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EFFECT OF ALLIANCE ON PROFIT RATE IN JAPANESE LINER SHIPPING INDUSTRY

Zi-Yi Gao*
Shigeru Yoshida**
Na-Young-Hwan Choi***

ABSTRACT
This study investigates the effect of alliance on profit rate in the Japanese liner shipping industry by theoretical and empirical analysis. Alliances dropped the freight rate, which was not caused by changing the market concentration, but by the worsening of the supply and demand balance and reducing costs by the development of large-sized ships. Based on estimated profit function, the improvement of profit rates by alliances in Japanese liner shipping companies is determined by the development of large-sized ships and revenue growth. The revenue growth can be considered beneficial to the improvement of competitiveness of Japanese liner shipping companies, however, the growth of Japanese liner shipping companies is mainly cross-market. In addition, revenue growth rates are different among Japanese liner shipping companies. NYK has advantages in cost differentiation and service differentiation, but its growth rate is lower than that of MOL. The result is caused by a different strategy called low freight strategy.

Keywords: strategic alliance, liner shipping, profit rate, industrial organization

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1. INTRODUCTION

Modern business is facing fiercer competition and challenges in a constantly changing market. In order to improve competitiveness and survive in this tense and turbulent business environment, collaboration and strategic alliances are formed between at least two organizations with similar structure and compatible objectives. All along scholars have different interpretations on the concept of strategic alliances which was first proposed by J. Hopland and R. Nigel in the end of the 1970s (Yao (2003)). They defined strategic alliances as an agreement involving two or more organizations for achieving joint strategic goals in order to meet their business needs. Porter (1990) stated that strategic alliances are long-term agreements between firms that go beyond normal market transactions but fall short of a merger. Forms include joint ventures, licenses, long-term supply agreements, and other kinds of inter-firm relationships. According to Rigby and Buchanan (1994), strategic alliance is a partnership between firms linking parts of their businesses together whereby they mutually commit resources for the achievement of common objectives. Yoshino and Rangan (1995) indicated that strategic alliance is a partnership between two or more firms that unite to pursue a set of agreed upon goals but remain independent subsequent to the formation of the alliance to contribute and to share benefits on a continuing basis in one or more key strategic area, e.g. technology, products. As stated above, strategic alliances have the following characteristics, (1) a partnership between two or more organizations, (2) the partners have common strategic goals, and (3) the partners mutually share resources and benefits.

In the liner shipping industry, the formation of strategic alliances can be dated back to the end of 1995. In the mid 1990s an estimated 60% of total global liner capacity was accounted for by alliances (Agarwal and Ergun (2010)). Nowadays, there are five main strategic alliances that dominate the world's trade routes by providing global services. They are Maersk sealand, Grand alliance (Hapag Lloyd, OOCL and NYK), The New World alliance (APL, Hyundai M.M and MOL), CKYH alliance (COSCO, K-Line, Yang Ming and Hanjin) and the Evergreen Marine Company. Alliances play a significant role in the operation and cooperative activities of liner companies. Some studies have discussed the importance of strategic alliances in the liner shipping industry (Midoro and Pitt (2000); Song and Panayides (2002); Slack and Comtois (2002), among others). The main activity of an alliance not only comprises a vertical integration of transport operations, but also a horizontal share of fleet and route services (Lu et al. (2006)). Over the past few years, the researches on strategic alliances have captured more and more attention in academia. Studies exist in the literature that examine the behaviors of liner shipping companies within strategic alliances using game theory. For example, Song and Panayides (2002) deduce a conceptual framework through applying cooperative game theory to analyze cooperation among members of liner shipping strategic alliances. They address the stability of shipping alliances, noting its dependence on not only economic benefits of
liner companies but also cooperative partners. Agarwal and Ergun (2010) design a mechanism to guide the carriers in an alliance to pursue an optimal collaborative strategy in liner industry, which utilizes mathematical programming and game theory.

The designed mechanism provides side payments to the carriers, as an added incentive, to motivate them to act in the best interest of the alliance while maximizing their own profits. Wang and Yu (2007) established an evolutionary game theory model of the development of shipping alliances. Some forecasts about the development of shipping alliances are put forward by finding out the replicator dynamics equation's 3 fixed points and the evolutionary stable strategy (ESS) of the model.

