Cooperation and Competitiveness of Intra-Regional Container Ports

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Abstract: In order to cope with the ever-increasing competitive environment and enhance the overall competitiveness of ports in a region, cooperation between adjacent container ports is emerging. The main purpose of this paper is to explore causal relationships between influence factors, types of port cooperation (i.e. complementary cooperation and coopetition), and port competitiveness. Besides, potentially important items for port cooperation are also identified. The results indicated that both two types of port cooperation would positively influence the competitiveness of adjacent ports in same region. Moreover, competitive intensity in a region would support through both types of cooperation to influence regional competitiveness indirectly. Shipping and terminal operators' strategy would also influence regional competitiveness through both types of cooperation indirectly. Finally, port internal conditions, liners service and pricing strategy are identified as important items for complementary cooperation and that for coopetition are port operational management, liners service, resource integration and pricing strategy.

Key Words: *Container Ports, Complementary Cooperation, Coopetition, Competitiveness, Structural Equation Modeling*

1. INTRODUCTION

Keen competitions between ports are often observed in a region even in the same country. Increasing ship size, greater negotiating power and greater market share of shipping companies through alliances may heighten the competition. Therefore, cooperation of adjacent container ports might be adopted as a counter-strategic option against shipping lines in order to survive on the ever-increasing competitive business environment (Avery, 2000). Wang and Slack (2004) also pointed that in view of the competition unleashed by globalization, the constituents of a regional port system need to be organically integrated for achieving a win-win solution for all concerned.

Although researches in port cooperation can be found in literature, most of these studies focused on ports cooperation between different countries. In view of competition between adjacent ports in a region or in a country with small area like Taiwan sometimes leads to a waste of resources and could be detrimental to the economy, it is very important to integrate adjacent ports through inter-port cooperation to enhance the overall competitiveness of all ports in same region and/or country. For instance, port authorities in a region could get together or finance facilities in one port, and this port could then act as the nodal point of the transport networks reaching the region and, therefore could avoid unnecessary over-investments in each port (UNCTAD, 1996).

This study began with literature reviews of studies concerning types of port cooperation and possible influence factors. Two distinct types, namely complementary cooperation and coopetition, were defined as the focus of this study. Complementary cooperation is developed as a port needs another port and it also can create situations where ports may complement one another's competitive advantage. For instance, the relationships in the various hub-and-spoke networks established around the world, or the origin and destination ports served by the same container shipping service schedule(Yap and Lam, 2006). One practical example is the complementary cooperation on Shanghai and Ningbo port in the past. Shanghai didn't have sufficient water depth and therefore Ningbo was arranged as a complementary port; on the other hand, this complementary cooperation helped Ningbo to gain awareness from the shipping companies. Another example is the port of Ningbo and Zhoushan before merging. Zhoushan can complement the disadvantage of the water front development in Ningbo, and Ningbo can complement the disadvantage of hinterland and port development in Zhoushan. Thus, this complementary cooperation created a win-win scenario to increase benefit for both sides. As to coopetition, it takes place when companies work together for parts of their business might not the competitive advantage, and where they think they can share common costs while remaining competitive in other areas. For example, while port of Seattle and Tacoma have competed with each other for cargoes in the overlapped hinterland, they did cooperate on infrastructure, transportation, regional promotion and environmental issues. The port commissioners for Seattle and Tacoma indicated that joint planning and cooperation was vital and increasing competition from Canada western ports (Pacific Shipper, 2008).

A questionnaire survey was then designed and conducted to collect data required for the following purposes of this study: (1) to explore factors influence each type of cooperation, (2) to examine causal relationships between influence factors, types of port cooperation, and port competitiveness, (3) to identify potential items for port cooperation. Quantitative methods such as factor analysis and structural equation modeling were used in this study. Although the survey was conducted in Taiwan, where three international container ports are located in fairly short distances between each others, it is expected that most results of this study can also be reasonably inferred to other similar circumstances, i.e. where several ports existed in a small region and/or country.

The rest of the paper is organized as follows: The relevant literature is surveyed in section 2. Section 3 describes research design and methods. Section 4 and section 5 present empirical results of structural equation modeling and important items of port cooperations respectively, followed by conclusions in section 6.

2. LITERATURE REVIEW

2.1 Types of Port Cooperation

Globalization, shipping alliances, growing size of vessels and the other environmental forces have intensified international competition of ports, port operators have to seek new approaches in order to benefit from their competitors, one of which is "port cooperation". Brandenburger and Nalebuff (1996) proposed a value net concept based on game theory, in which four groups of players were identified as Figure 1. They also mentioned that sometimes the best way to succeed is to let others be successful, including the competitors. To encourage both cooperative and competitive ways, they suggested the term "coopetition" which looks for a win-win opportunity. In addition, another type of cooperation called "complementary cooperation" can also be found from the horizontal axle of the value net. Although the

concept of value net was originally proposed with reference to a company, it can be applied to illustrate the port industry in which corresponding players are denoted in the brackets of Figure 1.

