Research on horizontal integrating strategy pricing game of competitive ports

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Abstract. The homogenization of port services makes the competition among ports fierce. The long construction cycle makes it difficult for port companies to launch new differentiated services. Adopting horizontal integrating strategy to form a regional port group could more or less avoid the over competition for ports. In order to study the change of port companies’ profit, market share from adopting horizontal integrating strategy, this paper developed a multi-objective optimization pricing game model for port companies based on game theory and MNL discrete choosing model and solved the pure strategy nash equilibrium with an numerical algorithm. From the numerical example, we obtained the optimized pricing strategies, integrating routes for highway transportation service as well as sensitivity analysis of user preference factor in the context of horizontal integrating strategy. The result shows that: When user preference factor is 0.008, adopting horizontal integrating strategy could bring 103% profit promotion for port company A and 45% for port company B. While such measure would reduce the profit from adopting vertical integrating strategy. Therefore port companies decide to cancel some integrating routes in both ends of the network in order to reduce the costs. Moreover, there’s a collusion between two companies after adopting horizontal strategy. Decision making of both companies will aim at maximizing the profit of the group. Finally, the sensitivity analysis shows that with the growing of user preference factor $\theta$, profit of regional port group will become stable after a decrease while the difference of profit between two companies become larger. It’s suggested that the regional port group should redistributes the profit so that the cooperation could be more persistent. Finally, port companies should also pay attention to self-development to avoid the profit loss when cooperation breaks or competition from outside.

1. Introduction
The continued downturn of International trading has forced port companies to change their pricing in order to win a higher market share but simultaneously led a fiercer competition between them. In such context, there are some port companies found that adopting horizontal or vertical integrating strategies to integrate the redundant resources will help remarkably mitigate the pressure from the competition. The horizontal integrating strategies indicate different port companies cooperate on setting up a regional port group which is independent from the original companies. The vertical integrating strategies indicate that port companies adopt differentiation services such as integrating highway transportation. Pure vertical integrating strategies will allow port companies win a higher profit and competitive edge in a relative short time. Since the competitor will try to follow the leader after the profit had notably declined. The homogenous services will change a new equilibrium and the completion will become intense again. Wang [1] proposed that when the distribution of profits is
reasonable, port companies could get more profits from cooperation than from non-cooperation context. So naturally port companies are willing to cooperate with others. Therefore, the horizontal integrating strategies are seems to be better solutions for port companies in a fierce competition.

The game theory could deal with several problems related to port economics [2]. As a result, a considerable amount of researches about port competition/cooperation are based on the game theory. Referring to these papers, researches about non-cooperate pricing game within port companies are relatively advanced. Álvarez-SanJaime [3] worked on the pricing strategies of port when integrating inland transportation services based on one-dimensional Hotelling Model. Ishii [4] considered the uncertainty of transport demand and the port investment sequences and develop a game model to deal with the pricing problems during different construction period. Aiming at growth markets, Luo [5] developed a two-stage duopoly game model to analyse the best pricing and capacity strategies of existing and new ports. Cheng [6] analysed the port investment equilibria in a multi-port region in China with profit-oriented and GDP-oriented game model. Song [7] considers the competition between two ports involving both hinterland shipments and transshipments using non-cooperative game model.

Though the regional port integration is becoming a popular trend, the researches about port cooperation are limited. Dong [8] developed a two-stage non-cooperative game model to study the pricing competition between ports and how pricing match strategies would affect the cooperation of ports. Saced and Larsen [9] used a two stage Bertrand game model to study the competition and cooperation relationship within three container ports. Asadabadi [10] developed a bi-level multiplayer game theoretic approach to study the co-opetition among ports. Zhou [11] studied the competition/cooperation between three ports with a developed Hotelling model. Wan [12] developed a spatial game model to study how the investment of local government would affect the port infrastructure with different cooperation projects.

Market share change is one of the notable result for port competition/cooperation. Exiting researches about market share competition are mainly based on the utility theory. What’s more, the Multinomial Logit Model (MNL model) is usually adopted to express users’ choices [13-15].

