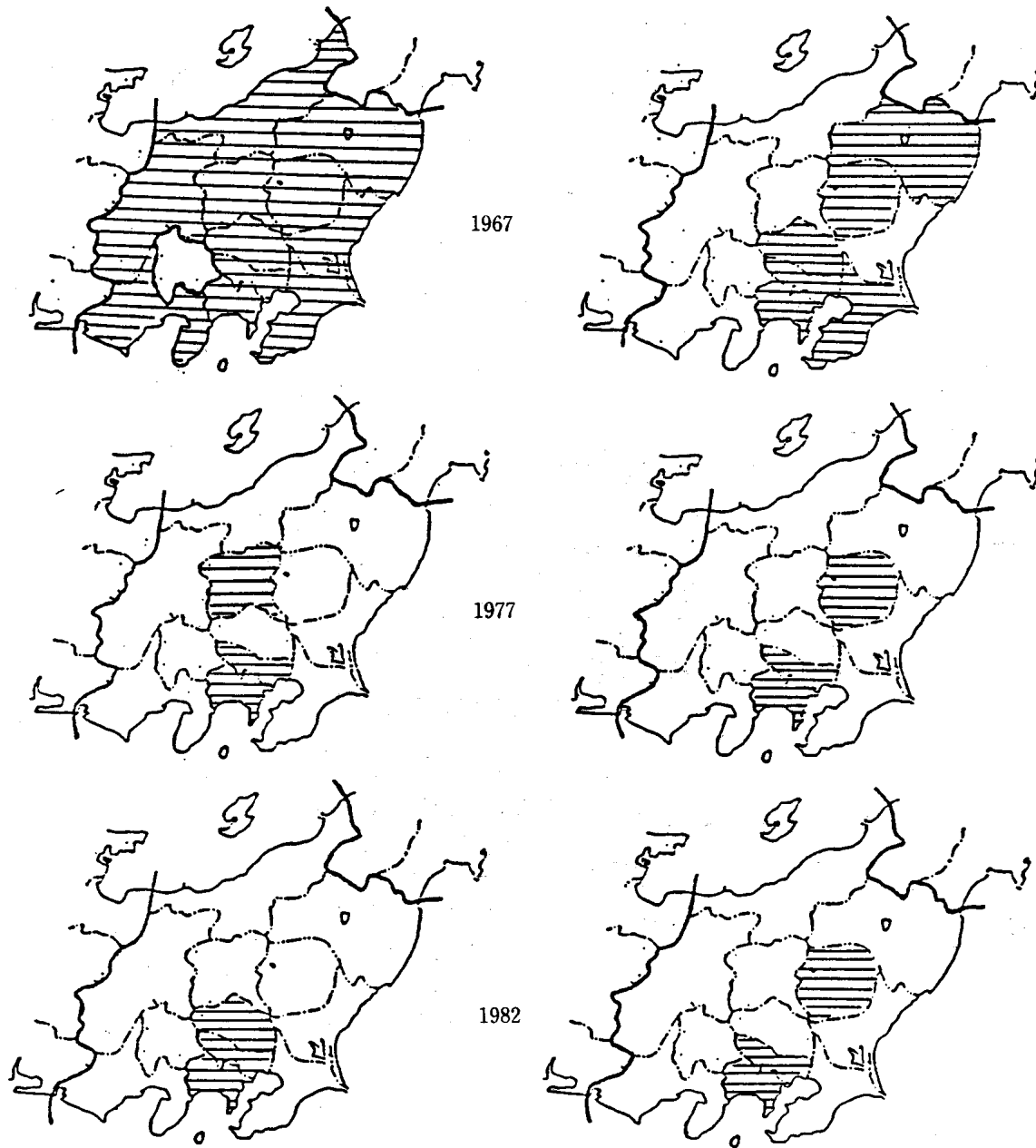


Fig. 4. Change of the hinterland of the port of Kawasaki

3. Elements affecting the range of the hinterland

It became clear that the ranges of the hinterlands of neighboring ports are quite different from one another by the results of the analysis in the foregoing chapter. To analyze the reason why such difference occurred, the following four leading factors are chosen among various factors;

- Historical background
- Challenge of the periphery
- Diversification of handling cargo
- Technical innovation

1) Historical Background

Each country has different forms of port administrations, port planning by different principles. This is due to historical backgrounds, structural differences in its administrative systems, differences in economic and social structure of the region surrounding the concerned port.