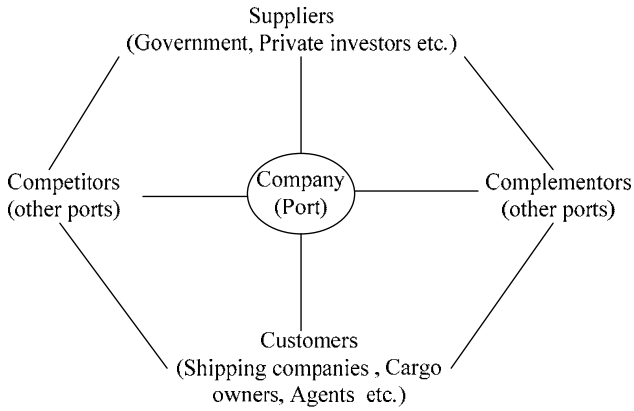

Figure 1 Value Net

In addition, statements about these two types of port cooperation can also be found in some literatures of port studies. Song (2003) illustrated that coopetition is a way of collaborating to compete which is compatible and mutually benefited strategies with different objectives can be strengthened when players are combined together. As to complementors, Yap and Lam (2006) stated that complementary relationships can be developed from the basic fact that a port needs another port; for instance, the flow of container traffic between the ports of origin and destination and hub-and-spoke networks. Since this study focuses on port cooperation in a same region or small country, therefore, the complementary relationship denotes not only functional, but also other aspects of cooperation, such as port facilities etc.. In short, complementary cooperation focuses on increasing advantages by complementing to each other; coopetition focuses on coordinating each other to reduce unnecessary inter-ports' competition by cooperation.

2.2 Advantage of Port Cooperation

There is often a fear that cooperation can lead to a monopoly situation or a reduction of competition. However, cooperation driven by market forces and fostered by the changing environment does not mean limiting competition. Cooperation may actually help to strengthen competition (UNCTAD, 1996). For example, when ports cooperate to adopt a common tariff structure, this does not mean that they will adopt the same commercial attitude towards shippers and shipping lines. In fact, port authorities would cooperate in some areas and compete in others which can exalt the ports benefit to the largest in same region and/or country.

Regional ports become involved in partnership arrangements in order to achieve cost savings, resource pooling, risk sharing, investment sharing and uncertainty reducing and so on. An alliance can strengthen both partners against outsiders so as to increase the competitiveness of both (Song, 2003). Juhel (2000) pointed that ports could enter into cooperative agreements on a local/regional basis, in particular in geographical areas that lend themselves to a flexible traffic distribution pattern through several port outlets. In addition, coopetition facilitates the international expansion of port operators, through easily penetrating a new geographical market. Port coopetition through collaborating with partners may achieve the benefits of increased and spare capacity as well as improved capacity utilization (Song, 2003).Complementary relationships also can create situations where ports may complement one another's competitive advantage and thereby help to boost performance (Yap and Lam,

2006).

2.3 Influence Factors of Port Cooperation

Williams (2005) stated that conflict and competition between members of interorganizational networks may create pressures to change the network's structure so that it supports desired levels of cooperation. Competitive intensity itself is a major factor driving firms pursues a strategy of cooperation (BarNir and Smith, 2002). Firms that face high levels of competitive intensity have a greater desire to collaborate due to their need to reduce competitive pressures (Ang, 2008). Therefore, port authorities might tend to cooperate with other ports when faced severe competition in local market.

Besides environmental factor, it is necessary to examine the market players involved in port activities, because the optimal form for shaping the coordination and cooperation within a port network largely depend upon the institutional and legal status of the partners involved. The major market players involved in port activities may include shipping companies, port authorities, terminal operators, and inland transport operators. The shipping companies and terminal operators in particular have chosen the equity joint venture as the strategic tool in formulating co-opetitive strategies; therefore, two different ports through the common ownership of the same company cooperate with each other (Song, 2003).

2.4 Overall Competitiveness of Adjacent Ports in a Region

Ports in same region can be regarded as a single organization. When several ports located in same region and not managed by one same authority, competition may be expected (Wang and Slack, 2004). Therefore, ports competition in same region which is essentially similar to intrafirm competition also has positive and negative consequences for the organization. Positive consequences include the development of a greater number of strategic options, shorter time to market for new products, and broader market coverage. Negative consequences include duplication, waste of resources, and the potential to engender noncooperative behavior among organizational units (Birkinshaw and Lingblad, 2005). Thus, it can be inferred that cooperation of adjacent ports in same region (i.e. intra-regional ports) could influence the overall port competitiveness of the region.

