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The Rise of International Shipping in East Asia

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Abstract

East Asia has enjoyed a dynamic economic evolution at a continuously high speed compared with other regions of the world since the 1980s. Benefitting from the rapid economic growth, the demand of consumption in East Asia has ever been increasing. Blessed by the geographical advantages of East Asia, the international trade in terms of volumes and amount of five countries and regions in East Asia including Japan, China, Taiwan, Hong Kong and Korea (herein after referred to as FEA) has ever been soaring and ocean shipping becomes the main stream of transportation in the region.

Under these circumstances, the hub ports in FEA have played pivotal roles in accommodating the ever increasing export/import cargoes in the region in terms of new ports development and expansion.

On the other hand, the Shipping lines in FEA, in order to gain a slice of the big pie that is the shipping market, have been aggressive in forming the shipping alliances with other overseas shipping lines, remapping the world shipping industries.

Keywords:

International Shipping, Container Throughput, Hub Port, Global Shipping Alliance, East Asia

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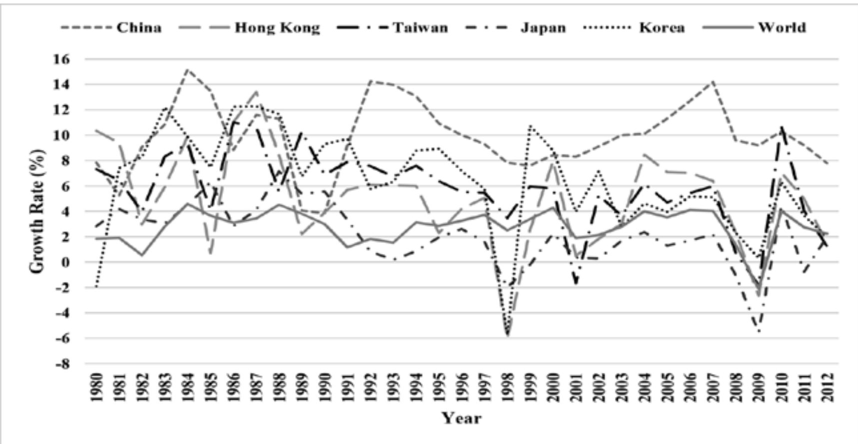
1. Introduction

Academically, the study on global logistics of East Asia focuses on Japan, China, Asian NIEs (Taiwan, Korea, Hong Kong and Singapore) and ASEAN4 (Philippines, Malaysia, Thailand and Indonesia) (Wang, 2001).

Benefiting from stable political situation since the end of the 1970s, five main countries and regions in East Asia (hereinafter referred to as FEA, which includes Japan, China, Hong Kong, Taiwan and Korea) have enjoyed a dynamic economic growth with a continuously high speed compared with other areas of the world since the 1980s. The real GDP growth rates reflect the economic development of FEA members from 1980 to 2012. As can be realized from Figure 1 that the average annual real GDP growth rates of Japan, China, Taiwan, Hong Kong and Korea demonstrated 2.11%, 9.93%, 5.78%, 5.02% and 6.34% respectively.

Figure 1. Real GDP Growth Rate of FEA (1980–2012)



Source: Created by the author based on the data of Real GDP growth rates, total and per capita, annual, 1970–2012, *United Nations Conference on Trade and Development.*

The new development era since 1980 in East Asia offers more opportunities to the rise of international shipping in the region. Based on such a background, it is necessary to study the factors that may influence international shipping in the past 30 years in order to make a better understanding on the international shipping development in the region, thus the study focuses on five research questions as follows:

What are the factors that triggered the rise of container throughput of FEA from 1980–2010?

To what extent did the main container hub ports in FEA develop from the 1980s to the 2010s and whether the port facilities are important to the increase of the container throughput of the main hub ports in FEA?

Whether the shipping lines in FEA are significant to the realignment and development of the global alliances from 1994 to 2012?

To what extent had the main shipping lines in FEA developed from 1994 to 2012?

Based on the research questions, this paper falls into five aspects to examine the influence of the economic development for the rise of international shipping in East Asia from the 1980s to the 2010s.

The first demonstrates the rise of container tonnage in East Asia focusing on analyzing the factors that influence the container throughput and the containerization development in FEA. The second discusses the development of hub ports in East Asia in terms of the accommodation of the increasing container tonnage and the influence by port facilities. The third reviews the formation and evolution of global shipping alliances triggered by the surge of container tonnage in the region and the fourth analyzes the status of FEA shipping lines in global marine transportation while the final part concludes the results of the study.

2. The Rise of Container Tonnage in East Asia

2.1 The Background of Drastic Economic Development in East Asia

The economic prosperity in FEA can be seen from three specified issues. First, China was granted the Official Development Assistance (ODA) from Japan to support its Open and Reform Policy in 1979. Japan offered 330.9 billion Japanese Yen (approximately 1.5 billion US dollars) with low interest loans for the first stage (1979–1984). By the end of 2011, the gross loans reached to 3,316 billion Yen (approximately 30 billion US dollars). The loans supported almost all Chinese large-scale development plans from 1979, especially in the soaring period of Chinese economic development in the 1980s and the 1990s.

Secondly, as the result of the "Plaza Accord" held in September 1985 among Japan, United States, United Kingdom, Federal Republic of Germany and France, Japanese Yen appreciated drastically against US dollar since then, which largely reduced the cost in production overseas and became an opportunity for the overseas expansion of Japanese enterprises.

The third causation of economic development in East Asia was the Foreign Direct Investment (FDI) from Japan into the region, which has brought “Win-Win” benefits for both sides since the end of the 1970s. By the end of 2004, the FDI in China and Asian NIEs has totaled US$ 31,847 and 56,332 million. Because of the success of FDI, Japanese corporations have been able to reduce the production cost largely. Blessed by the FDI, the manufacturing industries and shipping market have been developed in the region as well, which generates a huge opportunity for the labor force.

2.2 The Surge of International Trade in East Asia

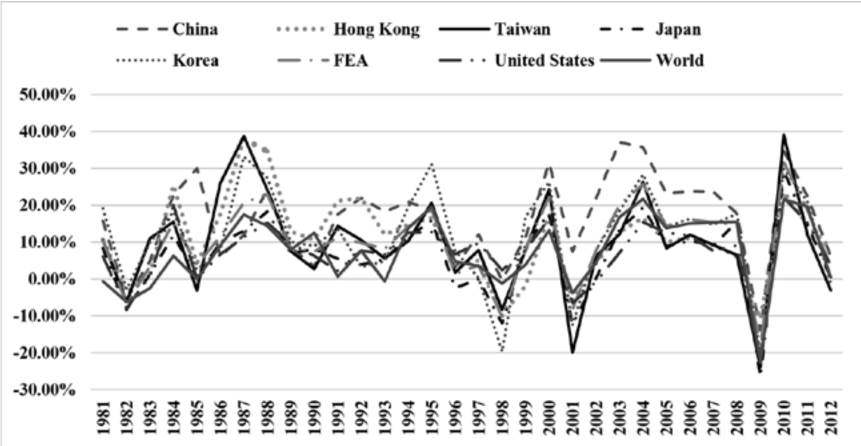
The drastic economic development of FEA brought an unprecedented expansion and prosperity to the international trade. On the other hand, because of the increasing demand of both the horizontal and vertical division of labor in the region, it has driven the move of container tonnages drastically during the past three decades.

Consequently, the international trade in East Asia grew enormously, thereby generating a remarkable record of high and sustained growth. In the period between 1981 and 2012, the annual average trade growth rate of Japan, China, Taiwan, Hong Kong and Korea demonstrated 6.61%, 16.50%, 9.57%, 10.77% and 7.14% respectively. The average of the annual trade growth rate of FEA in the period was 10.32% compared with 7.15% in United States and 7.47% in the world (see Figure 2).