The port of Yokohama is the oldest port (opened in 1859) of the Tokyo Bay ports. By this opening, Yokohama was emancipated from isolation, while playing a gateway role to the Kanto Metropolitan Area, and has been developed as the center of commercial distribution and foreign trade.

As table 3 shows, the port of Yokohama came to occupy 68% of the total volume of export and 76% of the import commerce of the whole country respectively by 1877. However, the huge earthquake in the Kanto plain in 1923 and World War II destroyed most of its port facilities. The central government and Yokohama city soon reconstructed the port of Yokohama.

Even though the two calamities caused the relative standing of the port of Yokohama to decrease a little in its share of foreign trade to the whole nation, the port of Yokohama has maintained the position of the doorway to the Kanto Metropolitan Area.

Table 3. Foreign commerce of Yokohama
(thousand yen)

year	Export	%*	Import	%
1859	597		543	
1877	15,916	68	21,028	76
1897	90,700	55	86,836	40

1922	667,065	55	287,267	35
1927	749,006	38	574,820	26
1947	1,323,000	13	6,431,000	32

Source: The port of Yokohama's 20 year course of history

*% is the share of the Yokohama to the whole country.

Through the enactment of the Local Government Law of 1947 and the port and Harbour Law of 1950, the ports which had been managed by the central government came under the control of the local governments. And so, the city of Yokohama became the port management body for the port of Yokohama in 1951.

In the same year, the port of Yokohama was designated as a major port on January and a specially designated major port on September respectively by the central government.

If a port was designated as a major port or a specially designated major port, the construction cost of facilities might be partially or completely subsidized (Table 4). From that reason, the major ports or the specially designated major ports strengthen their competitive power.

In the United States, the port authority is a body constituted outside of the government bureaucracy, which normally administers a separate port fund and, therefore, does not hand over income to the city, county, or state. And also it is free to make contracts, engage in business under its own name without

Table 4. Share of Construction Cost Paid by National Government

		Water facilities	Protective facilities	Mooring facilities	Waterfront traffic facilities
Port classification (Mainland)	Specially d. Major ports	5/10-10/10	5/10-10/10	5/10-7.5/10	-7.5/10
	Major ports	5/10	5/10	5/10	-5/10
	Minor ports	4/10	4/10	4/10	4/10
	Harbors of refuge	7.5/10	7.5/10	—	—

constant supervision of traditional governmental departments, and is, therefore, subject to public review only in terms of long run accomplishments.(7) In other words, the port authority of the United States is a kind of public enterprise, and therefore, enters into free competition with one another.

But in Japan, port management bodies are composed primarily of local government entities. Moreover the central government maintains a port policy and executes port construction in keeping with regional policies and national land development policies.(8) Accordingly, the principle of free competition in port management is restricted to a certain degree in Japan. However, it could be said that the real competition among ports in Japan began with the enactment of Port and Harbour Law of 1950.

The port of Tokyo was opened with a restriction, that is, opened to only Asia in 1941, and fully opened in 1948. In 1951, Tokyo prefecture also became the port management body based on the above-mentioned Laws on November, and the port of Tokyo was designated as a major port on January, a specially designated major port on September.

The port of Kawasaki had been developed with the port of Yokohama, while falling under the fourth district of it. By the opening of the canal from the port of Yokohama in 1908, the port of Kawasaki became the leading industrial port of the Keihin(Tokyo and Yokohama area) industrial area. After the enactment of the Port and Harbour Law, the port of Kawasaki was separated from the port of Yokohama, and the city of Kawasaki became the port management body in 1951. Also, the port of Kawasaki was designated as a major port and a specially designated major port on the same day as Yokohama was done. Historical events of the ports in Tokyo Bay are arrayed in table 5.