The objectives of modern liner shipping companies include risk and investment sharing, the reaping of economies of scale, cost control and a capability to increase the frequency of services in a dynamic environment of a growing containerized trade (Panayides and Wiedmer (2011)). These objectives have promoted alliance formation in the liner shipping industry. Companies have given consideration in recent years to whether alliances are the most effective avenue for achieving organizational objectives and growth (Song and Panayides (2002)) with some attempts have been made to evaluate alliances in liner shipping from different perspectives (Midoro and Pitto (2000); Cariou (2002) and Lu et al. (2006), among others). Interest in strategic alliances of liner shipping has been multifaceted in the literature, but as one of the important objectives, the profit rates of liner shipping companies have been rarely discussed in the existing literature. This study investigates the effect of alliance on profit rate in the liner shipping industry by theoretical and empirical analysis. The study is organized to achieve specific objectives as follows. Section 2 discusses the issue theoretically from the aspect of industrial organization theory and Porter’s five forces analysis. Section 3 is an empirical study on profit rates influenced by alliance formation. Based upon the results, a conclusion is drawn in section 4.

2. IMPACTS OF ALLIANCE ON INDUSTRIAL PROFIT RATE

2.1 Perspective of industrial organization theory

The section discusses the effect of strategic alliances on the industrial profit rate in liner shipping industry only from the viewpoint of market concentration. According to the traditional industrial organization theory, industrial profit is determined by the market concentration (or market dominant power), given the certain technical condition. In other words, a high market concentration will influence the price and output of production, and consequently increase the profit rate. However, such a correspondence relation between market concentration and profit rate does not appropriate in the contestable market. Hence, in order to evaluate the impact of alliance

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1 Cost is another influential factor on profit. The relation between cost and alliance is analyzed in empirical study section.
on the profit rate in the liner shipping industry from the perspective of market concentration, it is essential to clarify whether the liner shipping market is a contestable market. However, this issue has long been debated. We bypass this issue for the present.

The alliance in liner shipping industry actually takes effect in the production process, rather than in the selling process. It does not restrict the competition in the sales process so that an alliance has no market dominant power related to freight decision.

Generally speaking the merger and acquisitions (M&A) could enhance the market concentration. Nevertheless, it is appreciable that the alliance in the liner shipping industry adopts the cooperation strategy in the production process but the competition strategy in the selling process. When negotiating with shippers, even alliance members may compete fiercely for cargo collection. In this sense, with regard to the freight decision, market concentration or market dominant power that can influence the profit rate is not increased by strategic alliances.

Consequently, despite whether the liner market is a contestable market, an alliance does not significantly affect either the liner market structure or the freight rate, which will lead to no change in the industrial profit rate.

2.2 Perspective of Porter’s five forces analysis
As shown in Figure 1, Michael Porter (1979) proposed a framework of five principal forces determining the industrial profit rate. The five forces include rivalry among competitors, the threat of new players, the bargaining power of buyers, the bargaining power of suppliers and the threat of substitute products, among which, the first three possess important relationships with alliances in liner shipping industry.

Source: Porter 1979

Fig. 1 Diagram of Porter’s Five Force

The alliance intensifies the horizontal competition in the liner shipping industry. As it prompted the development of global services and the formation of global markets
in the liner shipping industry, alliances raised the difficulty for newcomers to enter. However, the number of players leaving this trade is far more than entrants, effectively increasing the market concentration of shipping tonnage. Hence, the oligopolistic competition becomes fiercer in the rivalry among existing competitors.

The threat of new players proves weak for an alliance. After an alliance formation, few new players can enter. In contrast, a considerable number of players withdraw from the major market, even without taking the withdrawal from the niche market into account. This is because an alliance prompts the formation of megacarriers, whose competition dominates the market. Consequently, weak competitors are driven off, and new players are blocked away. In a certain sense, alliances increase sunk costs, and effectively constructs a barrier for new players.

What is the impact of an alliance on the bargaining power of buyers? High quality service could surely enhance the bargaining power with shippers. An alliance enhances the ability of shipping companies to provide diversified services to meet a variety of the needs of shippers. However, it is doubtful whether improvement in service quality is effective as a competitive advantage or differentiation factor by alliance. Therefore, an alliance is supposed to have a marginal effect on the bargaining power of the shippers.

The above discussion illustrates that the influence of an alliance formation on profit rate is determined by the intensification of oligopolistic competition among megacarrier-sized liner companies. As a matter of practice, such tense competition will probably reduce the freight rate. However, it is theoretically dependent on expense, supply and demand balance, and oligopoly action among other factors. Therefore, empirical analysis is necessary in this study because alliances lower freight rates or profit rates that cannot be assumed to be true prior to the formation of the alliance.