During the past 30 years (1980–2012), the weight of FEA in the world trade amount rose from 10.46% to 22.31%, accounting for more than one fifth of the world’s trade amount in 2012. The weight of China in the world’s trade amount rose from 0.92% to 10.48%, accounting for one tenth of the world’s container tonnage in 2012. In comparison, Hong Kong rose from 1.05% to 2.83% (3.55% in 1995), Korea rose from 0.96% to 2.89% and Taiwan rose from 0.96% to 1.55% (2.33% in 2000), meanwhile, Japan declined from 6.57% to 4.56% (7.71% in 1985) in the same period (see Table 1).

Obviously, the international trade in China contributed largely to the substantial growth of trade amount in FEA. From the phenomenal change, it is clear that the center of international trade in FEA has been shifting from Japan to China from 2005 and the international trade amount of China was catching up with that of United States during the recent years, meanwhile, East Asia became the new international trade center in the world.

Figure 2. Annual Trade Growth Rate of FEA compared with United States and the World (1981–2012)



Source: Created by the author based on the data of Exports and imports of goods and services, annual, 1980–2012, *United Nations Conference on Trade and Development.*

Table 1. The Weight of FEA compared with United States in the World Trade Amount (1980–2012) (in Million US Dollars)

Country/Region	1980	1990	2000	2010	2012	2012/1980
Japan	271,737	522,948	858,806	1,463,899	1,684,411	6.20
% of the world	6.57%	7.36%	6.55%	4.77%	4.56%	0.69
China	38,041	115,436	474,227	2,974,001	3,867,119	101.66
% of the world	0.92%	1.63%	3.62%	9.69%	10.48%	11.39
Taiwan	39,596	122,027	291,999	525,837	571,654	14.44
% of the world	0.96%	1.72%	2.23%	1.71%	1.55%	1.62
Hong Kong	43,317	167,115	416,725	842,061	1,046,394	24.16
% of the world	1.05%	2.35%	3.18%	2.74%	2.83%	2.71
Korea	39,804	134,860	332,749	891,596	1,067,454	26.82
% of the world	0.96%	1.90%	2.54%	2.90%	2.89%	3.00
FEA	432,495	1,062,386	2,374,506	6,697,394	8,237,032	19.05
% of the world	10.46%	14.96%	18.12%	21.82%	22.31%	2.13
United States	482,551	910,579	2,041,218	3,247,679	3,881,245	8.04
% of the world	11.67%	12.82%	15.57%	10.58%	10.51%	0.90
world	4,135,346	7,103,015	13,105,789	30,697,785	36,914,679	8.93

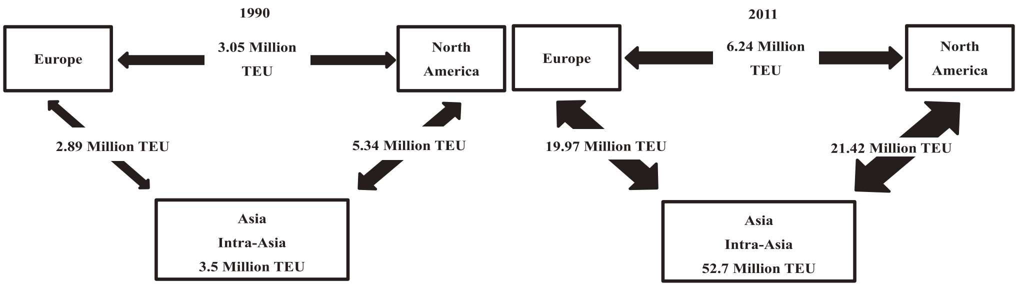
Source: Created by the author based on the data of Exports and imports of goods and services, annual, 1980–2012, *United Nations Conference on Trade and Development.*

2.3 The Weight of FEA in Global Container Tonnage

With the booming international trade in East Asia, the container tonnage calculated by 20-foot-equivalent units (TEU) has been increasing since the 1980s. The global container transportation focuses on three international trade lanes: Transpacific trade lane (between Asia to East and West Coast of North America), Asia-Europe Trade Lane and Intra-Asia trade lane.

The container tonnage of Transpacific trade lane was up to 21.42 million TEU in 2011, which increased by 3.01 folds compared with 5.34 million TEU in 1990. Asia-Europe Trade Lane demonstrated 19.97 million TEU in 2011, which increased by 5.91 folds compared with that of in 1990. Intra-Asia trade lane recorded 3.5 million TEU in 1990 and 52.7 million TEU in 2011; the volume increased by 14.05 folds in 22 years. Compare with the trade volume between North America and Europe, which was from 3.05 million TEU in 1990 to 6.24 million TEU in 2011 (104% increase), the container tonnage between Asia and both of Europe and North America, and Intra-Asia Lane enjoyed a remarkable growth in the same period (see Figure 3).

Figure 3. Growth of Asian Trade Lanes in the World Container Transportation (1990–2011)



Source: Created by the author based on the data of *Report of Japan Maritime (1997) and Maritime Report (2013).*

Table 2 shows the container throughput of FEA members and their weight in comparison with the United States and world's total container traffic from 1980 to 2010. As is evident from the table, during the past three decades years (1980–2010), the weight of FEA in the world world's container throughput rose from 19.52% to 39.31%, accounting for almost two fifth of the world's container throughput in 2010. It is surprising to find that during the 30 years, the weight of China in the world's container throughput rose from 0.15% to 24.85%, accounting for one fifth of the world's container tonnage in 2010. In comparison, Hong Kong rose from 3.94% to 4.70% (9.14% in 1995) and Korea rose from 1.81% to 3.76% (3.90% in 2000), meanwhile, Japan declined from 9.19% to 3.52% (9.87% in 1985) and Taiwan declined from 4.42% to 2.48% (6.37% in 1990) in the same period. Evidently, the hub ports in China contributed largely to the substantial growth of container traffic tonnage in FEA. From the phenomenal change, it is clear that the center of global container traffic has been shifting from Japan and Taiwan to China and the center of container transportation moved from United States to China in 2005 (see Table 2).

From the analysis of economy and international trade development in East Asia, it is clear that the trade amount is an important factor to the container throughput during the past 30 years for each FEA member except Taiwan. Though the container throughput of Taiwan in the world rank was between 3 and 10 from 1980–2010, the trade amount of Taiwan is much less than that of the other FEA members.

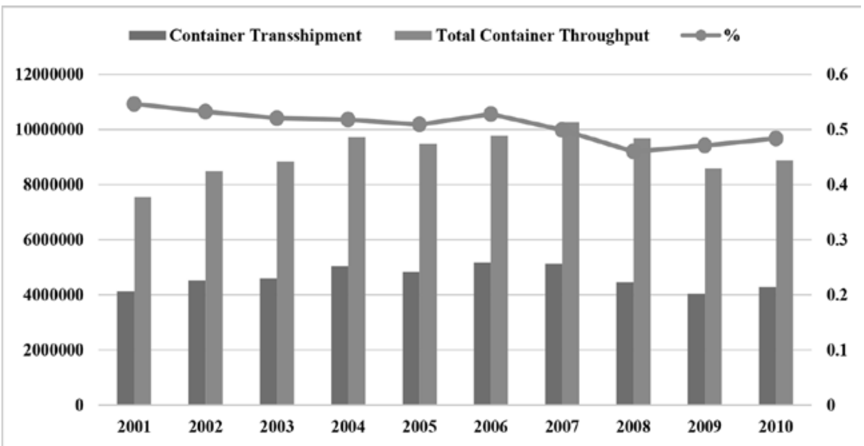
The reason is that Taiwan has been playing a crucial role as a container entrepôt for transshipped cargoes from Southeast Asia and North America which account for high weight of the total container throughput. For example, the average transshipped cargoes account for 50.67 % of the total container throughput of Kaohsiung Port from 2001 to 2010 (see Figure 4). However, as these transshipped containerized cargoes don't originate from Taiwan, so statistically, those cargoes are not listed as export/import cargoes from/to Kaohsiung Port in terms of international trade.