Table 5. Historical events of the ports in Tokyo Bay

port	opening	major port	specially designated major port
Yokohama	1859	1951	1951
Tokyo	1941(restricted) 1948(complete)	1951	1951
Kawasaki	1941	1951	1951

In table 1, the ranges of the hinterlands for import cargo in 1954 are different among three ports. That is, the port of Kawasaki spreads over 12 prefectures; the port of Yokohama, 11 prefectures; the port of Tokyo, only 5 prefectures.

The fact that the port of Yokohama and Kawasaki had secured almost all the area of the hinterland of Tokyo Bay as their own hinterlands reflects their historical backgrounds. The port of Kawasaki not only had had its long history, but also had been developed as a leading industrial port of the Keihin industrial area. Accordingly, its range of the hinterland was wider than that of Yokohama.

The range of the hinterland of the port of Tokyo is narrower than that of Yokohama or Kawasaki. The cause of it might be due to its later opening than the other two ports. Moreover, the port of Tokyo had been developed as the center of commercial activities of the Tokyo Metropolitan Area.

Even though the ranges of the hinterlands for export cargo in 1954 spread over a narrower area than that of cargo, I can also point out the same thing about the changes of the hinterlands for import cargo of the three ports.

2) The challenge of the periphery

As the port system structure reaches a maturity, the challenge of the periphery by some of the smaller ports intensifies. (9) Some leading ports may lack space for expansion. The growing traffic may cause increased congestion. In practice, serious congestion occurred from 1961 to 1962 in the principal ports of Japan, and it accelerated the expansion of the port facilities of the some smaller ports as well as those of the leading ports.

As the port has a close relationship to region, the traffic of cargo has an interrelationship with distance. Accordingly, the growth of the other ports which have a common hinterland causes changes in the range of the hinterland of each port.

Indices of cargo handling turnover of some smaller ports in and around the Kanto area are arrayed in table 6. Especially, the rates of growth of Chiba, Kisarazu, and Kashima are enormous.

Table 6. Indices of handling turnover of some smaller ports

					import cargo				export cargo			
	opening	major	s. major		1954	1967	1977	1982	1954	1967	1977	1982
3 ports(mean)					100	526	665	639	100	676	1245	1241
Chiba	1954	1957	1965		13	360	1038	1139	14	440	1498	1565

Shimizu	1899	1951	1952	19	105	133	119	15	201	138	171
Nigata	1868	1951	1967	19	78	170	139	18	65	185	193
Yokosuka	1948	1951	—	4	70	82	73	10	87	231	194
Kisarazu	1968	1968	—	0.3	45	350	384	0.6	123	607	925
Kashima	1969	1963	—	0	2	404	385	0	0	383	389

If we compare table 1 with table 6, we can point out the fact that the growth of the port of Chiba in 1967 made the range of hinterland of the port of Yokohama and Kawasaki narrow, and that the remarkable growth of the port of Chiba, Kisarazu, and Kashima in 1977 made that of the port of Yokohama, Tokyo, and Kawasaki narrow.

Table 7. Relations between the cargo carried out and distance

port year	Yokohama	Tokyo	Kawasaki
1954	$\ln Y = 13.5 - 0.994 \ln X$ (-5.7) $r = 0.875$	$\ln Y = 15.7 - 1.789 \ln X$ (-5.4) $r = 0.863$	$\ln Y = 12.4 - 0.701 \ln X$ (-4.0) $r = 0.786$
1967	$\ln Y = 16.5 - 1.684 \ln X$ (-7.3) $r = 0.918$	$\ln Y = 15.4 - 1.182 \ln X$ (-5.4) $r = 0.864$	$\ln Y = 15.5 - 1.095 \ln X$ (-6.3) $r = 0.895$
1977	$\ln Y = 17.5 - 1.471 \ln X$ (-5.7) $r = 0.874$	$\ln Y = 17.4 - 1.579 \ln X$ (-8.3) $r = 0.935$	$\ln Y = 17.2 - 1.528 \ln X$ (-6.3) $r = 0.895$
1982	$\ln Y = 17.9 - 1.535 \ln X$ (-8.4) $r = 0.937$	$\ln Y = 17.1 - 1.559 \ln X$ (-10.5) $r = 0.957$	$\ln Y = 17.8 - 1.617 \ln X$ (-7.2) $r = 0.916$

note(1) Y is the cargo carried to each prefecture from port.