Furthermore, cooperation of intra-regional ports is also regarded as horizontal cooperation. Horizontal cooperation is concerted practices between companies operating at the same level(s) in the market in order to increase performance. Cruijssen *et al*. (2007) pointed that the potential benefits of horizontal cooperation is to increase their profitability or to improve the quality of their services. Bartlett and Ghoshal (2000) described three ways in which strategic alliances and networks allow participating firms to reap the benefits of scale economies by pooling their resources and concentrating on (core) activities, sharing and leveraging the specific strengths and capabilities of the other participating firms, and trading different or complementary resources to achieve mutual gains and eliminate the high cost of duplication. One of such examples is China government set up the Yangtze River Delta International Shipping Center in order to group container terminals and allocate its capacities properly to prevent duplicated constructions and raise the international competitiveness of Chinese ports as a whole (Wang and Slack, 2004).

3. RESEARCH DESIGN AND METHODOLOGY

Questionnaire design and survey, factor analysis, reliability and validity testing, and structural equation modeling are the methods adopted in this study. An exploratory factor analysis was performed for reducing the number of variables and combining these variables into a factor as a measure construct. This procedure would help to minimize multicollinearity or error variance correlations among indicators in the confirmatory factor analysis of the measurement model. Such errors should be avoided as much as possible in structural equation modeling procedures. Finally, structural equation modeling was used for testing the hypothesis and estimating causal relationships.

3.1 Questionnaire Design and Survey

The questionnaire was divided into three parts. The first part of the questionnaire contains 20 designed questions for measuring competitive intensity, shipping & terminal operators' strategy, two types of cooperation, and port competitiveness. All the variables were selected and modified on the basis of reviewing literatures related to port operation, port selection, port cooperation, and port competitiveness etc.. The fist part of the questionnaire is to ask the degree of agreement of these twenty statements, using a six point Likert-scale from 1 being "strongly disagree" to 6 being “strongly agree”. The respondents are advised to answer the 20 questions based on the situations of adjacent ports in Taiwan, or other similar conditions they are familiar with. Part two is to ask the degree of importance of potential items for both types of cooperation, using a same six point Likert-scale, ranging from 1 being "not very important" to 6 being "very important". Potential items for both types of cooperation were also selected through the same process as part one, of which the details will be described in section 5. The third part is the socio-economical attributes of the respondents.

Initial questionnaire was pre-tested and revised before sending out to the selected professors, experts, officials of port authorities and managers of shipping companies. Out of the 380 surveyed samples in total, 259 questionnaires were returned with a response rate of 68%. The profile of the respondents is summarized in Table 1.

Table1 Respondents profile

Item	Keelung Harbor Bureau	Taichung Harbor Bureau	Kaohsiung Harbor Bureau	Shipping Company	Professors and Experts
Top managers	6	3	7	11	24 (10%)
Managers	11	4	4	54	
Front-line managers	7	2	4	30	
Senior Clerks	6	20	22	44	
Total Sample	30 (12%)	29 (9%)	37 (14%)	139 (55%)	

The respondents in Table 1 are divided into several groups. Experts and professors are those who have devoted to studies of port industry. Top managers of port bureaus include director-general, harbor master, deputy harbor master, chief engineer and deputy chief engineer; managers include department director and deputy director; front-line managers include section chiefs, and senior clerks are those with at least fifteen years experiences in port management, operation and planning. As to shipping companies, top managers include the chief executive officer, deputy general manager/ assisting general manager etc.; managers include department manager and associate manager etc.; front-line managers include chief of section, officer; senior clerks of shipping companies are those with at least fifteen years experiences in operation, planning department.

The survey was conducted in this way with the consideration that respondents of port authorities may reflect the viewpoints from port management and operations, respondents of shipping companies may reflect the viewpoints of port uses, where as professors and exports are assumed to be more neutral. By combing those different characteristics of respondents together, the overall results of the survey can be expected to be less biased.

3.2 Results of Factor Analysis

Exploratory factor analysis (EFA) is a variable reduction method usually used to identify groups of observed variables, and was used to reduce 20 variables to extract the crucial dimension in this study. It was used to analyze variables separately for each facet with varimax rotation, and the latent root criterion of 1.0 was used for factor inclusion. A factor loading of 0.50 was also used as the benchmark to include items in a factor. Five interpretable factors were extracted and named as: (1) competitive intensity, (2) shipping and terminal operators' strategy, (3) complementary cooperation, (4) coopetition and (5) competitiveness of regional ports (means overall competitiveness of adjacent ports in same region). The results are listed in Table 2. These procedures were performed using SPSS 12. Subsequently, these composite variables (factors) were treated as indicators to measure a construct in structural equation modeling of section 4.