Table 2. The Weight of FEA compared with United States in the World Total Container Throughput (1980–2010) (Unit: TEU)

Country/Region	1980	1990	2000	2010	2010/1980
Japan	3,417,118	7,955,705	13,129,864	17,726,645	5.19
% of the world	9.19%	9.29%	5.67%	3.52%	0.38
China	54,038	1,203,851	22,884,361	125,103,189	2,315.10
% of the world	0.15%	1.41%	9.88%	24.85%	165.67
Taiwan	1,644,322	5,450,913	10,510,762	12,501,059	7.60
% of the world	4.42%	6.37%	4.54%	2.48%	0.56
Hong Kong	1,464,961	5,100,537	18,100,000	23,669,442	16.16
% of the world	3.94%	5.96%	7.81%	4.70%	1.19
Korea	672,380	2,348,475	9,030,174	18,947,427	28.18
% of the world	1.81%	2.74%	3.90%	3.76%	2.08
FEA	7,252,819	22,059,481	73,655,161	197,947,762	27.29
% of the world	19.52%	25.77%	31.79%	39.31%	2.01
United States	8,566,838	15,244,585	27,315,136	35,601,582	4.16
% of the world	23.05%	17.81%	11.79%	7.07%	0.31
world	37,163,242	85,596,903	231,689,448	503,512,074	13.55

Source: Created by the author based on the data of Port Traffic League, *Containerisation International Yearbook (1982–2012), Container Port Ranking 1970–2000, China Port Yearbook (2001).*

Figure 4. The Weight of Transshipped Cargoes in the Total Container Throughput of Kaohsiung Port(2001–2010)



Source: Created by the author based on the data of Port of Kaohsiung, Taiwan International Ports Corporation, Ltd.

3. The Development of Container Hub Ports in FEA

3.1 The Importance of Container Hub Ports in FEA

Ports, the nodes of global logistics, are defined as an important components of global value chains (Robinson, 2002). The hub ports in East Asia have been recast since the mid-the 1980s as major global trading centers (Rimmer, 1999). Hub ports facilitate the cargos from global shipping centers to smaller regional hubs and distribution networks. The railways, roads and pipelines function as arteries to the ports where ocean cargoes are loaded and unloaded. Nowadays, the representative hub ports are Shanghai, Hong Kong and Shenzhen in East Asia.

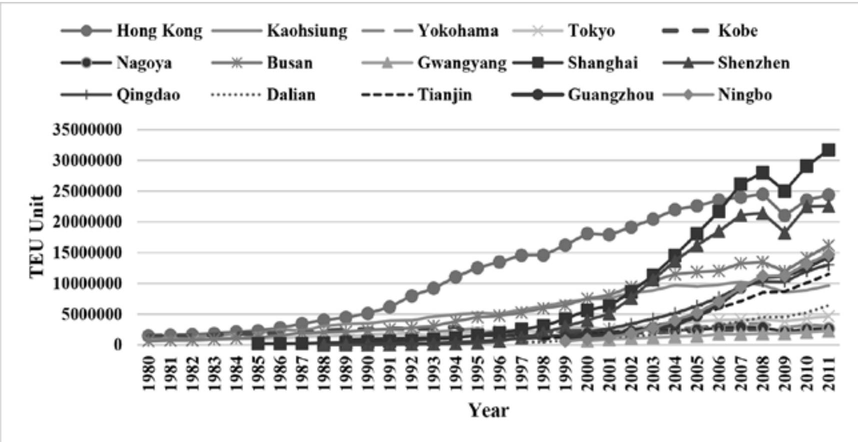
In the early 1970s, Japan consolidated its economic and trade position, spurning the shipping services to expand substantially. By contrast, it has been the emergence of East Asia, particularly Hong Kong and Korea from the 1980s and China from 2000 to the present and the rapid economic growth in the region that underlie containerization and the development of container handling capacity in the regional ports. As mentioned above, the rapid and sustained growth of international trade and cargo tonnage in East Asia can be attributed to the boom of the investments from Japan of as well as the global shipping alliances in East Asia emerged as exceptional generators of container traffic over the past two decades.

The centers of container shipping in East Asia were mainly concentrated on Japan, Hong Kong Taiwan and Korea before 2000. Triggered by the rapid economic growth after 2000, the cargo tonnage has risen steeply, generating a large concentration of container tonnage in China. Consequently, some ports in China have become the main hub ports for the region. At the same time, though affected by the rise of main ports in China, the container throughput of the main ports in Taiwan and Korea are still keeping a steady increase (see Figure 5).

As a consequence, the main ports in the region, such as Port of Shanghai, Hong Kong, Busan, Tokyo and Kaohsiung become the shipping hubs in terms of marine transportation. Nowadays, the container throughput of those hub ports is still keeping a steady increase. By the end of 2011, twenty seven container hub ports in FEA were listed in the World Top 100 Ranking while seven of them were ranked in top 10. The total throughput of the twenty seven hub ports reached to 195.13 million TEU in 2010, accounting for 38.75% out of the world's container throughput. In 1994 Hong Kong Port became the first 10-million TEU throughput hub port all over the world, and, of the eight 10-million TEU throughput hub ports in the region in the year of 2011, six were Chinese hub ports.

Special attention should be paid to the rise of container hub ports in China. In 1995 there were only four Chinese ports, Shanghai, Tianjin, Qingdao and Xiamen, were listed in World Top 100 Container Port. By the end of 2011, 15 Chinese ports were listed in the ranking and 8 out of them were at top 20. The ports distribute from Northeastern to Southern China, from Dalian to Shenzhen. The development of Chinese container hub ports is largely due to their excellent geographic location, natural deep-water advantages and the rapid economic growth of economy in East China.

Figure 5. Container Throughput of Main Ports in East Asia (1980–2011)



Source: Created by the author based on the data of Port Traffic League, *Containerisation International Yearbook (1982–2012),* Container Port Ranking 1970–2000, *China Port Yearbook (2001).*

3.2 Port of Shanghai

Among Chinese hub ports, Shanghai Port obtains the maximum benefit from Chinese exports that have moved into high gear to supply the needs of swelling world trade as well as the huge expansion in trade to the East and West Coast of North America.

Container throughput at Port of Shanghai was up to 26.15 million TEUs in 2006, placing Shanghai Port the first in the world ranking. Despite growing concerns that operational capacity is being squeezed, with the development of the new deep-water port area—Yangshan Port, Shanghai continues to occupy the lofty perch way at the head of the hub ports all over the world.

3.3 Port of Hong Kong

The port of Hong Kong, as a key node in global logistics network, dominates the central cluster and its continuing high growth reflects the rapid economic development in southern China as well as its central position and significance.

Given its friendly environment and excellent infrastructures, the port is not only blessed with its unique geographical location bearing mainland China as its hinterland, but also plays a vital role as the entrepôt for container transshipment for both Asia-North America and Asia-Europe lanes. Additionally, the port provides the feeder services for the export and import cargos between inland of China and the adjacent Pearl River Delta. For those reasons, the port has been one of the leading container ports in the world for many years.

3.4 Port of Busan

The Port of Busan is located at the southeastern Korean peninsula facing the Korea Strait, plays a pivotal role as a transshipment hub port for Northeast Asia.

Busan won a big piece of Japan's transshipment cargo since Kobe earthquake in 1995. The container throughput of Busan had an increase of 18.42% by its highest margin in 2010. The container throughput of Busan Port is increasing with an annual average growth 8.3% (–11.14% in 2009 due to Lehman Shock) from 2000–2011 because of its geographical advantage in the region.

3.5 Port of Tokyo

The Port of Tokyo, comprising 15 container berths, handles 20% of Japan's total overseas container traffic and has been ranked the number one container hub port in Japan since 1998.

As a part of a super-hub port scheme driven by the state government, Tokyo Port has been selected as a "Super Hub Port" qualifying for future prioritization of Japanese national investment. The port intends to become a model port capable of competing with the best major ports in northeast Asia for 21st century. A 10-year development plan (2006–2016) devised by the Tokyo Metropolitan Government (TMG) is implementing by Tokyo Port. The 7th Revised Port and Harbor Plan involved a large-scale container terminal development that comprises three container berths and terminal facilities capable of handling the vessels of 100,000-tonne capacity.