Most researches using formula deviation to solve the equilibrium. Yet they assumes that hinterlands are located in the one or two dimensional continuous space. However, discrete network is more proper to describe the spatial relationship between hinterlands, though related researches are limited. What’s more, researches about quantifying the influences of horizontal integrating on port competition with this strategy are missing. With an eye to applying game theory on the competition with discrete demand oriented network, this paper developed a multi-objective optimization pricing game mode (MOOPG model) to study the market share and profits change of port companies adopting horizontal integrating strategies. The first part of the model is optimizing the maximum profit of the regional port group when port companies adopting horizontal integrating strategies. The decision variable is the routing of vertical integrating strategies for port companies. Which means that the group has the right to forbid competition from vertical integrating services between port companies. The second part based on the game theory, which consider both the routing of vertical integrating strategies and the pricing strategies of two port companies, respectively. This paper used MNL model to represent users’ choice preference and a numerical algorithm to solve the nash equilibrium.

2. Problem description
Both ends of the network nodes are port A and port B, respectively. Nodes indicate the hinterland where the users located in. Users need to choose port services to upload their cargoes as well as highway transportation services to transport those cargoes back to their local hinterland. Choices are fully affected by the total transportation utilities. In this paper, the market share is reflected by the probability of user choosing specific port services. And such probability is calculated by the MNL model based on utilities. In China, ports are public infrastructure which are owned by the government. And they are mostly managed directly by government or the companies with government’s investment.
On this account, the port companies discussed in this paper are the port owners. Figure 1 indicates how users located in the network nodes make their choices.

When adopting horizontal integrating strategy, the maximum profit of one’s own will be the main purpose for regional port group and port companies when they choose their strategies. So how the horizontal strategy will affect both port companies and users became a critical problem. More specifically, this problem is included three parts listed below:

1) If both the port companies adopt the horizontal integrating strategy, how will the pricing change?
2) Comparing with the original total profit of two port companies, will the total profit of the regional port group arise after adopting horizontal integrating strategy?
3) What’s the difference of users’ choices before and after adopting horizontal integrating strategy?

3. Modelling

3.1. Assumptions
To consider the convenience of discussion, this paper purposed the below assumptions:

1. Both the port companies have the same hinterlands and compete with each other. Both companies provide the same services and the basic conditions, which include but not limited to shipping fee, capacity, etc.; 2. Port companies A and B are capable to handle all the demands of the users in the network. The transport demands are inelastic; 3. Transportation from the ports is highway transportation only and all the hinterlands are covered. The expenditure of transportation will not change according to the volume. 4. The random term of users’ transportation utilities subject to the Gumbel Distribution and the average value is 0. 5. All the participants have the perfect information.

3.2. Users’ choice model
There’s a probability for a user choosing different port services, which indicates the distribution percentage of user’s cargo volume. And such probability is decided by the user’s total transportation utilities. In this paper, this utilities are divided as fix term and random term, which is:

\[ U^i_z = V^i_z + \varepsilon^i_z \]  

\[ V^i_z = \alpha - \left( P^i + c^i \times I^i_z \right) \]

\[ \varepsilon^i_z \] denotes the total transportation utilities for user z choosing the service i; \( V^i_z \) denotes the fix term of the total transportation utilities; \( \varepsilon^i_z \) denotes the random term of the total transportation utilities.

The fix term of the total transportation utilities is the maximum willingness to pay minus the expenditure of the service, which is:

\[ V^i_z = \alpha - \left( P^i + c^i \times I^i_z \right) \]
\( \alpha \) denotes the maximum willingness to pay for user; \( P^i \) denotes the expenditure of port services when choosing service \( i \); \( c^i \) denotes the expenditure of highway transportation services; \( l_z^i \) denotes the distance between the hinterland where user \( z \) located and the port which provide service \( i \).

\( \varepsilon^i_z \) is an i.i.d. random variable, which subject to Gumbel distribution and the average value is 0. It’s the random deviation of the users’ choice, which would change according to the transportation freight, distance, environment, handling capacity, convenience of the port services and reliability, etc.

In the utility function, since the \( \varepsilon^i_z \) is subject to the Gumbel distribution, so the probability \( \delta^i_z \) could be calculated by the Logit Discrete Choosing Model, which is:

\[
\delta^i_z = \frac{e^{-\alpha u^i_z}}{\sum_i e^{-\alpha u^i_z}}
\]  

(3)

\( \delta^i_z \) denotes the probability for user \( z \) choosing service \( i \); \( \theta \) is the user preference factor.