(2) X is the distance from port to each prefecture.

(3) The figure in parentheses means t-value.

(4) r means coefficient of correlation.

But what was the reason why the port of Tokyo widened, exceptionally, the range of its hinterland in 1967? I can not insist on the accuracy of my guess, but I suppose that the influence of the other factors, for example diversification of handling cargo, might be stronger than that of the challenge of the other ports(See table 9).

The influence of the peripheral ports for export cargo is not conspicuous except for the port of Kawasaki. That was why the port of Tokyo and Yokohama had been developed as commercial ports, while the port of Kawasaki had been developed as an industrial ports. As a matter of course, the port of Chiba, Kisarazu, and Kashima had been developed as the industrial ports.

To examine differently the effect of the challenge of the peripheral ports, I used the regression analysis technique to estimate the relations between the cargo carried to each prefecture from each port and the distance between the two. The results are summarized in table 7.

In table 7, the coefficient of $\ln X$ is the distance elasticity coefficient. As the coefficient is not more than zero, it mean that if the distance increases, the cargo carried out decreases. In other words, if the coefficient becomes smaller, the range of the hinterland becomes narrower. When table 7 is compared with table 1, the results of table 7 clarify the changes of table 1.

By comparing the distance elasticity coefficients with the ranges of the hinterlands(the number of prefectures) for the three ports, we can see the extent of the effect of the peripheral ports. As Fig. 5 shows, the growth of the port of Chiba in 1967 and the magnificent growth of the port of Chiba, Kisarazu, and Kashima in 1977 made the ranges of the hinterlands for the three ports narrow.

However, among the causes of the changing range of the hinterland, there are also the effects of the other factors, that is, technical innovation and diversification of handling cargo. These factors help us to explain the case of Yokohama and Tokyo in 1977 and 1982.

3) Diversification of handling cargo

The diversification of the handling cargo among ports which have the same hinterland in common affects the range of the hinterland of each port. Particularly, the diversification of the handling cargo coped with the industrial structure of its hinterland will influence intensively the expansion of the hinterland. It is because the level of the service of the port is raised up, the competitive power becomes stronger.

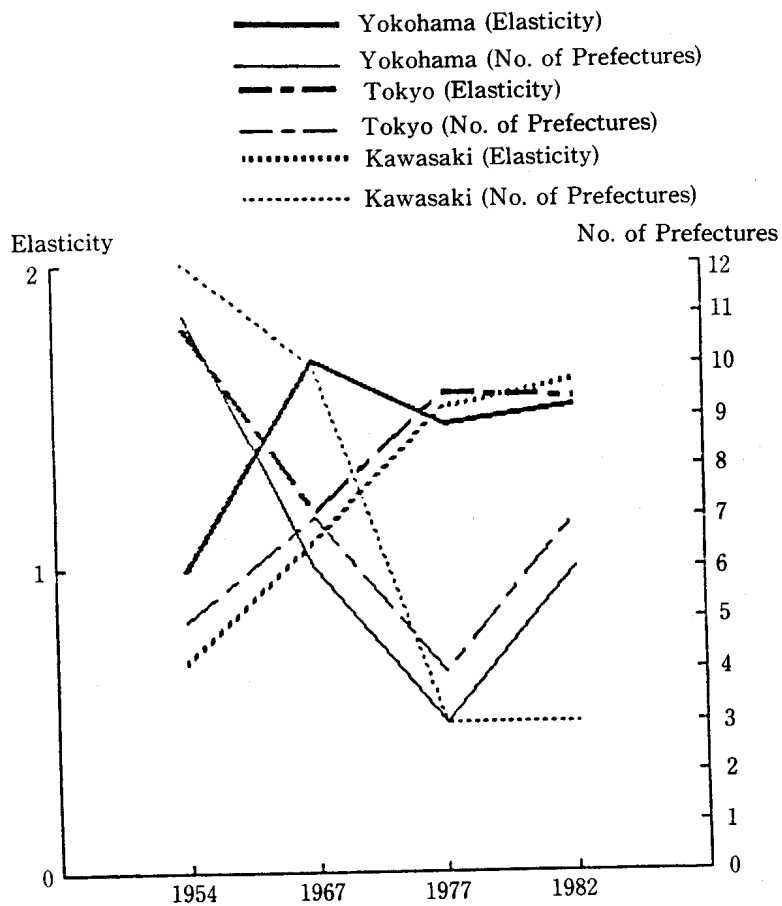


Fig. 5. Relations between the distance elasticity coefficient and the range of the hinterland

The shares of the consignment of the manufacturing industry in the hinterland of Tokyo Bay and those of handling cargo of the three ports are arranged to the items of manufacture in table 8.