3.6 Port of Kaohsiung

Kaohsiung Port, with its geographical advantage locating along the southwestern coast of Taiwan on the key trade lanes running through the Taiwan Strait, is the largest international hub port in Taiwan handling an average 72.76% (2000–2010) of its container throughput.

The port is ideally located as the transshipment hub for the export cargoes between the west coast of North America to Southeast Asian countries. Furthermore, owing to the opening of direct sailing between Kaohsiung Port and port of Xiamen and Fuzhou (Fujian Province, China) in China in 1997, it provides Kaohsiung Port more opportunities for securing the transshipment cargoes from North America and China.

The historic agreement that was signed in November 2008 to resume completely direct transportation between Taiwan and China in December 2008, after the interruption of nearly 60 years due to the political reasons. This means that freight now can be shipped directly across the Taiwan Strait from 63 Chinese ports to 11 ports in Taiwan vice versa, without having to make a detour via the port of Ishigaki (Okinawa, Japan) or Port of Hong Kong. This saves 16 to 27 hours of shipping for Taiwanese vessels, as well as around 15–30% on cost.

3.7 The Facility Evaluation of Container Hub Ports in FEA

The fast growth in container tonnage in FEA makes shipping lines to deploy the trunk routes and select the hub ports more complicatedly than North America and Europe. In container transportation, shipping lines make decisions in choosing ports. However, there exist many factors that may influence the choices. They are cargo source (Slack,1993; Murphy & Daley, 1994; Song, 2002, 2003), port facilities (Chen, 1997; Cullinane et al., 2002; Fung, 2001), delivery distance (Malchow and Kanafani, 2001; Zohil and Prijon, 1999), port location (Ha, 2003; Malchow and Kanafani, 2001), operating cost (Tai and Hwang, 2001; Tai, 2000; Wu, 2000), etc.

Based on the need to make a decision to select the hub port for heightening the container handling efficiency of the shipping lines, this part focuses on the port facility evaluation of the hub ports focusing on port infrastructures according to the Gray Theory due to the constraint of other types of data. Then the evaluation results will be used to examine the relationship between container throughput and port facility situation by the application of simple regression analysis.

The facility evaluation is helpful to find the handling advantages among the different ports. However, there are variable factors could influence the development of a port. Moreover, the information is uncertain and limited. As defined, the situation of no information is black while the perfect information is white; both of the conditions are idealizing in reality. The common situation that between the two extremes are described as "gray". Thus, the Gray Theory, which focuses on the evaluation of uncertain or imperfect information conditions, is suitable for the uncertain condition.

The Gray Theory could provide better solutions rather than find the best answers. The theory sets up a non-functional model with less data in order to avoid the need of large number of samples for statistics in the uncertain circumstances (Deng, 1982). The application of the theory also offers a logical view to analyze the strengths and weakness among different variables that could disclose the relative competitiveness of handling capacity of the hub ports.

For the analysis, if the information is uncertain or imperfect, the Gray Theory is a proper tool to describe the situation, and then makes out the clear and definite analysis (Tai and Hwang, 2005). For this study, if the analysis of port infrastructures of hub ports is defined as an event, the individual port will become a different alternative (**B_i**), the collected information (**A_j**) can be transferred to definite the value that comparisons of all alternatives that can be made (see Table 3).

Table 3. Analysis Model for an Event on Multi-alternatives

$B_i \backslash A_i$	A_1	A_2	…	A_n
B_1	U_{11}	U_{12}	…	U_{1n}
B_2	U_{21}	U_{22}	…	U_{2n}
…	…	…	…	…
B_m	U_{m1}	U_{m2}	…	U_{mn}

Source: Orgainated by Tai and Hwang based on Foundation of Theory of Gray System (2000).

Tai and Hwang identified several functions on transferring **U_{ij}** to **R_{ij}** according to the theory. Uij means the measure of some information (**A_j**) against alternative (**B_i**), if the function M existed and could be mapping from **U_{ij}** to **R_{ij}**, if and only if:

$M(U_{ij}) = R_{ij}$, $R_{ij} \in [0, 1]$, $R_{ij} \in X^+$; X^+ belong to positive space:

Upper effect measure: the effect derived from the measure **U_{ij}**, such as profit, revenue, throughput, etc., is positive. It could use the following formula to transfer the $\mathbf{U_{ij}}$:

$$\mathbf{R_{ij} = U_{ij} / Max\ (i)\ U_{ij}}$$

Lower effect measure: the effect derived from the measure $\mathbf{U_{ij}}$, such as cost, time, etc., is negative. It could use the following formula to transfer the $\mathbf{U_{ij}}$:

$$\mathbf{R_{ij} = Min\ (i)\ U_{ij} / U_{ij}}$$

Medium effect measure: if $\mathbf{U_{ij}}$ is belong to neutrality effect, it could use the following formula to transfer the $\mathbf{U_{ij}}$:

$$\mathbf{R_{ij} = Min\ (i)\ (U_{ij}\ U_{i0}) / Max\ (i)\ (U_{ij}\ U_{i0});\ U_{i0} = (1/m) \textstyle\sum_{i=1}^{m} U_{ij},}$$

After the transference, an overall index for each alternative R_i^{Σ} is calculated by summing up the new measures ($\mathbf{R_{ij}}$) using the following equation. The evaluation is made by comparing the overall index R_i^{Σ} of each alternative then.

$$\mathbf{R_i^{\Sigma} = (1/n) \textstyle\sum_{i=1}^{n} R_{ij},\ i=1, 2, 3, \ldots, m}$$

Tai and Hwang's model could be developed for more comprehensive evaluation for the hub ports. Their research adopted the container throughput in the same year and average container throughput growth rate of several years as the evaluating variables. Indeed, that data reflect the development of hub ports and cannot be used to explain the competitiveness of the ports for a particular year. In addition, the answers to the questionnaire which were not the exact data issued by the authority and not objective, were also used for the model as the variables. Thus, the two aspects are deleted in the study in order to offer the more objective evaluation results. The new evaluation focuses on infrastructures and facilities, which are not only the crucial variables for the development but also the benchmarks of TEU handling capability of the hub ports.

The study of port facilities in East Asia focuses on some of the representative ports in FEA. The methodologies that apply to the study are the methods mentioned above and the data for the study have been selected according to the actual situation. The results demonstrate the facilities situations of the hub ports in 2010 (see Table 4).

Table 4. Facility Evaluation of Hub Ports in East Asia

		A	B	C	D	E	F	G
Shanghai (SH)	**Uij**	30	8,956	16	8,569,837	350,084	113	372
	Rij	**0.462**	**0.706**	**0.889**	**1.000**	**1.000**	**0.507**	**1.000**
Hong Kong (HK)	**Uij**	65	10804	15.5	3,438,500	300,238	127	335
	Rij	**1.000**	**0.851**	**0.861**	**0.401**	**0.858**	**0.570**	**0.901**
Shenzhen (SZ)	**Uij**	30	12686	18	3,491,999	285,247	223	172
	Rij	**0.462**	**1.000**	**1.000**	**0.407**	**0.815**	**1.000**	**0.462**
Busan (BS)	**Uij**	30	9473	17	4,063,585	325,155	76	240
	Rij	**0.462**	**0.746**	**0.944**	**0.474**	**0.929**	**0.341**	**0.645**
Guangzhou (GZ)	**Uij**	17	4950	15.5	4,604,600	281,871	69	134
	Rij	**0.262**	**0.390**	**0.861**	**0.537**	**0.805**	**0.309**	**0.360**
Kaohsiung (KS)	**Uij**	27	12692	16	2,935,000	142,488	69	31
	Rij	**0.415**	**1.000**	**0.889**	**0.342**	**0.407**	**0.309**	**0.083**
Dalian (DL)	**Uij**	17	4253	17.8	2,048,579	126,468	26	105
	Rij	**0.262**	**0.335**	**0.989**	**0.239**	**0.361**	**0.117**	**0.282**
Tokyo (TK)	**Uij**	15	4479	15	1,332,641	201,958	41	72
	Rij	**0.231**	**0.353**	**0.833**	**0.156**	**0.577**	**0.184**	**0.194**
Yokohama (YH)	**Uij**	20	5390	15	2,004,922	107,186	35	83
	Rij	**0.308**	**0.425**	**0.833**	**0.234**	**0.306**	**0.157**	**0.223**
Kobe (KB)	**Uij**	22	6320	16.5	1,541,487	76,840	36	63
	Rij	**0.338**	**0.498**	**0.917**	**0.180**	**0.219**	**0.161**	**0.169**
Nagoya (NG)	**Uij**	12	3320	16	1,405,549	77,430	27	41
	Rij	**0.185**	**0.262**	**0.889**	**0.164**	**0.221**	**0.121**	**0.110**
Osaka (OS)	**Uij**	15	4435	15	1,303,767	55,675	26	30
	Rij	**0.231**	**0.349**	**0.833**	**0.152**	**0.159**	**0.117**	**0.081**

Note: A: Number of Container Berth; B: Gross Quay Length (m); C: Max Depth of Water of Container Berth (m); D: Squire of Container Terminal (m2); E: Storage Capacity (TEU); F: Ship-shore Container Gantry Crane; G: Other Gantry Crane.