3.3. Multi-objective optimization pricing game model for port companies

The first part of the model stands for the maximum profit of the regional port group. It’s consist of two parts, the profits of port companies A and B, respectively. Which is:

\[
\max \; \prod_G = \prod_A + \prod_B
\]

(4)

The second part of the model is a bi-level programming pricing game model for the port companies considering integrating highway transportation service. The upper level of the model is the maximum profit function for port company A, and the lower level is that for port company B. The profit of the port companies is consist of the profit of common port service (CPS) and the integrating port service with highway transportation (IPS). The operating costs of port companies is consist of fixed costs and variable costs. Profit is the main reason for port companies’ decision making. And the result of competition is reflected by the equilibrium price. The function of the second part is given below:

\[
\max \; \prod_{A(t^A, p^A, c^A, o^A, p^B, c^B, o^B)}
\]

\[
= \sum_z w_z \left( \delta^A_z \left( P^A - h_p \right) + o^A_z \delta^A_z \left[ \left( P^A - h_p \right) + \left( c^A - h_c \right) \times l_z^A \right] \right) - h_f^{A+A} - n^A \times h_f
\]

(5)

\[
\max \; \prod_{B(t^B, p^B, c^B, o^B, p^A, c^A, o^A)}
\]

\[
= \sum_z w_z \left( \delta^B_z \left( P^B - h_p \right) + o^B_z \delta^B_z \left[ \left( P^B - h_p \right) + \left( c^B - h_c \right) \times l_z^B \right] \right) - h_f^{B+B} - n^B \times h_f
\]

(6)

s.t.

\[
\delta^i_z = \frac{e^{-\alpha u^i_z}}{\sum_i e^{-\alpha u^i_z}}, \; i \in \{A, A', B, B'\} \; ;
\]

(7)

\[
u^i_z = \alpha - \left( P^i + c^i \times l_z^i \right) ;
\]

(8)

\[
\delta^A_z + \delta^A_z + \delta^B_z + \delta^B_z = 1 ;
\]

(9)

\[
o^A_z, o^B_z, n^A, n^B \in \{0,1\}, \; \forall z \in Z ;
\]

(10)

\[
P^A, P^B, P^A, P^B, c^A, c^B \geq 0 ;
\]

(11)
In the function, $\Pi_C, \Pi_A, \Pi_B$ denote the profit of regional port group, port company A and port company B; $z$ denotes the user, and $Z$ denotes the set of all users; $w_i$ denotes the demand for user $z$; $h_p$ denotes all the variable costs for CPS handling one unit of cargo; $h_c$ denotes the variable costs for IPS handling one unit of cargo; $h_p^{A+B}$, $h_c^{A+B}$ denote all the fixed cost for port companies; $\delta z^A$, $\delta z^B$ denote the probability for user choosing different services; $\delta z^A$, $\delta z^B$ denote the binary variable for port companies choose to open a new integrating route to where user $z$ located.

Solving the nash equilibrium of bi-matrix game is a PPAD problem (Polynomial Parity Arguments on Directed graphs) which mainly use the iterated elimination of strictly dominated strategies or reaction function method. However, in this paper, the decision variables of port companies are discrete. Then the objective function is non-linear as well as non-differentiable. So the reaction function method is not feasible. What’s more, due to the great amount of strategy combinations, use the iterated elimination of strictly dominated strategies would also cost a relative long time. Grauberger [16] purposed an equilibrium numerical algorithm to solve the pure strategy nash equilibrium for game model. The algorithm is able to simulate the decision making procedure and terminates when both of the competitors will not win a higher profit from changing strategies. This algorithm gives a good solution for avoiding the huge amount of calculation for all the combination of strategies. In this paper, such algorithm is adopted and developed to simulate the decision making of both port companies who choose its strategies according to the competitor best strategies. The solution method is given below.

**Step 1. Decide initial decision maker and strategy** Select one of the port companies as starter, $p$ indicates the current decision maker, $\neg p$ indicates the competitor. Competitor’s initial strategy $S_{z, p}^0$ is chosen randomly.

**Step 2. Iterative Selection Procedure** Loop until the condition below satisfies.

Loop

for j=1 to 2

$\begin{align*}
 & p \leftarrow p_j, \\
 & \text{If } j = 1, \text{ } k \leftarrow k - 1; \text{ else, } k \leftarrow k.
\end{align*}$

According the competitor’s strategy, $S_{z, p}^0$, calculates the best response $S_{z, p}^1$ for the current decision maker and calculates the profit $\Pi_{z, p}^1$ according to model (5) or (6).