3. EMPIRICAL STUDY

Before analyzing profit rates of the liner shipping industry, it is necessary to observe the movements of the supply and demand balance in addition to the liner freight rate. The observation period is from 1990 to 2010 and in order to analyze the influence of strategic alliances, the period is divided into the two decades of 1990~2000 and 2000~2010 in order to reflect the periods before and after the strategic alliances formation. The periods are divided by 2000, as this year marked the beginning of the service of the large vessel by the strategic alliances formation (Figure 2). 2In addition, the profit rates of two Japanese shipping companies: NYK and MOL3

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2 The principal reason for impact of alliance on profit rate is cost reduction that can be determined by development of large sized ship. Size of ordered ships definitely shows the impact of alliance on development of large sized ship; the liner market can be affected by completed ships. From 2000, size of completed ships shows a significant increase (Figure 2). Therefore, it can be considered that the effect on market began from this year.
which belong to different alliances groups are analyzed in this section.  

3.1 Movement of demand and supply balance

The supply and demand ratio index is calculated by container cargo movement volume and container shipping tonnage in the world on beginning from the year 1990. Figure 3 shows different trends of declining rates before and after the strategic alliances formation. The trend value is -4.9 point from 1990 to 2000, but it is -1.7 point from 2000 to 2010. This means that the decline of the supply and demand balance in liner shipping market was steeper before the strategic alliances formation, but it has leveled off after the strategic alliances formation.

3.2 Movement of freight rate

Movement of the freight rate index is calculated based on the freight revenue of

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3 Three big shipping companies provide liner service in Japan; they are NYK, MOL and K-Line. Case of K-Line is not discussed in this study, since there is a lack of essential liner sector’s data.

4 This analysis presents the effect of differentiation strategy on the industrial profit rate.
Japanese shipping companies. As shown in figure 4, the freight rate had been rising steadily until 1995, and then it dropped sharply during the period of the alliance formation. After the alliance formation, although the rate fluctuates somewhat, it overall remains steady. A trend value of -0.8 shows a downward tendency during the period of 2000-2010, while the trend value is 0.6 point during the period of 1998-2010. Statistically, the trend of the freight index is neither a positive value nor a negative value. Therefore, it can be concluded that there has been little change in the freight rate after the alliance formation. This means that the freight rate has not fallen much in comparison to the worsening of the supply and demand balance after the alliance formation.

(3) Estimation of freight rate function

With the collapse of the liner conference system, a global alliance gradually formed, but there is almost no research on the freight model in liner shipping market. The study supposes the most basic competitive model of freight function in relation to the supply and demand balance and cost with no assumption of oligopolistic behavior.

Estimated results of the model are shown in Table 1, sign conditions of variables and statistics values present significance of the estimated equation because their confidence levels are approximately 95%. The exchange rate variable has a significant negative factor on the profit of Japanese shipping companies because the freight rate is expressed in Japanese yen. The significance of the supply and demand ratio variable shows that the liner freight rate is determined by the balance and the liner market is competitive. Although oligopolistic competition intensified, it is unknown whether the

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5 It is questionable whether this data reflects the world liner freight rate. However, the liner market is composed of partial markets but basically world-wide market. Japanese companies’ operation is mainly in cross trade market rather than in export and import market. Judged by these factors, it can be considered that the fluctuation of this freight rate reflects that of the world liner freight, apart from the level of freight rate.

6 Note this rate is nominal.
supply and demand balance is affected by oligopolistic behaviors. The average ship size is used as a proxy variable of expense in a certain sense, which means that the development of large sized container ships pulled down the freight. Predictably, in addition to the factors relating to the cost above, soaring oil prices have had a remarkable effect on cost.

**Table 1** Estimated freight rate function

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>SE</th>
<th>F-value</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange rate</td>
<td>-0.2392**</td>
<td>0.0704</td>
<td>11.5411</td>
<td>-3.3972</td>
<td>0.0037</td>
</tr>
<tr>
<td>Supply and demand ratio</td>
<td>0.6468**</td>
<td>0.1421</td>
<td>20.7319</td>
<td>4.5532</td>
<td>0.0003</td>
</tr>
<tr>
<td>Av. ship size</td>
<td>-0.0191*</td>
<td>0.0085</td>
<td>5.0597</td>
<td>-2.2494</td>
<td>0.0389</td>
</tr>
<tr>
<td>Oil price</td>
<td>0.2252*</td>
<td>0.0954</td>
<td>5.5759</td>
<td>2.3613</td>
<td>0.0312</td>
</tr>
<tr>
<td>Constant</td>
<td>89.8168</td>
<td>23.4226</td>
<td>14.7043</td>
<td>3.8346</td>
<td>0.0015</td>
</tr>
</tbody>
</table>

Adj. R = 0.9727, Adj. R2 = 0.9569, DW = 2.3064

Note: * means significant at 5% level, ** means at 1% level.

