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Impact of the Carat Canal on the evolution of hub ports under China's Belt and Road initiative

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ABSTRACT

Under China's Belt and Road (B&R) initiative, Carat Canal, a potential new channel of the Century Maritime Silk Road, will have a great impact on the shipping networks and the evolution of hub ports. A modified gravity prediction model with entropy maximizing principle is developed to calculate the changes in transshipment traffic. Taking account both customer preferences and spatial interaction, numerical experiments show that the opening of the Carat Canal shifts traffic volumes from the Malacca Strait, influences transshipment market shares among hub ports, and diversifies shipping network pattern. This study serves as a reference for hub port development along the Maritime Silk Road.

1. Introduction

The liner shipping route through the Strait of Malacca is the most common shipping route from East Asia to Europe, and the Strait of Malacca is also an important node of the global shipping network because of its advantageous geographical location. However, maritime transportation is beset by poor natural conditions and potential safety hazards. In the context of the construction of the "21st Century Maritime Silk Road" proposed by China under its Belt and Road initiative, Asian and European countries are closely connected by the Maritime Silk Road and the Carat Canal would provide valuable strategies and opportunities for market participants (Sun, 2014). The Carat Canal traverses the Kra Isthmus in southern Thailand, known as the "Oriental Panama Canal," and connects the Gulf of Thailand to the Andaman Sea. Compared with the existing main route through the Strait of Malacca, the Carat Canal, shown in Fig. 1, shortens the average shipping distance about 1200 km between regional ports on the West and the East side of Thailand. As a consequence, the Carat Canal route would become an attractive "Golden Waterway."

The opening of the Carat Canal directly shortens the shipping distance between ports in Europe and East Asia, which contributes to time and cost saving for shippers. Major changes in the liner shipping network would also take place, and accessibility and connectivity would increase. Thus, this new shipping route alternative would become more and more attractive to shipping carriers, and the changing market share of regional hub ports affects the port status, which is reflected by hub

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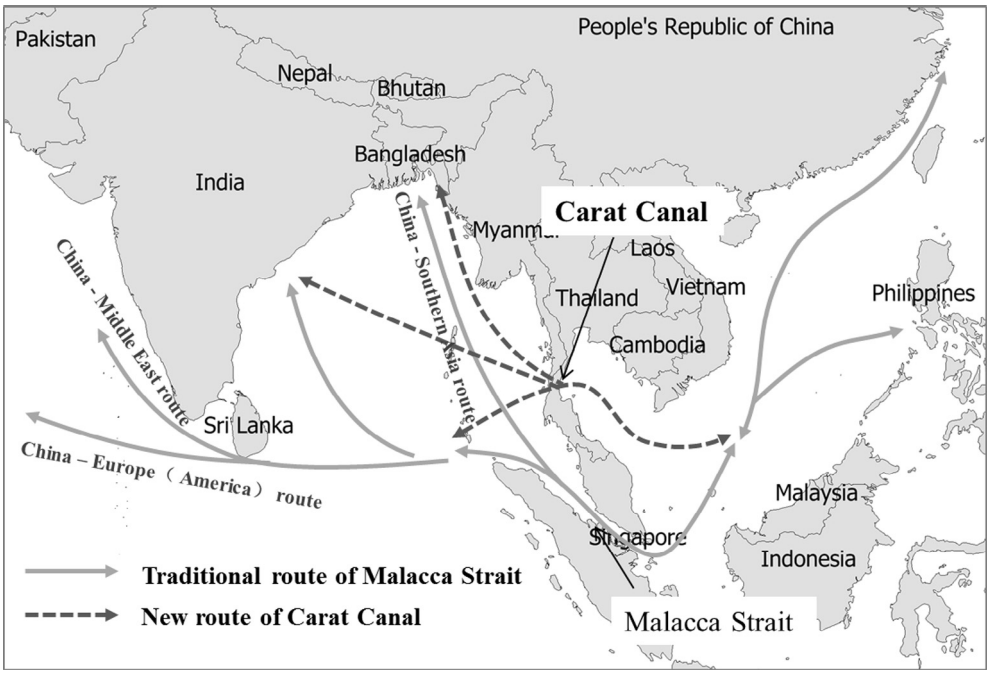

Fig. 1. Changes of routes in case of the opening of Carat Canal.

dimensions. Herein, to study the impact of the Carat Canal on the evolution of hub ports, hub ports along the Carat Canal are selected as research objects. The evolution of hub ports in Southeast Asia and East Asia are analyzed by comparing transit-trade market share before and after the opening of the Carat Canal.

The first contribution of this research is to provide suggestions to understand the impacts of such a possible new facility (Carat Canal) on the maritime system, such as hub port performance, port competition and shipping network. Second, it provides a theoretical foundation using port selection criteria for shipping operators and spatial interaction between competing ports, which helps to understand the spatial layout of potential regional hub ports and preferences of carriers in different developmental stages of the canal construction. Third, it proposes a bi-dimensional evaluation method for hub ports, which helps to understand the performance of hub ports by external traffic generation and connectivity.

The remainder of this article is organized as follows. A literature review on inter-port competition and shipping route selection is provided in Section 2. In Section 3, a theoretical model framework is developed, including an improved prediction model based on spatial interaction and a hub evaluation model. Section 4 presents the prediction results and the evaluation of port competitiveness. Conclusions are given in Section 5.

2. Literature review

In shipping services, ports connect the demand side, shippers, and the supply side, carriers. Indeed, ports are focal points in the international shipping network and directly relate to routes and transportation time (Robinson, 2002; Yap and Notteboom, 2011; Du et al., 2017). With port infrastructure construction and improvements in service quality, multiple routing options for inter-regional shipping demand have developed in recent years (Veldman and Bückmann, 2003). It is worth noting that port competitiveness interacts with the port selection decision of shippers and carriers. On the one hand, port authorities take measures to address major customer requirements. On the other hand, customers, including shippers and carriers, might make port choice decisions according to their own criteria.

There have been many studies that have focused on inter-port competition and the factors that affect competitive relationships and shipping network. Bae et al. (2013) and Ishii et al. (2013) analyzed inter-port competition under a non-cooperative game model. Wan et al. (2013) showed that urban road congestion directly affects hub port competition with econometric models, while Czerny et al. (2014) considered the effect of port privatization. Wang (2017) examines how to incorporate the inventory costs of containerized cargoes into existing liner service planning models. Yang and Wang (2017) develops an optimization model for bulk-shipping network.

Moreover, changes in market circumstances, such as new investment and institutional policies, are consolidating the dominant status of ports and changing transshipment port choices of shippers, thus container cargo flows will likely be improved further (Wilmsmeier et al., 2014; Vermeiren and Macharis, 2016). Port authority plays an increasingly important role in the changes of market environment. Martínez and Feo (2016) reviewed the port choice literature and pointed out that

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