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Title(English)	Port cooperation for competition in international maritime network
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Outline

The number of container ports that cooperate to improve port productivity or profitability has been increasing. Various types of port cooperation have different business scopes, such as terminal management and port access. For these cooperation types, the motivations are divided into two types based on the market in cooperation: regional welfare or competition. The main objective of this study is to reveal the effectiveness of port cooperation in competition with a strong competitor. This study analyzes the cooperation for competition from three perspectives; evaluation of current cooperation in Kobe and Osaka ports in Japan, port choice by the shipper on the demand side, and network design by the shipping line on the supply side.

First, this study evaluates the impact of port cooperation on a port hierarchy based on network analysis. Specifically, this study analyzes the cooperation between Kobe and Osaka ports (Hanshin port) in the Japanese cargo network compared to a strong competitor, the Busan port (Korea). The network is built based on Japanese cargo in 2008 and 2018 because the cooperative strategy for Kobe and Osaka ports was designed in 2010. As for the cargo in 2018, this study prepares two networks: without and with a synergistic effect called 2018 (Base) and 2018 (Coop), respectively. The comparison between 2008 and 2018 (Base) indicates the impact of current port cooperation on the network. The comparison between 2008 and 2018 (Base) indicates the expected impact of port cooperation in the network. This study finds that the current cooperative strategy did not realize the higher connectivity of Hanshin port than Busan port. The comparison between 2018 (Base) and 2018 (Coop) indicates whether building cooperative relationships contribute to a higher position in the port hierarchy and affects the network configuration, such as creating a higher interconnection of ports as a community structure.

Secondly, this study simulates the effective cooperative strategy of ports for competition with two simulations considering the relationship between port and shipper as the demand side. This study analyzes the three ports competing or cooperating in a linear city where shippers are uniformly distributed in the first simulation. The first simulation derives and compares the cooperative effort as cooperation level, which indicates the willingness to participate in port cooperation as optimum cooperation to fit each motivation that includes cooperation for regional welfare and competition. The focus market differentiates the motivations in the simulation. The optimum cooperation levels for regional welfare and competition are different because of the difference in the cooperation effects in each motivation. Additionally, this study develops the bi-level optimization model with three equilibriums to reveal the more detailed cooperative strategies in the second simulation. This study applies the model to a case study of the competition between Hanshin and Busan ports. Optimum cooperation type changes depending on the focusing market. Specifically, cooperation to reduce the shipping time is effective for Hanshin port to compete with Busan port in North American cargo.

Third, this study simulates the effective cooperative strategy of the port for competition, considering the relationship between the port and shipping line on the supply side. This study solves the liner shipping

network designing problem, defined as the task of designing a set of weekly services, assigning vessels to the services, and flowing the demand through the resulting network. The answer to the problem indicates the deployment of shipping services to two hundred-one ports worldwide. This study analyzes the impact of five scenarios about cooperation between Kobe and Osaka ports as Hanshin port. This study obtains the following two findings. First, port cooperation is an effective strategy for competition in terms of increasing centrality in the shipping network. Second, port cooperation influences ports other than cooperative ports, and the impacts are different depending on the ports and scenarios. Specifically, although Hanshin port can obtain enough competitiveness to compete with Busan port as a strong competitor, Hong Kong port, as another strong competitor, increase the centrality in the network.

The findings in this dissertation conclude that cooperation contributes to the increase of competitiveness of cooperative ports. However, the competitiveness is weaker than the strong competitor. Cooperation is a trigger to increase competitiveness. An additional strategy to continuously increase the competitiveness for stronger competitiveness than a competitor, which is not necessarily port cooperation, is needed.

Some findings of this dissertation might have policy implications. The results related to network analysis of Kobe and Osaka ports in the Japanese cargo network indicate that low synergistic cooperation cannot realize higher competitiveness than a strong competitor. The results related to the relationship between ports and shippers indicate the importance of considering the port situation and focusing market to realize the optimum cooperative strategy for competition. The results related to the relationship between ports and shipping line indicate that although cooperation can obtain competitiveness enough to compete with a strong competitor, another strong competitor occur with the port cooperation. This dissertation has significant contributions through policy suggestions for cooperation for competition.