The estimated result is not significant owing to the multicollinearity when the dummy variable of alliance is added. The effects of alliance are not shown explicitly by the estimated equation, but it can be considered that alliance affects demand and supply ratio variable and average ship size variable because the alliance dummy is of great relevance to demand and supply ratio and average ship size.

### 3.4 Influence on freight rate by alliance

The supply and demand ratio variable and average ship size variable are closely related to the change of the freight rate. This section identifies the impacts of the alliance on these two variables based on the estimated freight function (Table 2).

Before the alliance formation, the freight rate was reduced by -28.3 points and -11.2 points by the worsening of the supply and demand balance and large-sized container ships, respectively. It reached a total of -39.5 points. After the alliance formation, the values changed to -11.2 points and -19.9 points respectively, giving a total of -31.1 points.

**Table 2** Impact of alliance on freight rate

<table>
<thead>
<tr>
<th>Year</th>
<th>Demand and supply ratio</th>
<th>Av. ship size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>100.0</td>
<td>1241TEU</td>
</tr>
<tr>
<td>2000</td>
<td>56.4</td>
<td>1829TEU</td>
</tr>
<tr>
<td>2010</td>
<td>39.1</td>
<td>2873TEU</td>
</tr>
</tbody>
</table>

Before: -0.65×43.6-588×0.0191=-39.5

After: -0.65×17.3-1044×0.0191=-31.1

It is evident that the alliance promoted the development of large-sized container
ships. The worsening of the supply and demand balance is caused by overinvestment that is mainly in large-sized container ships, which means that the alliance influences the supply and demand balance. Consequently, it can be concluded that the alliance has had a great effect on reducing the freight rate.

3.5 Profit function of top companies in the world

As shown in figure 5, the profit rate of liner companies is computed from the mean of the revenue profit margin of the top 13~20 liner companies in the world (excluding Japanese liner companies). They are 5.4% in the period of 1990~2010, 6.4% in the period of 1990~2000 and 4.0% in the period of 2001~2010. The slope of the trend line is +0.2% from 1990 to 2000 and it is -1.0% from 2000 to 2010. It is evident that the profit rate after the alliance formation experienced negative growth.

Source: Japan maritime center

Fig. 5 Operating profit margins of top 13~20 liner companies in the world

The basic model of profit function is estimated on the basis of the income variable, the expense variable, and the alliance dummy variable. The following equation is the estimated result which used the revenue growth rate and average ship size as proxy variables of income and cost, respectively (Table 3). The result indicates that every variable is statistically significant at less than 5%. The alliance dummy variable was removed since it is not statistically significant at the 5% level.

Table 3 Profit rate function of world liner companies

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter</th>
<th>SE</th>
<th>F-value</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av.ship size</td>
<td>-0.0042*</td>
<td>0.0015</td>
<td>7.3101</td>
<td>-2.7037</td>
<td>0.0151</td>
</tr>
<tr>
<td>% revenue growth rates of world liner companies</td>
<td>0.3043**</td>
<td>0.0492</td>
<td>38.1896</td>
<td>6.1798</td>
<td>0.0000</td>
</tr>
<tr>
<td>Constant</td>
<td>10.1460</td>
<td>3.1860</td>
<td>10.1411</td>
<td>3.1845</td>
<td>0.0054</td>
</tr>
</tbody>
</table>

Adj.R=0.8342, Adj.RR=0.7279, DW=1.2050

Note:*means significant at 5% level, **means at 1% level.
Revenue growth rate is a statistically significant variable, which means that the profit rate changes in accordance with fluctuations in revenue. Moreover, based on the parameter of the average ship size variable, the effect on the profit rate from the increase of the average ship size from 2000 to 2010 is calculated as follows, \(-0.0042 \times 1044 = -4.38\) showing that the profit rate decreased at an annual average rate of 0.4%.

### 3.6 Profit rate in Japanese liner companies

This section calculates the profit rates of Japanese liner companies based on the profit rate function of the top liner companies in the world. In this estimated equation, as stated above, the relative ratios of the revenue growth rate of NYK and MOL compared with that of the world are both around 0.4 in the period from 1990~2000, 0.7~0.8 in the period from 2000~2010. It improved during the last decade, but still remains below 1. Accordingly, the profit rates of Japanese liner companies are worked out as follows, \(-(1-0.4) \times 0.3 = -0.18\%\) in the period of 1990~2000, and \(-(1-0.7~0.8) \times 0.3 = -0.09 ~0.06\%\) in the period of 2000~2010.