Table 8. The shares for the items of the three ports

year	item	Agri-culture	Forest	Min-eral	Ma-chine	Che-mical	Light indus.	Others
	manufac. industry	11.9	2.5	11.5	40.1	13.9	11.9	8.1
	Yokohama	6.3	1.9	39.3	15.0	29.1	4.0	4.3

67

An econometric analysis on the changes of the hinterlands of the ports in Tokyo Bay 19

77	Tokyo	5.9	11.1	20.6	24.2	26.0	7.2	5.0
	Kawasaki	2.4	1.2	51.1	13.2	30.2	1.4	0.4
	manufac. industry	11.0	1.7	9.6	42.8	17.0	9.9	8.0
	Yokohama	4.4	0.6	33.5	24.7	28.0	2.7	6.1
82	Tokyo	4.0	6.4	12.7	39.7	24.5	7.2	5.4
	Kawasaki	4.4	0.5	43.7	14.1	36.2	0.6	0.4
	manufac. industry	10.0	1.2	8.6	45.8	18.3	8.8	7.3
	Yokohama	4.9	0.6	29.9	31.2	24.9	3.2	5.3
	Tokyo	4.7	5.8	13.0	42.4	19.3	8.0	6.7
	Kawasaki	4.1	0.3	43.8	13.9	35.7	0.7	1.4

To check the fitness of the facilities of each port to the consignment of the manufacturing industry, I used the following formula.

$$F_i = \frac{(B_i - A)^2}{A}$$

Where, F_i is the fitness index of the port i .

A is the share of the item manufactured in the hinterland.

B is the share of the item handled by the port i .

The results of the fitness are arrayed in table 9.

Table 9. Fitness of the three ports

port	year	1967	1977	1982
Yokohama		109.34	84.63	66.80
Tokyo		59.69	23.56	23.12
Kawasaki		198.37	182.82	199.22

Even though the values of the fitness are considerably large, it is considered that there is no trouble in comparing the relative values. The figures of table 9 indicate that the facilities of the port of Yokohama and Tokyo have coped with the changes of the industrial structure of their hinterlands, on the other hand the port of Kawasaki has not accorded with the industrial changes.

By comparing table 1 and 2 with 9, the following points are obtained: first, the trend of the expansion and reduction in the range of the hinterland of each port for import cargo is consistent with the trend of the fitness of each port except for the abnormal situations of the port of Yokohama and Tokyo in 1977. Also, the trend for export cargo is in accord with the trend of the fitness, except for the case of the port of Yokohama in 1977.

Especially, the fitness of the port of Kawasaki explains well the fact that the range of the hinterland has become narrower for export and import cargo. It is guessed that the cause for the abnormal situation of the port of Yokohama and Tokyo in 1977 might be due to the striking effect of the growth of the peripheral ports, namely, Chiba, Kisarazu, and Kashima (See table 6).

4) Technical innovation

During the last two decades ocean transportation has experienced rapid changes. The tendency for ship's size to grow larger, specialization of ships, and containerization are, in particular, worthy of notice. Especially, containerization caused the system of handling cargo drastically to be modified, and changed the range of the hinterland.

The studies on the economics of containerization have been conducted by many researchers. (10)

(11) (12)

But the studies on the influence of containerization upon the changes of the range of the hinterland are few. (13)

In this section, I make clear the effects of containerization on the range of the hinterland. Japan's first container berth was completed at the port of Tokyo in 1967, and then at the port of Yokohama in 1969. But the port of Kawasaki does not have a container berth yet.

The handling turnover of container cargo in the two ports have increased in amount and share. It is considered that this trend will go on in the future. Accordingly, the influence of containerization upon the change of the hinterland will grow more and more.