Table2 Results of exploratory factor analysis

Index	Variable	Named Factor	Factor Loading	Cronbach's α
V1	The port has many competitors in local market.	F1 Competitive Intensity in a Region	0.647	0.715
V2	Temporary price discounts are used in local market.		0.575	
V3	Price discounts are very often used in local market.		0.823	
V4	The range of price discounts in local market is very high.		0.805	
V5	Shipping and terminal operator selects ports based on their operating strategy.	F2 Shipping and Terminal Operators' Strategy	0.710	0.811
V6	Shipping and terminal operator signs the long-term terminal lease contract with port authority.		0.806	
V7	Shipping and terminal operator invests in port operating business.		0.786	
V8	Shipping and terminal operator invests in terminal constructions.		0.795	
V9	Ports are complemented to each other with its advantages.	F3 Complementary Cooperation	0.710	0.779
V10	Disadvantages of ports are remedied by each other.		0.730	
V11	Ports differentiate their roles based on advantages of each other.		0.680	
V12	Ports help each other to increase performance.		0.678	
V13	Ports coordinate with each other in operations and development.	F4 Coopetition	0.678	0.837
V14	Ports coordination can reduce competition with each other.		0.748	
V15	Proper integration of ports' characteristics.		0.743	
V16	Ports differentiate its development based on different functions.		0.763	
V17	Improvements in operating performance.	F5 Competitiveness of Regional Ports	0.709	0.871
V18	Improvements in response to demand of market.		0.774	
V19	Improvements in adaptability to environmental changes.		0.811	
V20	Improvements in providing new services.		0.726	

3.3 Hypothetical Framework and Hypothesis

According to the abovementioned literatures, competitive intensity in a region and the shipping companies and/or terminal operators' strategy are the major influential factors on the port cooperation. Tongzon (2005) found that port selection preferences of carriers and shippers, efficiency and landside accessibility had the most influence on port competitiveness, which might imply that shipping companies and/or terminal operators' strategy has influence on regional competitiveness. Additionally, intrafirm competition had potential benefit of increasing the speed to market for new products, enhancing the range of strategic options open to the firm, and broadening the firm's coverage of the different segments in the market (Sorenson 2000, Kalnins 2004, Birkinshaw and Lingblad 2005). Therefore, competitive intensity in a region might also have influence on the regional competitiveness. Accordingly, the following hypotheses are proposed and the hypothetical framework is shown as Figure 2.

Hypothesis 1: Competitive intensity in a region positively influences complementary cooperation of ports.
Hypothesis 2: Competitive intensity in a region positively influences coopetition of ports.
Hypothesis 3: Shipping and terminal operators' strategy positively influences complementary cooperation of ports.
Hypothesis 4: Shipping and terminal operators' strategy positively influences coopetition of ports.
Hypothesis 5: Complementary cooperation of ports positively influences the competitiveness of regional ports.
Hypothesis 6: Coopetition of ports positively influences the competitiveness of regional ports.
Hypothesis 7: Competitive intensity in a region positively influences the competitiveness of regional ports.
Hypothesis 8: Shipping and terminal operators' strategy positively influences the competitiveness of regional ports.
Hypothesis 9: Competitive intensity in a region and shipping and terminal operators' strategy toward the competitiveness of regional ports is positively influenced through complementary cooperation or coopetition of ports.

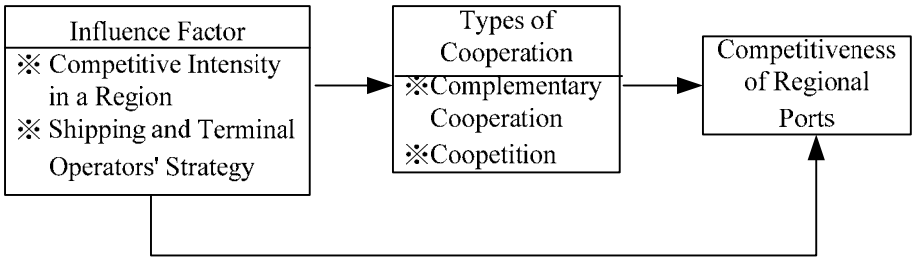

Figure 2 Hypothetical Framework

4. STRUCTURAL EQUATION MODELING

The process of structural equation modeling includes two steps: validating the measurement model and fitting the structural model. The former is accomplished primarily through confirmatory factor analysis, while the latter is accomplished primarily through path analysis with latent variables. Both steps were performed using SAS 9.0.

4.1 Validation of the Measurement Model

First, a confirmatory factor analysis of the measurement model was used to specify the posited relationships of the observed indicators to the latent constructs, and each latent construct is allowed to correlate freely with every other latent construct. Confirmatory measurement models should be evaluated before measurement and structural equation models are examined simultaneously. Thus, each construct in the model was analyzed separately. These procedures provide evidence concerning the extent to which the indicators used in the study are producing reliable data and are measuring what they are intended to measure.