If $k > 1$, jump to Step 3.

$k \leftarrow k + 1.$

**Step 3. Verification Procedure** Verifies if the best strategy $S_{z, p}^j$ and profit $\Pi_{z, p}^j$ occur in the previous iteration.

For $l = 1$ to $k - 1$

If $\Pi_{z, p}^j = \Pi_{z, p}^l$ \&\& $S_{z, p}^j = S_{z, p}^l$

If $l = k - 1$

Nash equilibrium exists, If $j = 1, S_{z, p}^j \leftarrow S_{z, p}^j$ and $S_{z, p}^j \leftarrow S_{z, p}^j$; else, $S_{z, p}^j \leftarrow S_{z, p}^j$ and $S_{z, p}^j \leftarrow S_{z, p}^j$. The Nash equilibrium is $S_{z, p}$ and $S_{z, p}$. Jump to Step 4.

else
Nash equilibrium not exists, Jump to Step 4.
else
    Change role of decision maker, back to Step 2.

\( k \leftarrow k + 1 \)

**Step 4. Termination** Output result. Program terminates.

### 4. Numerical example

A numerical example is given to analyze the influences on market when choosing horizontal integrating strategy. At first, both port companies adopt the vertical integrating strategy. Which indicates integrating port service with highway transportation service. The symbols are \( A' \) and \( B' \), respectively. These two companies compete for the users among them. The number of users are set as 10. The user preference factor \( \theta \) is set as 0.008 according to the empirical value. Detailed parameters for the hinterlands are listed in table 1. Figure 2 shows the spatial position for network nodes.

#### Table 1. Basic parameters of hinterlands.

| No. | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |
|-----|------|------|------|------|------|------|------|------|------|------|
|     | Distance to A (km) | 80.2 | 154  | 174.2| 244.8| 232.8| 247.2| 238  | 272  | 314  | 347.4|
|     | Distance to B (km)  | 336.6| 277.2| 246.6| 279  | 244  | 247.2| 196  | 161.4| 116  | 77.4 |
|     | Demands (t)         | 228.9| 267.6| 264.2| 308.1| 328.1| 381.8| 293.01| 280.23| 248.3| 199.3|

![Figure 2. Network nodes of hinterlands.](image)

4.1. Original profit distribution for ports

Firstly, the price of different services are set in order to solve the equilibrium. The \( h_{A^{+}} = h_{B^{+}} = 80000 \) CNY, and the \( h_{f} = 12000 \) CNY. Detailed parameters are listed in table 2.

The Grauberger’s equilibrium numerical algorithm was programmed by C++. The parameters in table 2 are input data to solve the original market performance with vertical integrating strategy only.

#### Table 2 Service price parameters. (CNY)

| Items                  | Price of port service for CPS | Price of port service for IPS | Price of highway transportation service for IPS |
|------------------------|-------------------------------|--------------------------------|-----------------------------------------------|
| Lower bound of price   | 420                           | 320                            | 0                                             |
| Upper bound of price   | 870                           | 920                            | 9                                             |
| Calculating interval   | 15                            | 20                             | 0.3                                           |
| Cost per unit          | 240                           | 240                            | 6                                             |
**Table 3** Equilibrium price of ports considering vertical integrating strategy. (CNY)

| Items                        | CPS of A | IPS of A | CPS of B | IPS of B |
|------------------------------|----------|----------|----------|----------|
| Price of port service        | 870      | 920      | 870      | 900      |
| Price of highway transportation service | 6.5      | 4.5      | 6.5      | 4.5      |
| Profit                       | 446304   | 498842   |          |          |

The equilibrium price of port service in CPS are 870 CNY for both ports. While in IPS are 920 CNY for A and 900 CNY for B. The price of highway transportation in IPS are 4.5 CNY for both port companies, which is 1.5 CNY lower than the prime cost. Detailed value are listed in table 3:

The market share are calculated according to the function (8) and listed in table 4:

**Table 4** Market share of port services considering vertical integrating strategy.

| No. | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| A   | 99.97%| 89.99%| 7.78% | 2.16% | 1.96% | 1.28% | 0.50% | 0.27% | 0%    | 0%    |
| A'  | 99.97%| 89.99%| 92.48%| 74.76%| 56.30%| 46.11%| 15.54%| 14.43%| 0.03% | 0.03% |
| (A+A') | 0%    | 0%    | 84.70%| 72.61%| 54.34%| 44.83%| 15.04%| 14.34%| 0.03% | 0.03% |
| B   | 0%    | 0.15% | 0.18% | 0.36% | 1.09% | 1.28% | 4.42% | 85.57%| 99.65%| 99.99%|
| B'  | 0.03% | 9.86% | 7.34% | 24.87%| 42.61%| 52.61%| 80.04%| 0%    | 0%    | 0%    |
| (B+B') | 0.03% | 10.01%| 7.52% | 25.24%| 43.7% | 53.9% | 84.46%| 85.57%| 99.7% | 99.99%|

According to table 4, when port companies only adopting vertical integrating strategy, the market share of both sides are almost the same. The percentage of market share declined dramatically with distance. The profits are $\prod_{A} = 446304$ CNY, $\prod_{B} = 498842$ CNY. The profits show that in this context, competitiveness of two companies remain the same level.

4.2. Pricing game considering horizontal integrating strategy

Remained the basic parameters unchanged, modified the program considering port companies adopting horizontal integrating strategy. Solve the equilibrium of the new context. The result shows that nodes forbidding vertical integrating strategy are {1,9,10}, other value are listed in table 5:

The equilibrium market share in the new context are showed in table 6:

**Table 5**. Equilibrium price of ports considering both horizontal and vertical integrating strategy. (CNY)

| Items                        | CPS of A | IPS of A | CPS of B | IPS of B |
|------------------------------|----------|----------|----------|----------|
| Price of port service        | 870      | 920      | 870      | 540      |
| Price of highway transportation service | 6.5      | 6.6      | 6.5      | 9        |
| Profit                       | 906439   | 724852   |          |          |

Comparing table 3 and 5, the prices of port service in CPS of both A and B remain the same with the new strategies, while that in IPS has a remarkable change. Before adopting this strategy, $P^A$ and $P^B$ are equal or slightly less than the upper bound of the computing interval for 920 CNY. Price of highway transportation service in IPS, $c^A$ and $c^B$, are both 1.5 CNY less than the prime cost. After adopting this strategy, the gap between $P^A$ and $P^B$ becomes larger, which are 920 CNY and 540 CNY, respectively. While $c^A$ and $c^B$ elevate to 6.6 CNY and 9 CNY, both higher than the price of highway transportation service in CPS. The profits of both companies get great promotion after adopting the horizontal integrating strategy. Profits promotes 103% and 45%, respectively.
Table 6. Market share of port services considering both horizontal and vertical integrating strategy.

| No. | 1   | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |
|-----|-----|------|------|------|------|------|------|------|------|------|
| A   | 100%| 62.72%| 62.26%| 58.14%| 47.28%| 39.22%| 8.10%| 0.20%| 0%   | 0%   |
| A'  | 0%  | 37.17%| 36.30%| 32.04%| 26.31%| 21.57%| 0%   | 0%   | 0%   | 0%   |
| (A+A')| 100%| 99.90%| 98.56%| 90.18%| 73.59%| 60.79%| 8.10%| 0.20%| 0%   | 0%   |
| B   | 0%  | 0.10%| 1.44%| 9.82%| 26.41%| 39.22%| 71.91%| 64.16%| 100% | 100% |
| B'  | 0%  | 0%   | 0%   | 0%   | 0%   | 0%   | 19.99%| 35.64%| 0%   | 0%   |
| (B+B')| 0%  | 0%   | 1.44%| 9.82%| 26.41%| 8.10%| 91.90%| 99.80%| 100% | 100% |

(a) Origin market share of port services  
(b) Final market share of port services considering horizontal integrating strategy

Figure 3 Market share comparison before and after adopting horizontal integrating strategy.

Figure 3(a) and (b) are plotted based on table 4 and 6. From them, it’s obvious that the market share of both companies have a great change after adopting the horizontal integrating strategy. The reason that market share of IPS drop significantly after this strategy is because the elevation of price of highway transportation service in IPS lead more users allocating their cargo to the CPS. The profit of B promotes slower than A with a remarkable market share drop. And such drop shifts to the A’s IPS. That’s because the total distances are different. A could win more profit than B through IPS with a greater total distance from hinterlands. Then the maximum profit of regional port group rises.