Source: Created by the author based on the data of Outline of Main Hub Port 2010, *The Ports And Harbours Association of Japan.*

According to the theory and calculation mentioned above, all of the measures (U_{ij}) could be transferred to R_{ij} with using upper effect mode. Table 4 lists all the information (U_{ij}) and the result of transferred measure (R_{ij})

$\boldsymbol{R_i^{\Sigma}} = (1/n)\ \Sigma_i^n \mathbf{R_{ij}}$, i=SH, HK, SZ, BS, GZ, KS, DL, TK, YH, KB, NG, OS, j=1, 2, 3… 12, n=7

The evaluation result is shown below:

$[\boldsymbol{R_{SH}^{\Sigma}}, \boldsymbol{R_{HK}^{\Sigma}}, \boldsymbol{R_{SZ}^{\Sigma}}, \boldsymbol{R_{BS}^{\Sigma}}, \boldsymbol{R_{GZ}^{\Sigma}}, \boldsymbol{R_{KS}^{\Sigma}}, \boldsymbol{R_{DL}^{\Sigma}}, \boldsymbol{R_{TK}^{\Sigma}}, \boldsymbol{R_{YH}^{\Sigma}}, \boldsymbol{R_{KB}^{\Sigma}}, \boldsymbol{R_{NG}^{\Sigma}}, \boldsymbol{R_{OS}^{\Sigma}}]$

=[0.795, 0.777, 0.735, 0.649, 0.504, 0.492, 0.369, 0.361, 0.355, 0.355, 0.279, 0.275]

MAX (i) $\boldsymbol{R}_i^{\Sigma} = 0.795 = \boldsymbol{R}_{SH}^{\Sigma}$

Based on the results, the facilities evaluation index of Shanghai Port is at the top ranking with the highest score, followed by Hong Kong and Shenzhen Port in 2010.

The evaluation shows the relative advantages and commonness of the facilities of the 12 hub ports. In addition, the results also indicate that all the water depths of the container terminals are more than 15 meters. Taking the rapid growth of container throughput of the ports as well as the tonnage of container vessels into account, the deep-water berths have been the commonness of the hub ports in FEA.

3.8 The Analysis of the Relationship between Port Facility and Container Throughput

The analysis is used to test whether the port facilities evaluation index in current year is significant to the container throughput of the main hub ports of FEA for the next year. The port facilities evaluation index in 2010 mentioned above and the container throughput of the main hub ports of FEA of 2011 are adopted.

Figure 6. Scatter Plot of Port Facilities Index and Container Throughput of the Hub Ports

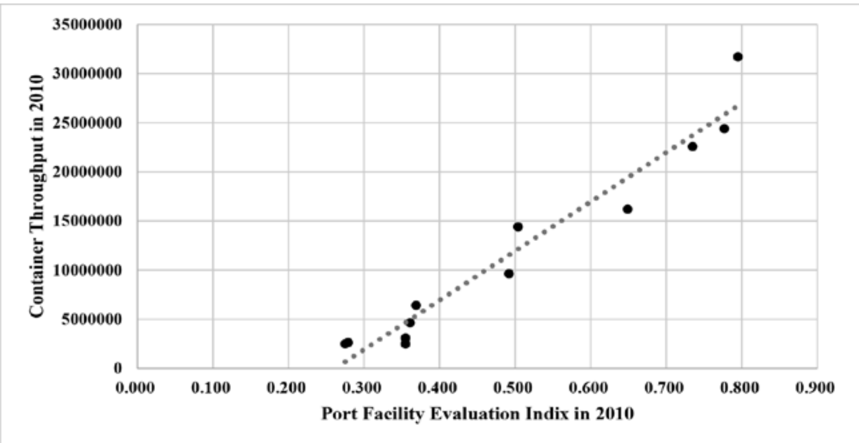


Figure 6 demonstrates that the correlation is positive when the values increase together and the scatters accord with the law of liner relationship, thus, the simple regression is suitable for the analysis. The formula for the regression line is:

$Y=\beta_0+\beta_1 x$

where the evaluation index in 2010 (x) is the independent variable while the container throughput of each selected hub port in 2011 (y) is the dependent variable.

Assumption of the analysis:

On a 95% confidence interval (α=0.05), the null hypothesis and alternative hypothesis are:

• Null hypothesis (H_0): the port facilities evaluation index in the current year is irrelative to the container throughput of the main hub ports of FEA in the next year;

• Alternative hypothesis (H_1): the port facilities evaluation index in the current year is significant to the container throughput of the main hub ports of FEA in the next year.

The result is shown in Table 5, the outputs indicates that x and y are highly correlative (R=0.9717), 93.86% of the container throughput of the main hub ports of FEA in the next year can be explained by the port facilities evaluation index in the current year, only 6.14% of the container throughput of the next year should be explained by other factors (Adjusted R^2= 0.9386) and β_0=−13125018.4758553, β_1=50131441.4245313.

It is found that the null hypothesis is rejected and the alternative hypothesis is accepted for P-Value<α, thus, the port facilities evaluation index in current year is significant to the container throughput of the main hub ports of FEA in the next year (P-Value=1.3628E-07).

The correlative formula is shown as below according to the output:

$y=-13125018.4758553+50131441.4245313x$

Table 5. Simple Regression Analysis Output of the Relationship between Container Throughput and Port Facilities Evaluation Index of Main Hub Ports in FEA

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.971701983
R Square	0.944204744
Adjusted R Square	0.938625218
Standard Error	2494540.304
Observations	12

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1.05305E+15	1.05305E+15	169.226707	1.36281E-07
Residual	10	6.22273E+13	6.22273E+12		
Total	11	1.11528E+15			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95%	Upper 95%
Intercept	-13125018.5	2040771.12	-6.43140152	7.5242E-05	-17672139.9	-8577897.05	-17672140	-8577897.055
Port Facility Evaluation Index of 2010	50131441.42	3853680.808	13.00871658	1.3628E-07	41544905.49	58717977.36	41544905.5	58717977.36

Source: Created by the author based on the data of Port Traffic League, *Containerisation International Yearbook 2012.*

4. The Formation of Shipping Alliance in FEA

The rise of container tonnage in East Asia provided a development opportunity for the international shipping in the region. It is because of the steep rise in cargos that suitable for container transportation over the past three decades. Consequently, the container transportation in the region needs improved shipping system and strategies for promoting transportation efficiency, reducing freight cost and advancing rationalization of the operation. Under these circumstances, the shipping alliances in East Asia have enjoyed a remarkable development era since the mid-1990s.

4.1 The Emergence of Global Shipping Alliance

After its opening in 1869, the Suez Canal provides a corridor that shortens the sailing time between Europe and South Asia. Consequently, the amount of ships suddenly increased in the new route. After slashing the ocean freight to increase the cargo share soon, the ship owners realized that this was benefiting no one. Thus, in order to adjust the freight, 7 liner owners formed the United Kingdom-Calcutta Conference (then its name was changed to India Pakistan Bangladesh Conference) in 1875 which eventually became the first liner conference in the world. This liner conference thrived around the world for more than a century.