Coefficient alpha is a reliability index of internal consistency. Moreover, it also needs to compute a composite reliability index for each latent factor included in the model, which can reflect the internal consistency of the indicators measuring a given factor. The results of the measurement model with five constructs and 13 indicators derived from confirmatory factor analysis (CFA) are showed in Table 3. The construct reliability values for all the latent constructs in this study exceeded the commonly accepted threshold value of 0.70 (Nunnally, 1978). As to convergent validity, it is assessed by the t-tests. Factor loading for all the indicators measuring the same construct are statistically significant and this is viewed as evidence supporting the convergent validity of those indicators. The measurement model describes the nature of the relationship between latent constructs and the manifest indicators to measure those latent constructs. Goodness of fit indices in Table 3 indicated that the overall measurement model was acceptable. Finally, the results of chi-square difference test reveal that the correlations between the measures of these different constructs are relatively weak as shown in Table 4.

Table 3 Results of convergent validity and composite reliability

Factor	Index	Cronbach's α	Standardized Loading (t-value)	Composite Reliability
F1	V3	0.795	0.7441(7.1826)	0.844
	V4		0.9553 (7.7567)	
F2	V5	0.811	0.6633 (11.0054)	0.818
	V6		0.7850(13.6616)	
	V7		0.6883 (11.5350)	
	V8		0.7674(13.2640)	
F3	V9	0.726	0.7996(13.2163)	0.743
	V10		0.7642(12.5586)	
	V12		0.5223(8.0889)	
F4	V15	0.814	0.8695(14.8252)	0.816
	V16		0.7902(13.3215)	
F5	V19	0.794	0.8224 (13.0295)	0.796
	V20		0.8034 (12.7351)	
Goodness-of-fit indices		N=259 X^2/df =1.528 p value=0.0001 NFI=0.935 NNFI=0.966 CFI=0.976 GFI=0.953 RMSR=0.025		

Table 4 Results of discriminatory validity

Factor Sets	Unrestricted Model $\chi^2(55) = 84.0641$	
	$\chi^2(56)$	χ^2 difference
(F1,F2)	264.8388	180.7747
(F1,F3)	238.9803	154.9162
(F1,F4)	261.2877	177.2236
(F1,F5)	228.6571	144.5930
(F2,F3)	251.0541	166.9900
(F2,F4)	211.0325	126.9684
(F2,F5)	223.5450	139.4809
(F3,F4)	182.3469	98.2828
(F3,F5)	166.7563	82.6922
(F4,F5)	178.0954	94.0313

4.2 Results of Structural Model

A measurement model can't specify any causal relationships between each latent constructs, therefore, a structural model is required to specify causal relationships between the latent constructs themselves. The process of hypothesizing structural causal model was guided by theoretical considerations, and the final structural model derived from the framework of Figure 2 as shown in Figure 3 had acceptable goodness of fit indices. The chi-suqare value is not significant (χ^2 (56) =129.9324, p=0.0001), and the χ^2/ df ratio is 2.32. A criterion that χ^2/df ratio less than 5 has been suggested as indicating an acceptable fit between the hypothesized model and the sample data (MacCallum, Brown & Sugawara, 1996). Root mean square residual (RMSR) of 0.04 is less than 0.05, goodness-of-fit index (GFI) of 0.93,nonnormed fit index(NNFI) of 0.92, normed fit index (NFI) of 0.90, and comparative fit index (CFI) of 0.94 all exceeded 0.9.

4.2.1 Hypothesis Testing

The hypothesized causal model was tested by structural equation modeling, which included a test of the overall model as well as individual tests of the relationships among the latent constructs. The results offered support for the relationship between influence factors, the port cooperation, and port competitiveness at a significant level of 0.05(Figure 3).

As shown in Figure 3 and Table 5, both complementary cooperation and coopetition of ports are positively affected by competitive intensity and the shipping and terminal operators' strategy. Moreover, overall competitiveness of regional ports is positively affected by complementary cooperation and coopetition.

However, hypothesis H7 and H8 were not supported by the data, it implies that "competitive intensity in a region" and "shipping and terminal operators' strategy" would influence the competitiveness of regional ports indirectly through complementary cooperation and coopetition of ports.