The relative ratios of two Japanese companies to the world average in the average ship size are shown in Table 4. Two Japanese companies developed large-sized ships significantly later than the advanced world levels during 1990s. Large-sized ships have accelerated in development since 2000, but in 2010, the relative ratios were still lower than in 1990.

#### Table 4 Average ship size and its relative ratios of NYK and MOL to the world

<table>
<thead>
<tr>
<th>Year</th>
<th>NYK</th>
<th>MOL</th>
<th>World</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>2036(1.64)</td>
<td>2103(1.69)</td>
<td>1241</td>
<td>828</td>
</tr>
<tr>
<td>2000</td>
<td>2082(1.14)</td>
<td>2180(1.19)</td>
<td>1829</td>
<td>266</td>
</tr>
<tr>
<td>2010</td>
<td>4025(1.40)</td>
<td>3810(1.33)</td>
<td>2873</td>
<td>1045</td>
</tr>
</tbody>
</table>

Note: * Value in parentheses shows relative ratios of NYK and MOL to the World.

** The difference is sum of differences between NYK or MOL and the world.

However, it is certain that the competitive superiority of the two Japanese companies has been established because the average ship sizes are bigger than the world average level. Their cost superiority is established by large-sized container ships, which contributes to the profit rate. Considering only this part, the effect on the profit rate by the ship size of Japanese companies is calculated as follows.

The average differences of ship size between two Japanese companies and the

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7 This means not profit maximization behavior but sale maximization or market share maximization behavior.

8 Management of NYK and MOL has been diversified with liner and bulk shipping sectors. It is difficult to obtain their liner sector’s profit rates. Therefore it has to calculate Japanese companies’ profit rates based on the estimated profit rate function of world liner companies.
world average are respectively 828TEU, 266TEU and 1045TEU in the year 1990, 2000 and 2010. Thereby, the effect on the profit rate is the following. (266-828) \times 0.004 \div 10 = -0.22\% \text{ in the period of 1990~2000}, \text{ and (1045-266) \times 0.004 \div 10 = 0.31\% in the period of 2000~2010.}

Based on the above calculation, from aspects of revenue growth rate and the ship size, the effects of the alliance on the profit rate are minus 0.4\% in the period of 1990~2000 and plus 0.3\% in the period of 2000~2010. Although it is controversial whether worked out values are large enough, at least it can be determined that the profit rates of two Japanese companies have been improved after the alliance formation on the basis of the revenue growth rate and the trend of the average ship size before and after the strategic alliances.

4. CONCLUSION

In order to improve competitiveness and survive in a constantly changing and complex contemporary liner shipping market, more and more businesses change individual activities to strategic alliances. As one of the important objectives of strategic alliances, the profit rates of liner shipping companies have been rarely discussed in the existing literature. This study investigated the effect of alliances on the profit rate in the liner shipping industry by theoretical and empirical analysis. Theoretical analysis is from the aspect of industrial organization and Porter’s five forces framework. On the other hand, the profit rates of two Japanese shipping companies, NYK and MOL which belong to different alliances groups are analyzed empirically.

Alliances pulled down the freight rate, which is not caused by changing the market concentration, but by the worsening of the supply and demand balance and reducing costs by the development of large-sized ships. In a certain sense, it can be considered that the alliance intensified the oligopolistic competition in the liner shipping market, thus pulling down the freight rate. The improvement of market concentration in the aspect of shipping tonnage is negligible compared with the influence of intensified competition. This means that the liner shipping freight is not easily explained by traditional industrial organization theory.

Like in freight function, the average ship size as an explanation variable is included in estimated profit function. Moreover, revenue growth rate affects profit rate, which shows that marketing competition is revenue maximization action, not profit maximization action in the liner shipping market. Especially, the pursuit of revenue maximization is strengthened after the alliance formation.

Based on estimated profit function, the improvement of profit rates by alliance in Japanese liner shipping companies is determined by the development of large-sized ships and revenue growth. The revenue growth can be considered beneficial to the improvement of competitiveness of Japanese liner shipping companies. However,
the growth of Japanese liner shipping companies presents mainly in cross market. Generally, the competitiveness is indispensable to growth in cross markets, but in Japanese liner shipping companies, business relations with shippers is a significant factor of growth in the cross market. In addition, revenue growth rates are different among Japanese liner shipping companies. NYK has advantages in cost differentiation and service differentiation, but its growth rate is lower than that of MOL. The result is caused by a different strategy called low freight strategy.

The study contributes to providing evidence for the effect of the alliance on the profit rate in the liner shipping industry. However, this empirical study only focuses on two Japanese shipping companies. In order to confirm these results, the scope of the empirical study requires further investigation.

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