For over a hundred years, the international liner shipping has been characterized by the presence of the conference system, whereby ocean carriers get together to set freight rates collectively. Partially in response to a more aggressive stance against the cartel market power, including efforts to constrain conferences by the U.S. Department of Justice, the Shipping Act of 1984 was passed to clarify the boundaries of antitrust immunity. That legislation reaffirmed the ability of conferences to file agreements covering rates and service conditions, subject to oversight from the Federal Maritime Commission (FMC) as to the agreement's conformity with the public interest. In 1998, the regulatory landscape changed dramatically with the passage of the Ocean Shipping Reform Act (OSRA). On its face, OSRA reduced transparency in freight rates, removed the FMC's cartel enforcement role and encouraged the offering of customer-specific shipping services that are different in terms of quality and price. All of these effects could inhibit the maintenance of effective cartels (Reitzes and Sheran, 2002).

4.2 Development of Shipping Alliance

East Asian shipping lines play pivotal roles in the new ear of global alliances under the circumstance of the surge of container tonnage in the region. There are five main development phases of global alliances from their initiation in 1994.

In the Initial Stage (1994–1995), in 1994, OOCL (Orient Overseas Container Line, Hong Kong), MOL (Mitsui O.S.K. Lines, Japan), APL (American President Lines, United States), Nedlloyd (Netherland) and MISC (Malaysia International Shipping Corporation) formed the Global Alliance. Maersk (Denmark) and Sea Land Service (United States) formed the Maersk-Sea Land alliance. NOL (Neptune Orient Lines, Singapore), NYK (Nippon Yusen Kaisha, Japan), Hapag-Lloyd (Germany) and P&OCL (Peninsular and Oriental Steam Navigation Co., UK) formed the Grand Alliance. Hanjin (Korea), DSR-Senator (Germany), Cho Yang Shipping (Korea) made the United Alliance. COSCO (China Ocean Shipping Company, China), K Line (Kawasaki Kisen Kaisha, Ltd., Japan) and Yang Ming (Taiwan) formed the “CKY Consortium”.

For the First Integration Period (1998-1999), in 1998 Nedlloyd merged P&OCL as Royal P&O Nedlloyd (short for P&ONL). In the meantime, NOL bought APL and put the container transportation to the business of APL. In addition, Hanjin purchased 80% shares of DSR-Senator. Moreover, Hapag-Lloyd, NYK, OOCL, P&OCL and MISC formed the new Grand Alliance. APL, MOL and Hyundai set up the “The New World Alliance (TNWA)”. The biggest shipping line was birth of the acquisition between Maersk and Sea Land Service in November 1999.

There was a reformation among the alliances in the Second Integration Period (2002). After the negotiation with Hanjin, CKY Consortium expanded as a new alliance named “CKYH Alliance” Hanjin began to exchange the slot space of container for Asia-North and West Coast Lanes with K Line.

East Asian shipping alliance started to strengthen the cooperation during the Third Integration Period (2006). Evergreen and CKYH Alliance established a new cooperative relationship with NYK and NOL in Asia-South Africa-East Coast of South America, Asia-Mediterranean and Intra-Asia lanes. In addition, Maersk purchased P&ONL and took 15% of total shipping capacity of the world.

During the Forth Integration Period (2011-2012), The Grand Alliance and New World Alliance formed the G6 Alliance. In 2012, a new alliance named CMA-MSC set up by MSC (Mediterranean Shipping Company, Switzerland) and CMA CGM (France) in order to join the competition of global shipping market. Evergreen and CKYH Alliance formed the CKYH-Green Alliance in the same year.

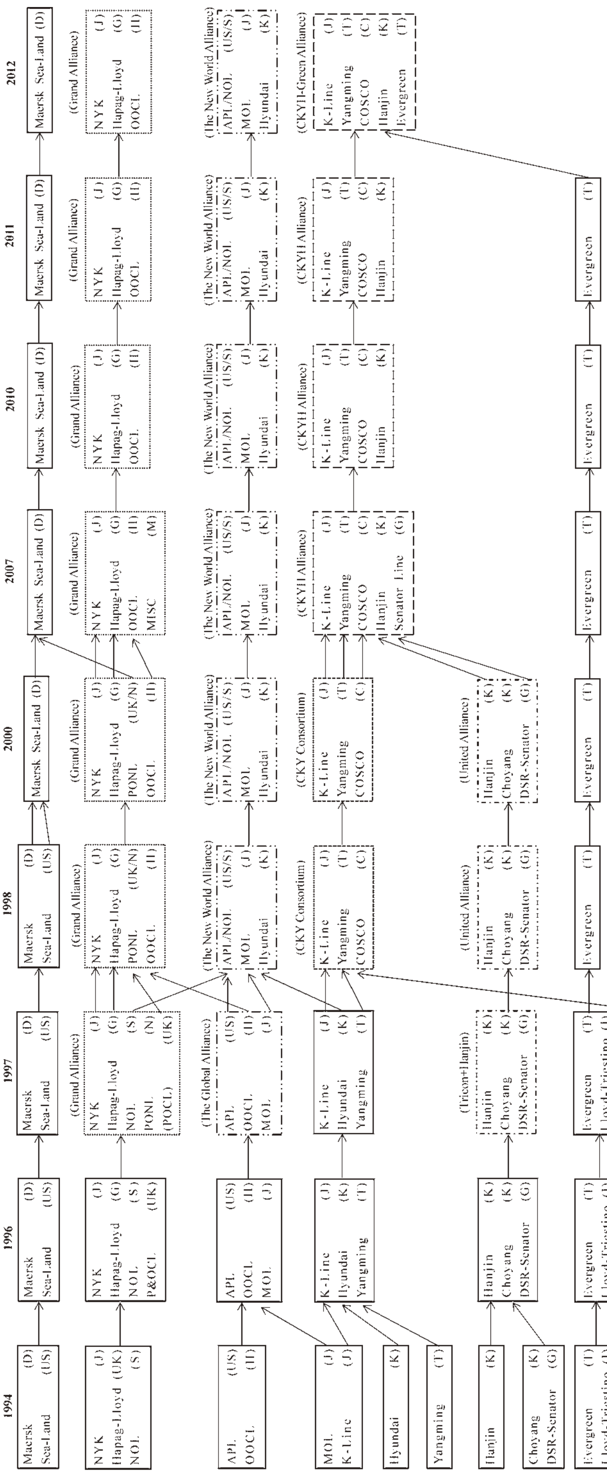
In 2012, four shipping line/alliances took 51.43% of the number of ships (11.63% by Maersk Line, 12.24% by G6, 15.47% by CMA-MSC and 12.08% by CKYH-Green) and 71.75% of container shipping capacity (15.35% by Maersk Line, 17.92% by G6, 21.65% by CMA-MSC and 16.82% by CKYH-Green). In comparison, other alliances took 48.57% of the vessels but 28.25% of container transportation. The phenomenon indicates that the transportation, marketing strategies and management of the main shipping alliances are better than that of other alliances. Moreover, the share of TEU shows that compared with other alliances that composed by both western and oriental shipping lines, the alliance formed by East Asian lines (CKYH-Green) is at a relative disadvantage.

In 2013, MSC announced that a new shipping alliance named P3 Network formed by the three largest container carriers, Maersk Line, MSC and CMA CGM, will operate a fleet of 255 ships with total capacity of 2.6 million TEU on 27 service loops in Asia-Europe, Trans-Pacific and Trans-Atlantic lanes. According to the statistical data in 2012, the forecasting TEU share of P3 Network might be over 37% of the total amount in the world.

In 1997, the member of the shipping lines of Trans-Pacific, Trans-Atlantic and Asia-Europe trade lanes were 19, 20 and 27 respectively; meanwhile, the alliances were 6, 6 and 7 respectively. After mergers and acquisitions within nearly 20 years, the lines of the three trade lanes became 12 of both Trans-Pacific and Trans-Atlantic lanes while the alliances were both 4 correspondingly in 2012. And there 15 shipping lines and 5 alliances were operating in Asia-Europe Lane (see Figure 5–7).