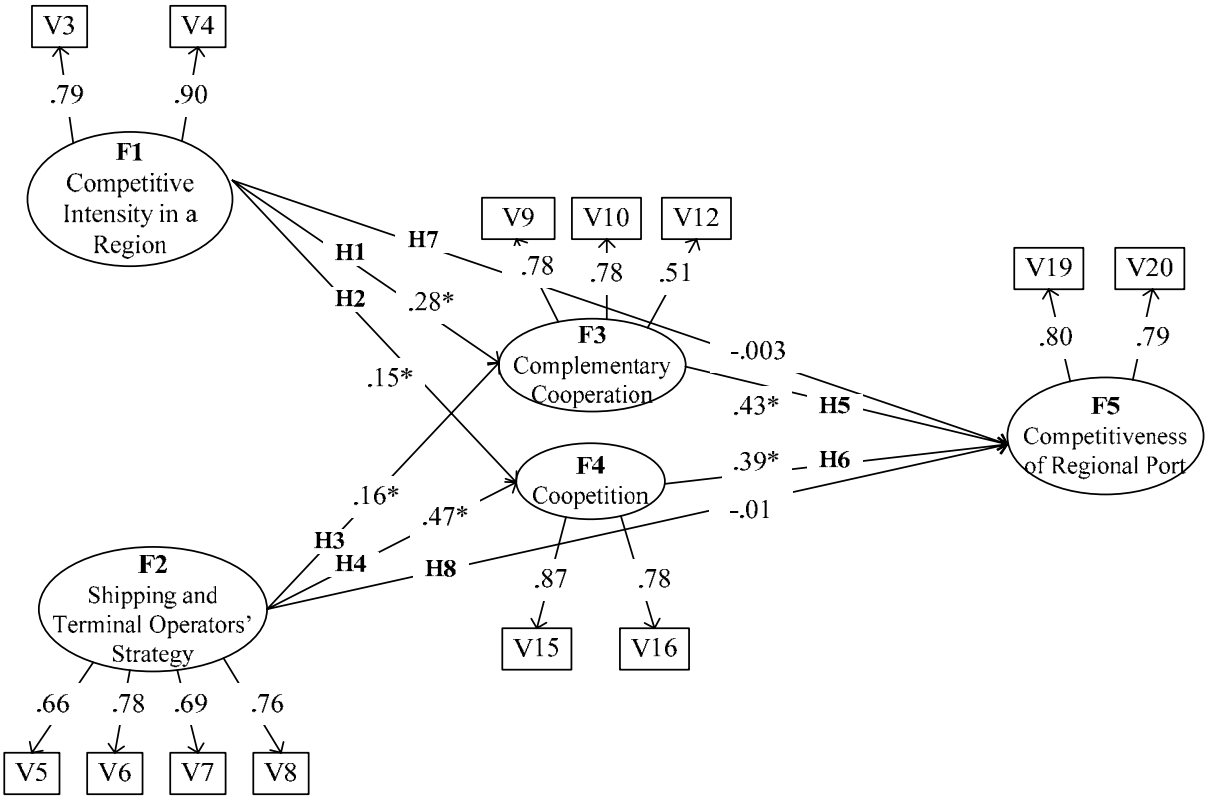

Figure 3 Results of hypothetical model testing

* indicates statistical significance at the 5% level

Table 5 Results of hypothesis testing

Hypothesis	Path Loading	t value	Result
H1	0.2841*	3.6534	Support
H2	0.1517*	2.2053	Support
H3	0.1588*	2.0957	Support
H4	0.4692*	6.1934	Support
H5	0.4256*	5.0244	Support
H6	0.3989*	4.3513	Support
H7	-0.0356	-0.4864	Not Support
H8	-0.0115	-0.1378	Not Support

* indicates statistical significance at the 5% level

4.2.2 Effect Analysis

Final testing is H9. An indirect effect assesses the impact of one variable on another as that variable's influence works through one or more intervening variables. Furthermore, it is better to measure the mediation and indirect effect in the model, by testing the influence of mediated model (i.e. with complementary cooperation and coopetition as mediator) between competitive intensity in a region, shipping and terminal operators' strategy and competitiveness of regional ports. Thus, model 1 which excludes the mediated variables was compared with the final structural model. The structure and testing results of model 1 is shown in Figure 4, which also fit good to the data, as indicated by RMSR =0.01, GFI=0.97, NNFI=0.97, NFI = 0.96, and CFI =0.98.