Meanwhile, the integrating route to nodes {1, 9, 10} are forbidden by the group since the over competing in relatively low market share place is non-profitable. By doing so, the costs for integrating highway transportation services could be reduced. What’s more, after adopting the new strategy, port companies are in collusion, and their decision making will depend on the maximum profit of the group.

4.3. Sensitivity analysis of user preference factor

In the model, $\theta$ denotes whether the users prefer the fix term or the random term of the utility when they making choices. To study the influence on the equilibrium and profit from the users’ preference, we set the computing interval of $\theta \in \{0, 0.028\}$. Calculation step was set as 0.002, then estimated the sensitivity of $\theta$. Numerical result is shown as figure 4 and 5:

From figure 4(a), it’s obvious that the growing of $\theta$ doesn’t affect the price of port service in CPS for port company A while the price of both port service and highway transportation service in IPS shows a downtrend. The fluctuation of $P^A$ is quiet significant which has an opposite change pattern with $c^A$. Figure 4(b) shows that $P^B$ drops dramatically when $\theta$ is growing. The fluctuation of $P^B$ is not as significant as $P^A$. $c^B$ also shows an opposite change pattern with $P^B$ while the value is always larger than $c$ in CPS. What’s more, figure 5 shows that though there’s a downtrend for $\Pi_G$, but it’s inclined to be stable when the $\theta$ is big enough. The gap between $\Pi_A$ and $\Pi_B$ shows a similar trend like $\Pi_G$. From the above three charts, we could draw a conclusion that in horizontal integrating strategy context, users are more likely to depend on the fix term when $\theta$ grows bigger.
The profit of the group will decline because of that. In order to mitigate the profit drop caused by the pricing competition, both of the competitors will decide to weaken the competition from vertical integrating service. More specifically, \( c_A' \) and \( c_B' \) will be set slightly higher than \( c_c \), so that the users’ choices will be led to the CPS with a relatively high price. Besides, for the hinterlands where IPS are provided, the profits from IPS become less important. Port companies A and B will choose a new price to change the market share. In this case, the total distance between A and hinterlands is larger than that of port B, so B chooses a higher price for IPS so that more users in the middle area will choose A. Such choices will allow A to win more profit from providing IPS.

![Figure 4. Sensitivity analysis of pricing strategies for port company A and B.](image)

![Figure 5. Sensitivity analysis of profits for regional port group, port company A and B.](image)

5. Conclusions

To study the influence on port companies’ profit, market share and the existing vertical integrating strategy from adopting horizontal integrating strategy, this paper developed a MOOPG model for port companies based on game theory and MNL discrete choosing model. With the pure strategy nash equilibrium for the numerical example and sensitivity analysis for user preference factor, the conclusions are drawn below:

1) After adopting horizontal integrating strategy, a regional port group is set up by both the port companies. The collusion between this two companies will force them to make decisions according to the maximum profit of the group. In such situation, the price of CPS maintains in a relatively high level, while the price of IPS changes frequently in order to win the maximum profit. What’s more, the profits of both companies have a remarkably promotion after adopting horizontal integrating strategy.

2) Market share change significantly after adopting horizontal integrating strategy. In other words, users’ choices shows a different pattern with the new strategy. Also, the vertical integrating strategy becomes less important to the port companies, for the declined profit from the IPS. Therefore, port companies decide to enhance the price of IPS and cancel some integrating routes in the both ends of the network, so that more demands of the cargo will be distributed to the CPS.

3) To avoid the homogeneity competition between competitors, port companies could provide new differential services or reach cooperation with competitors. However, the relative long period for
port construction limits the tempo of service upgrade, so cooperation or so called horizontal integrating strategies is a better choice. But port companies should also recognize that wining the maximum profit with collusion may widening the gap for the growth rate of profits between port companies. Then the faster one may risk breaking contract from the slower one. And cooperation break will make the competition fierce again. So the regional port group should consider the fairness of redistribution, in order to maintain the continuity for horizontal integrating strategy. It is suggested that port companies should remain partial independence to maintain self-development. Hence the risk of contract breaking still exists though it’s been minimized by the considerable profit. What’s more, there are also competitors outside the region. Maintain competitiveness by self-development would preserve port companies from profits loss in a long term.

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