The tendency indicates that the mergers and acquisitions among the shipping lines started from the mid-1990s, the phenomenon also means that the shipping lines are making their business strategies in order to accommodate the change of economic development.

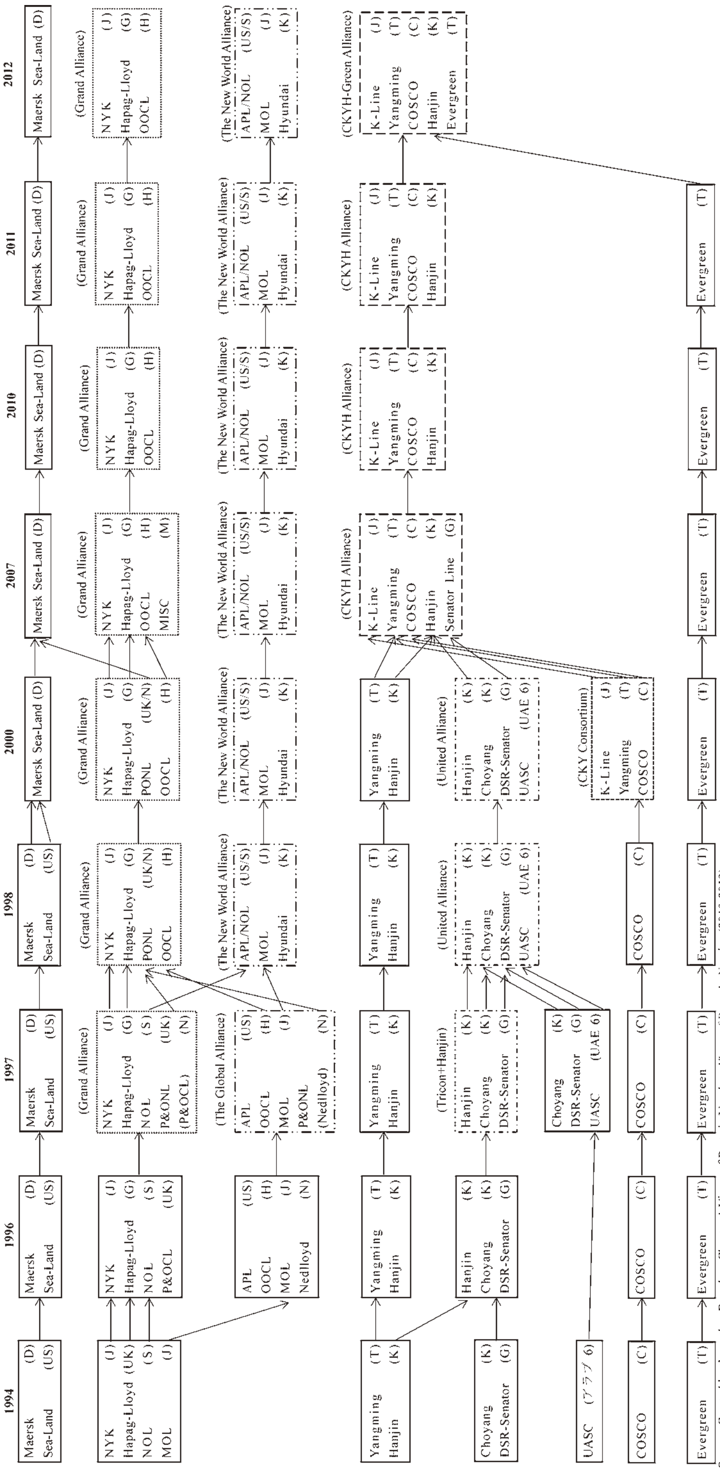
Figure 7. Shipping Alliances of Asia – North America West Coast Trade Lane (1994-2012)



Source: Created by the author Based on Chapter 1 Views of Ports in Number. *Views of Ports in Number* (2010-2013)

Note: D, Denmark; US, United States; J, Japan; S, Singapore; G, Germany; H, Hong Kong; C, China; T, Taiwan; N, Netherlands; K, Korea; UK, United Kingdom; I, Italy

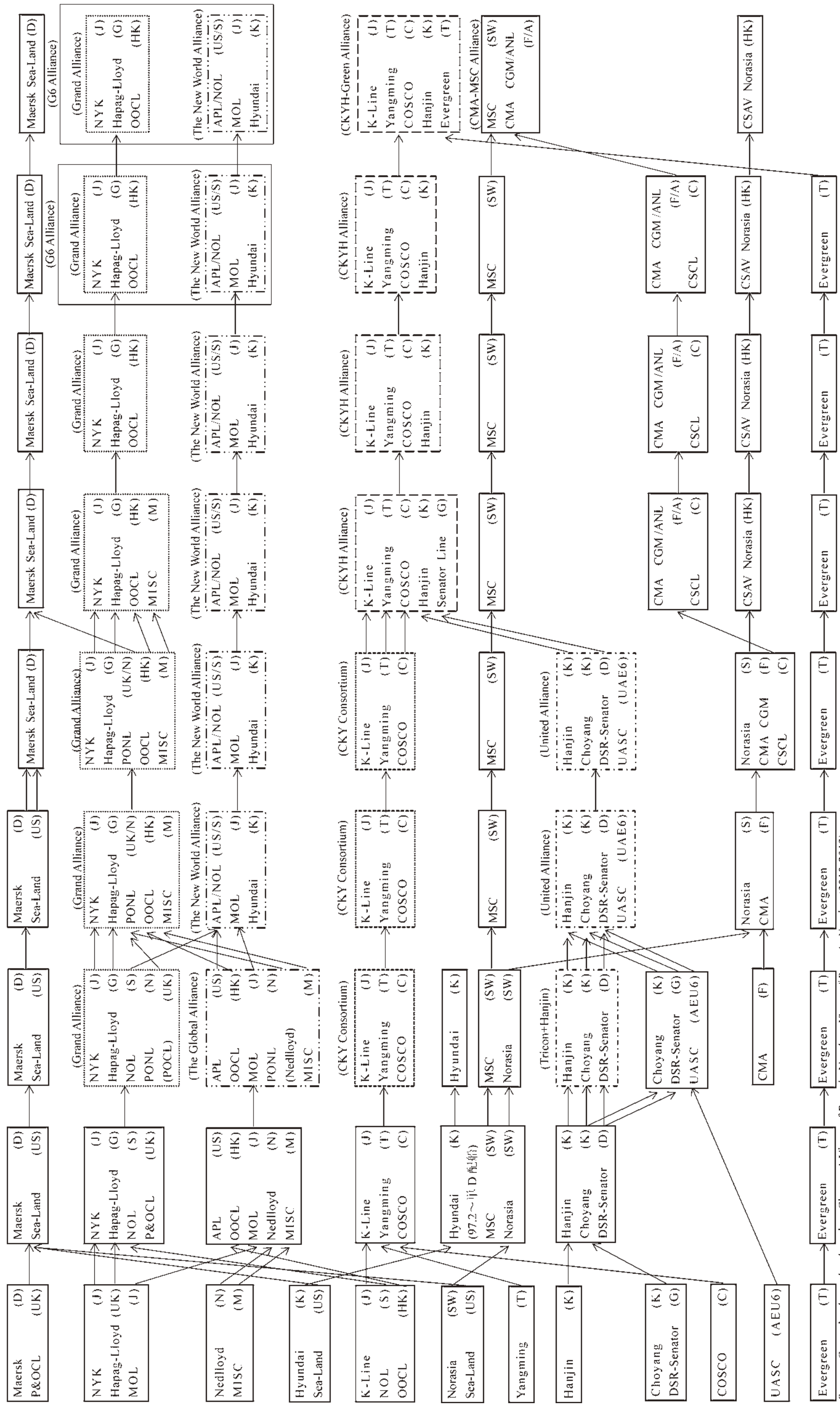
Figure 8. Shipping Alliances of Asia – North America East Coast Trade Lane (1994-2012)