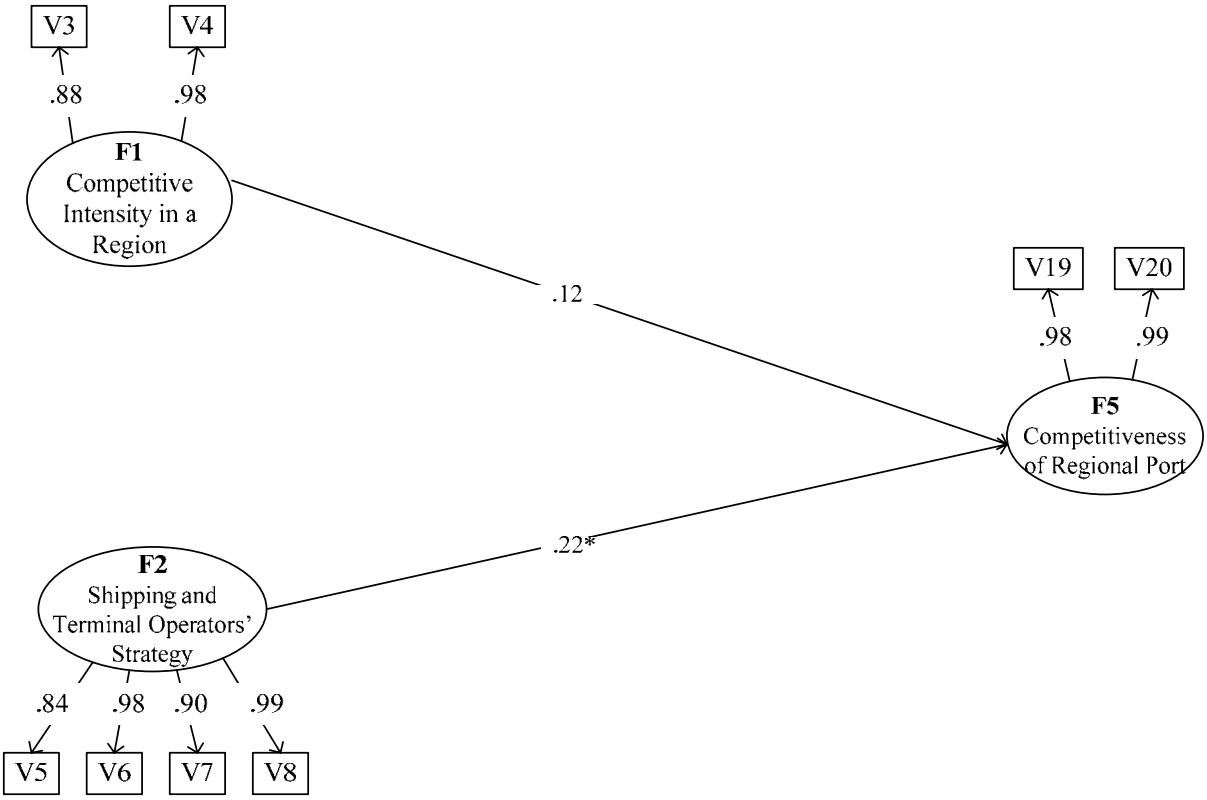

Figure 4 Results of model 1 testing
* indicates statistical significance at the 5% level

The results of model 1 reveal that the relationship between competitive intensity and the competitiveness of regional ports is insignificant which the same as the final structural model is. However, the indirect effect between competitive intensity and competitiveness of regional ports through two types of port cooperation are significant. Therefore, it can be inferred that the mediating role of port cooperation is pure mediation between competitive intensity and the competitiveness of regional ports. Moreover, shipping and terminal operators' strategy is positively related to the competitiveness of regional ports in model 1, but not significant when adds the mediator variable (i.e. complementary cooperation and coopetition). Thus, the mediating role of port cooperation is also pure mediation between the influence of shipping and terminal operators' strategy and the competitiveness of regional ports.

In Table 6, it indicates that the indirect effect of competitive intensity toward the competitiveness of regional ports through complementary cooperation (0.1209) is greater than through coopetition (0.0675). It implies that the effect of competitive intensity toward the competitiveness of regional ports through complementary cooperation is better than coopetition. But that of shipping companies and terminal operators' strategy is better through coopetition than complementary cooperation.

Table 6 Effects of mediating variables

Model	Hypothetical Model		Model 1
Path	Direct Effect	Indirect Effect	Direct Effect
F1→F5	-0.0356	--	0.1236
F1→F3→F5	--	0.1209*	--
F1→F4→F5	--	0.0675*	--
F2→F5	-0.0115	--	0.2217*
F2→F3→F5	--	0.0605*	--
F2→F4→F5	--	0.1871*	--

* indicates statistical significance at the 5% level

Furthermore, Table 7 also reveals that shipping companies and terminal operators' strategy has more influence on competitiveness of regional ports than competitive intensity does.

Table 7 Effect analysis of hypothetical model

Path	Direct Effect	Indirect Effect	Total Effect
F1→F3→F5	--	0.1209	--
F1→F4→F5	--	0.0675	--
F1→F5	-0.0356	--	0.1528
F2→F3→F5	--	0.0605	--
F2→F4→F5	--	0.1871	--
F2→F5	-0.0115	--	0.2361

Note: Total effect = Direct Effect + Indirect Effect

5. POTENTIAL ITEMS FOR PORT COOPERATION

In order to identify potential items for the two types of cooperation, this study identified 20 possible items of port cooperation, and the importance of each item was ranked from scale 1~6 by the respondents in Part two of the questionnaire survey. These items were divided into five major groups as shown in Table 8.

Table 8 Possible items of port cooperation

Group	Item
Port internal conditions	water depth, geographic location, inland transportation, facilities and equipments of ports
Liners service	density of liners, service area of liners, coordination of liners (e.g., near-coastal/ ocean going services), function of ports (e.g., hub or feeder port)
Port operational management	EDI system, information sharing platform, service diversification, efficient operating procedure, know-how techniques, berth assignment
Resource integration	cargo sources allocation, co-marketing, differential service, regional development
Pricing strategy	coordination in port charges, preferential port charges for shippers

In this part of analysis only 54 valid, questionnaires from high management level respondents in port authorities and shipping companies, as well as professors and experts were sieved out. Top five important items for these two types of cooperation are listed in Table 9 and Table 10,

which were ranked by the average scores. The most important items of complementary cooperation include port internal conditions such as water depth, geographic location, facilities and equipments of ports, inland transportation service, as well as liners service such as function of ports, coordination of liners and density of liners.