Table 10. Container cargo handled

port	(thousand tons)			
	Yokohama		Tokyo	
year	import	export	import	export
1970	666 (1.1)	1,335 (2.7)	472 (1.2)	406 (6.7)
71	1,235 (2.0)	2,099 (4.1)	361 (1.0)	435 (7.6)
72	1,424 (2.2)	2,678 (4.8)	1,096 (2.8)	1,272 (19.0)
73	2,103 (2.9)	2,477 (4.2)	2,315 (5.2)	2,463 (22.9)
74	1,834 (2.6)	2,815 (4.8)	2,865 (6.7)	2,924 (22.6)
75	1,633 (2.7)	2,919 (5.5)	2,119 (5.7)	2,591 (20.4)
76	2,061 (3.4)	3,561 (6.7)	2,693 (6.8)	3,760 (23.9)
77	2,237 (3.6)	3,721 (6.8)	3,237 (7.8)	4,353 (25.7)

78	2,659 (4.2)	4,196 (7.6)	4,001 (9.4)	4,752 (27.9)
79	3,072 (4.6)	4,581 (8.0)	4,411 (9.9)	4,563 (25.8)
80	3,333 (5.2)	6,223 (9.9)	4,248 (9.9)	5,316 (28.0)
81	3,486 (5.8)	7,559 (12.3)	4,269 (10.4)	5,837 (30.0)
82	3,873 (6.7)	7,908 (13.8)	4,264 (10.6)	5,332 (28.0)

note(1) The figure in parentheses means the share of the container cargo to total import(export)cargo.

$$\text{*share of the container} = \frac{\text{container import(export)cargo}}{\text{total import(export)cargo}} \times 100$$

To check the effect of containerization on the range of the hinterland, I examined the relations between the cargo of each prefecture carried to and from port and the distance to port. On account of a restriction of data, 7 prefectures in the Kanto area were chosen and the surveys were different from the surveys on the incoming and outgoing cargo by the overland transport by year. But even if we use it, we won't have any difficulties in grasping the trend of the change.

The results are arrayed in table 11, and are interpreted the same as table 7. The results show that there is a trend for containerization of the port to expand its hinterland, though there are a few exceptions. In the case of import cargo, the results of table 11 back up the fact that the range of the hinterland of the port of Yokohama and Tokyo in 1982 had been expanded more than before. But, they don't support the conditions of 1977. I think that the reason exists in low weight of container cargo to total handling turnover (See table 10) and the remarkable growth of the peripheral ports (See table 6).

Table 11. Relations between container cargo carried and distance

year	Yokohama	
	Import cargo	Export cargo
1972	$\ln Y = 13.2 - 1.159 \ln X$ (-2.9) $r = 0.794$	$\ln Y = 12.8 - 0.818 \ln X$ (-4.0) $r = 0.871$
1974	$\ln Y = 12.7 - 0.991 \ln X$ (-2.7) $r = 0.768$	$\ln Y = 13.3 - 0.859 \ln X$ (-6.7) $r = 0.948$
1978	$\ln Y = 13.1 - 0.904 \ln X$ (-2.6) $r = 0.755$	$\ln Y = 13.2 - 0.728 \ln X$ (-10.5) $r = 0.978$
Tokyo		
1972	$\ln Y = 13.7 - 1.496 \ln X$ (-4.4) $r = 0.892$	$\ln Y = 12.8 - 0.958 \ln X$ (-3.6) $r = 0.850$
1974	$\ln Y = 14.3 - 1.375 \ln X$ (-7.2) $r = 0.955$	$\ln Y = 13.2 - 0.944 \ln X$ (-4.8) $r = 0.906$
1978	$\ln Y = 14.3 - 1.182 \ln X$ (-6.2) $r = 0.904$	$\ln Y = 12.7 - 0.661 \ln X$ (-3.4) $r = 0.834$

* Source; the surveys on the container traffic for import and export cargo in Japan (Department of Custom of the Ministry of Finance)

For export cargo, they also support the situations in 1977 and 1982, except for the case of the port of Yokohama in 1977.

There was no change in the range of the hinterland of the port of Kawasaki which didn't have the container terminal.