Source: Created by the author Based on Chapter 1 Views of Ports in Number, *Views of Ports in Number* (2010-2013)

Note: UAE, United Arab Emirates

Figure 9. Shipping Alliances of Asia – Europe Trade Lane (1994-2012)



Source: Create by the author based on Chapter I Views of Ports in Number, *Views of Ports in Number* (2010-2013)
Note: F, France; A, Australia; SW, Switzerland

5. THE STATUS OF FEA SHIPPING LINES IN MARINE TRANSPORTATION

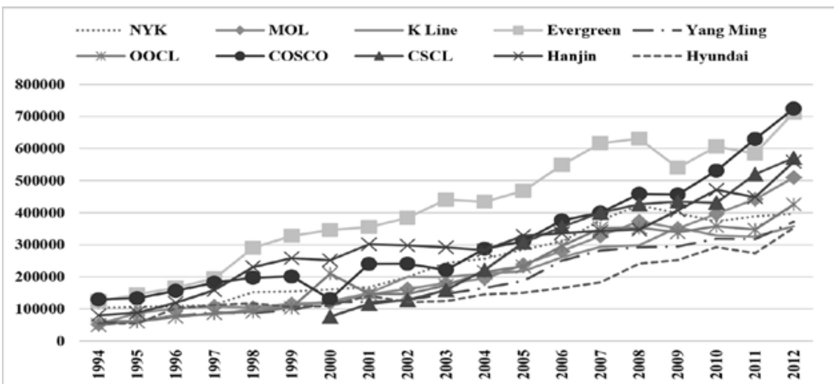
The trade volume has been increasing between East and West because of the drastic economic development in East Asia. The low cost of both of labor force and material stocking in the region have been attracting a lot of foreign investment from not only Japanese companies but also western companies. Consequently, the "Made in China", "Made in Taiwan" and such products made in the other eastern countries are spreading all over the world.

Under the excellent circumstance, shipping lines, particularly those from FEA, in order to share the regions slice of the pie that is the market, have formed the shipping alliances in terms of transporting more cargoes from Asia destined for East/West Coast of U.S., and Europe.

The surge of trade offers an excellent opportunity to FEA shipping lines to expand their business to all over the world. It can be found that the total container volume of ten shipping lines in FEA rose from 984,136 TEUs to 4,979,258 TEUs, accounting for 27.45% in 1996 and 30.75% in 2012 (35.25% in 2001) out of the world's container transportation (see Figure 10).

Blessed by the drastic economic development and international trade in East Asia, the shipping lines have enjoyed a sustained and high growth from the mid-1990s, particularly COSCO and CSCL (China Shipping Container Lines, China), benefited from the rapid economic development in China, both of the lines have obtained more TEU over the past 8 years.

Figure 10. Container Vessel Tonnage of Main FEA Shipping Lines (1994–2012) (Unit: TEU)



Source: Created by the author based on the data of *Report of Japan Maritime (1996–2000), Maritime Report (2001–2013).*

The scale of FEA shipping lines developed rapidly over the past 17 years. By October 28th, 2013, the 10 FEA shipping lines that owned 1,147 vessels with shipping capacity of 5,374,587 TEUs were listed in the world top 20 ranking, which accounted for 30.50% of the world container tonnage. Compared with the data in 2012, the 10 lines owned 1,105 vessels with the capacity of 4,979,258 TEUs, accounting for 30.75% of that of the world.

Though the share of Chinese lines is a little higher than that of Japanese lines in the past two years, the previous part indicates that the shipping market of Japanese lines is larger than that of Chinese lines. The strong activities of Japanese lines in the main trade lanes shows that Japanese international shipping service is at the top level in FEA. The new P3 Network that took 36.90% share of TEU in the first 10 months of 2013 will challenge all the other alliances in global shipping market.

In East Asia, a new cooperative relationship has been formed under the intense shipping market competition. Evergreen became a partner with CKYH in 2006 and a member of CKYH-Green in 2012 in the shipping lanes of Trans-Atlantic, Asia-Europe and Transpacific (North America East Coast line).

The expansion of EFA shipping lines in marine transportation can be attribute to two aspects, including outside and inside cooperation. Confronting the challenges from the powerful shipping lines from western countries, some Japanese and Korean shipping lines, such as MOL and Hyundai, started to develop the cooperative relationship with the western shipping lines in order to gain the business opportunity and absorb the management experience from the other lines to enhance their marketing competitiveness. Some other FEA shipping lines formed the alliance for strengthening and expanding their business in the competitive shipping market. The new marketing strategies of Evergeen is a noteworthy case for the study on the field.

In light of the trend of CMA CGM and MSC joining forces in Asia/Northern Europe trade lane and the Grand Alliance teaming up with the New World Alliance on the same service in 2013, Evergreen swiftly joined forces beforehand with CKYH to share their services on Asia/Europe trade lane in 2nd quarter, 2012.

The reason why Evergreen changed its marketing strategy with CKYH is the need to improve frequency in order to get a better competition against Maersk's daily westbound service on Asia/Europe trade lane which was introduced to the market in 2011, as cost cutting does not yet appear to be an obvious objective.

Evergreen gained access to the CKYH's four remaining weekly services between Asia and Northern Europe, plus the alliance's recently withdrawn NE4[1] loop, which was returned in 2012, in exchange for giving the same amount of slots to the alliance on its three weekly loops (CEM, CES and AEX7). The CES and AEX7 services are already shared with CSCL, CMA CGM, UASC (United Arab Shipping Company, established in 1976, jointly by six shareholding Arab Stats: Bahrain, Iraq, Kuwait, Qatar, Saudi Arabia and U.A.E) and ZIM Line (Zim Integrated Shipping Services Ltd., Israel).

The CKYH currently operates around 16% of all westbound capacity to Northern Europe and Evergreen's CES service provides another 2.3%.

In the Mediterranean, Evergreen gained access to the CKYH's three weekly loops from Asia (MD1, MD2 and MD3) in exchange for providing the CKYH access to its FEM service. These four loops currently provide approximately 17% of all westbound vessel capacity from Asia to the Mediterranean. In addition, more slots are available on carriers' vessels sailing from Asia to Northern Europe 'way porting' in the Mediterranean.

Evergreen has already chartered slots on MD2, and has a variety of different slot charter arrangements with other shipping lines. The practice is common amongst most major carriers in the Mediterranean due to its fragmented nature. Another benefit of the new consortia will be to share to burden of filling the extra space offered by the large number of Super Post Panamax vessels over 10,000 TEU.

6. Conclusion

This paper discusses the development of international shipping in East Asia from the 1980s to the 2010s. The descriptive analysis is adopted to study the rise of container tonnage, the development of main hub ports and the status of the shipping lines as well as the global alliances in the region.

The research results show that the booming international trade in East Asia that attributed to the large amount ODA and FDI from Japan into other countries in the region since the 1980s is one of the main motive factor of the rise of container throughput in FEA. Additionally, the study on the case of Taiwan indicates that the geographical advantage is another factor for the increase of container throughput. Benefiting from the surge of international

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1) NE4, CEM, CES, AEX7, MD1, MD2, MD3 and FEM denote the code of the loops of the shipping lines.

trade and container transportation, the main hub ports in the region are not only confining to Hong Kong, Kaohsiung, Tokyo and Busan but also extended to the ports that locating from northern to southern coastal areas of China since the mid-1990s because of the drastic economic development of the country since then. In addition, the rise of the container tonnage in the region also brought the prosperity to the East Asian shipping lines that participated the competition of the global alliances from 1994. By enhancing the cooperative relationships with the other western and oriental shipping lines, they have been active in each trade lane of the global shipping market since 2000.

The paper also proposed a combined method that consists of Gray Theory and simple regression to test the correlation between the facilities and container throughput of the main hub ports in the region. The result suggests that the conditions of the port facilities in the current year are significant to the container throughput of the ports for the next year. In the future research, more detailed information about the hub ports will be collected to conduct more accurate analysis.

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