It is noticed that although the rank order of the top five items by each category are different, geographic location, water depth and inland transportation service are identified within the top five by all the three categories. Coordination of liners is not identified within the top five by the shipping company, but is included by the other two categories. Contrarily, while preferential port charges is regarded as the most important item by the shipping company, it is not included in the top five items by the other two groups. In general, the viewpoints of the port authority group and the professors & experts group are more close to each other.

In the coopetition, the most important items were suggested as EDI system, coordination in function of ports, resource integration in regional development, preferential port charges for shippers, cargo sources allocation, Know-How techniques, efficient operating procedure, information sharing platform and density of liners. In this part, EDI system was ranked as the most important item of cooperation by almost all categories of respondents, which is coincided with the technological development trend in modern ports of the world. For example, the Port Community System enables all the links within the port of Rotterdam logistics chain to efficiently exchange information with one another. The ports of Rotterdam and Amsterdam will merge the individual port community systems and through joint port community system, the new organization will be able to offer customers of the two ports an even wider range of services. Except the very high consensus in EDI system, other top five items identified by each of the three categories are fairly diversified. Preferential port charges is the only item included by both shipping company group and port authority group. These results may imply that more difficulties will be expected for port coopetition than for complementary cooperation.

Table 9 Important items for complementary cooperation

Rank	Port Authority (N=20)	Shipping company (N=24)	Professor and Experts (N=10)	Overall (N=54)
1	water depth (5.40)	preferential port charges for shippers (5.50)	geographic location (5.40)	geographic location (5.29)
2	function of ports (5.10)	geographic location (5.42)	water depth (5.20)	water depth (5.27)
3	coordination of liners (5.05)	facilities and equipments of ports (5.38)	inland transportation service (5.10)	coordination of liners (5.11)
4	geographic location (4.95)	water depth (5.29)	coordination of liners (5.00)	inland transportation service (4.98)
5	inland transportation service (4.85)	inland transportation service (5.21)	density of liners (4.90)	function of ports (4.96)

Note: The number in brackets is the average score of the item

Table 10 Important items for coopetition

Rank	Port Authority (N=20)	Shipping company (N=24)	Professor and Experts (N=10)	Overall (N=54)
1	EDI system (4.95)	preferential port charges for shippers (5.38)	EDI system (5.30)	EDI system (5.19)
2	function of ports (4.90)	EDI system (5.33)	efficient operating procedure (5.20)	regional development (4.91)
3	regional development (4.80)	inland transportation service (5.25)	information sharing platform (4.90)	preferential port charges for shippers (4.85)
4	preferential port charges for shippers (4.65)	regional development (5.21)	cargo sources allocation (4.70)	function of ports (4.78)
5	cargo sources allocation (4.65)	Know-How technique (5.00)	density of liners (4.60)	coordination in port charges (4.72)

Note: The number in brackets is the average score of the item

6. CONCLUSIONS

(1) The findings of this study indicate that competitive intensity and shipping companies and/or terminal operators' strategy are associated with complementary cooperation and coopetition of ports in same region. Also, effects of competitive intensity toward the competitiveness of regional ports is better through complementary cooperation but the effect of shipping and/or terminal operators' strategy toward the competitiveness of regional ports is better through coopetition. Furthermore, both the complementary cooperation and coopetition would positively influence the overall competitiveness of ports in a region. Thus, port cooperation is one way to increase regional competitiveness of ports.

(2) The direct impact of competitive intensity on the competitiveness of regional ports is not significant. It might be attributed to the survey was conducted in Taiwan. Taiwan's ports are public ports and the port authorities are less sensitive to the competitive environment.

(3) Shipping companies and terminal operators have direct influence on ports' competitiveness. It is the fact that cooperation usually occurred between port authorities and transport operators, in the form such as dedicated container terminals, and joint venture to invest in ports. Dedicated terminals can facilitate the development of integrated services and bind shipping companies to the terminals. It was found that shipping companies would like to call on the ports which they invest, and terminal operators usually use preferential strategy (i.e. decreasing port charges etc.) to attract carriers to call on the ports/terminals which they invest in. Nevertheless, shipping companies or terminal operators can further enhance ports' competitiveness through ports cooperation as indicated by the results of this study.

(4) The importance ranking of cooperative items between ports suggested that geographic location, water depth, coordination of liners, inland transportation service and function of ports are most important for complementary cooperation, and that EDI system, regional development, preferential port charges for shippers, function of ports and port charges in coordination between ports are most important for cooptition.

(5) Cooperation is one way to develop synergies between ports in same region. New

behaviors of port authorities and the government are required, if they want to be a positive contributor to enhance the overall port competitiveness of the region.

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