Consequently, I can conclude that the more container cargo weight in total handling turnover becomes, the more containerization of the port expands its hinterland.

4. Conclusion

These four important factors are used to analyze the influence on the changes of the hinterlands of the ports in Tokyo Bay. These are as follows: historical background, challenge of the periphery, diversification of handling cargo, technical innovation.

In this analysis, I could grasp the range of the hinterlands quantitatively. And I could explain the factors which influenced the change of the hinterlands, and I could find the causes of the pattern of the changes of the three ports with the stream of time.

Right after the Second World War, it was clear that the port of Yokohama and Kawasaki maintained a wide range of the hinterland owing to their historical background. However, the challenge of the peripheral ports was inevitable in the fast growing national economy, and to overcome this challenge, it was an indispensable condition for the port authority to improve its competitive power.

The port of Tokyo, which improved its competitive power sensitively, has expanded its hinterland steadily under the disadvantage of a short historical background and the powerful challenge of the peripheral ports.

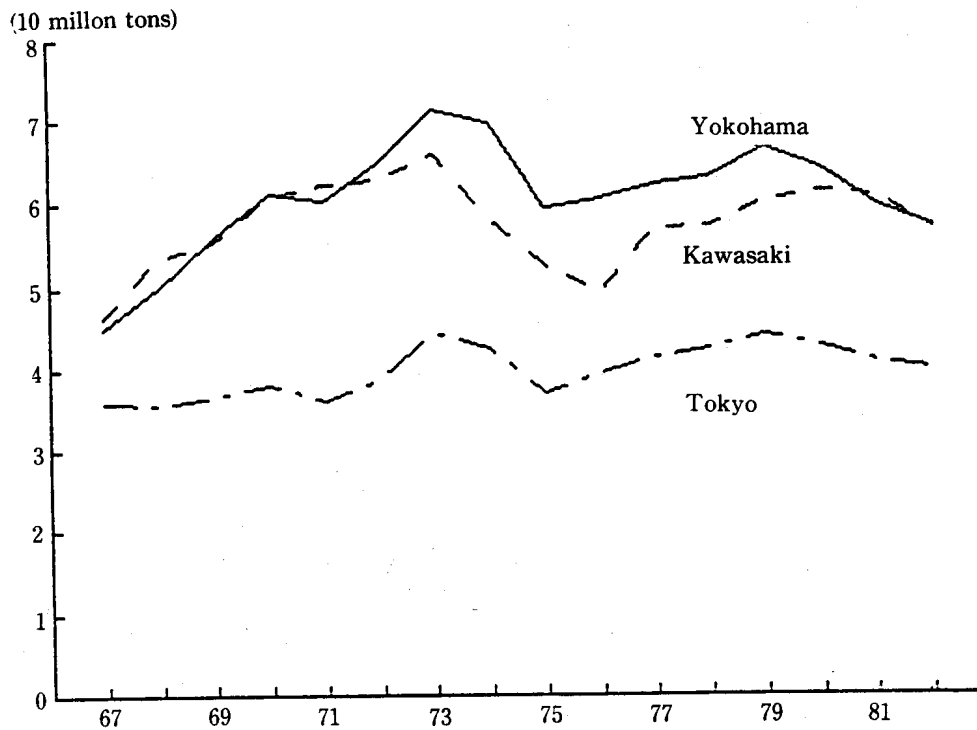


Fig. 6. Trend of Import Cargo

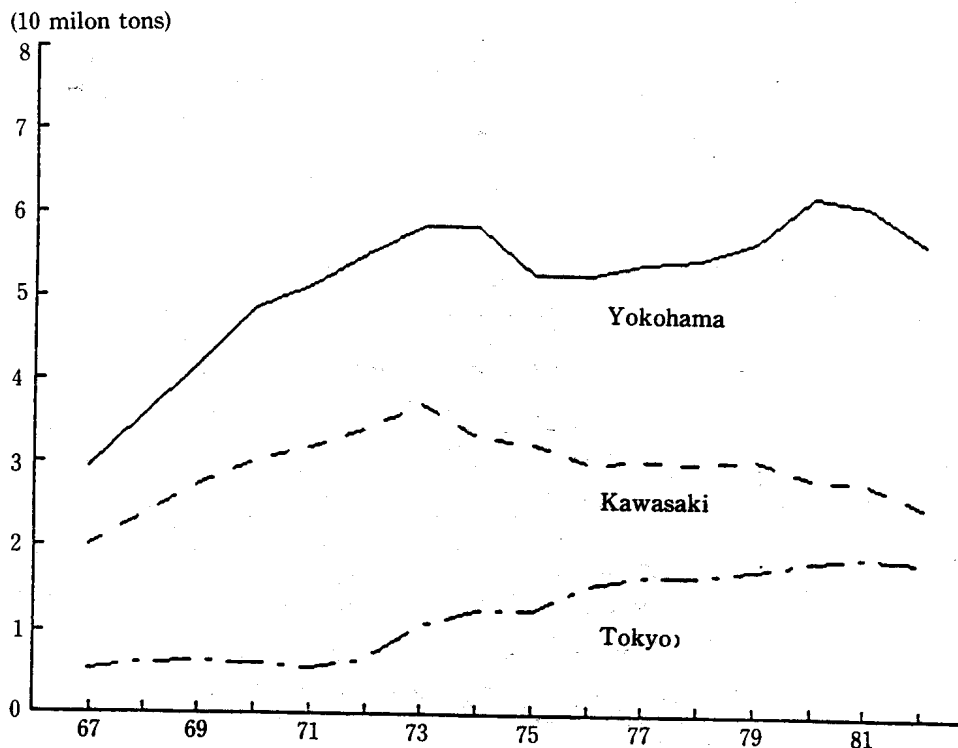


Fig. 7. Trend of Export Cargo

It is considered that the adoption of technical innovation by containerization and the improvement in the level of service by the diversification of handling cargo are the main factors which have supported the port of Tokyo.

Next, the port of Yokohama fell behind the port of Tokyo, but started recovering the hinterland previously lost by coping with the change of external circumstances.

As the port of Kawasaki had remained as only a leading industrial port of the Keihin industrial area, its hinterland continued getting narrower.

The range of the hinterland plays important roles in the stable growth of the port. The figure 4 and 5 are helpful to understand this. It is not easy to measure the stability of each port due to the effects of oil shocks of 1973 and 1979, but they show the port of Tokyo has kept a relatively stable growth.

Consequently, to assure the hinterland is an essential condition for the stable growth of the port, and to accomplish this purpose, the port authority has to improve its level of service in corresponding with the changes of the circumstances of the hinterland, especially the change of the industrial structure.

REFERENCES

1. Donald J. Patton, (1958), "General Cargo Hinterlands of New York, Philadelphia, Baltimore, and New Orleans", *Annals of the Association of American Geographers*, Vol. 48, pp. 436-455.
2. James B. Kenyon, (1970), "Elements in inter-port competition in the United States", *Economic Geography*, Vol. 46, pp. 1-24.
3. Howard L. Green, (1955), "Hinterland Boundaries of New York City and Boston in Southern New England", *Economic Geography*, Vol. 31, pp. 283-300.
4. Guido G. Weigend, (1958), "Some elements in the study of port geography", *Geographical Review*, Vol. 48, pp. 185-200.
5. Guido G. Weigend, (1958), *op. cit.*
6. Nomura Research Institute, (1985), "Long-term improvement project of the port of Yokohama", Tokyo, p. 6.
7. Marvin L. Fair, (1954), "Port administration in the United States", Cornell Maritime press, Cambridge, pp. 73-74.
8. Yoshio Takeuchi, (1983), "Concepts of Port Development", ESCAP port development series No. 6, Bangkok, pp. 9-30.
9. Yehuda Hayut, (1981), "Containerization and the Load Center Concept", *Economic Geography*, Vol. 57, pp. 160-175.
10. Mckinsey and Company, Inc., (1967), "Containerization: the Key to Lowcost transport", London.
11. K. M. Johnson & H. C. Garnett, (1977), "The economics of containerization", George Allen & Unwin LTD., London.
12. Sidney Gilman, (1980), "Ship Choice in the Container Age", Maritime Transport Centre, Liverpool.
13. Yehuda Hayut, (1981), *op. cit.*