



The equilibria of port investment in a multi-port region in China



Jiannan Cheng¹, Zhongzhen Yang*

Transportation Management College, Dalian Maritime University, Dalian, China

ARTICLE INFO

Article history:

Received 6 September 2016

Received in revised form 24 May 2017

Accepted 3 June 2017

Keywords:

Multi-port region

Port investment

Nash equilibrium

Investment revenue function

Strategy space

ABSTRACT

The port investment equilibria in a multi-port region in China are analysed. We present two models corresponding to two scenarios: port competition when port companies invest in port capacity for profit and port competition when port cities invest in port capacity for local GDP. It is verified that the profit-oriented investment in a multi-port region may reach Nash equilibrium, while the GDP-oriented investment cannot reach Nash equilibrium. The results of the case study show that the GDP-oriented investment is much greater than the profit-oriented investment. When the investment capacities of port cities are approximately the same, all port cities will actively invest in their ports, and a city's higher average investment return may decrease its willingness to invest in its ports.

© 2017 Elsevier Ltd. All rights reserved.

1. Background

As a key point in logistics systems and a transshipment interface between water transport and other modes, ports attract large flows of cargo, passengers, funds and information. At inbound, outbound and stored flow locations, industrial clusters of port logistics come into being, and much employment is created. Through economic multiplier effects, ports have become an engine to pull and push regional social-economic development. As a result of the spillover effects from port logistics industries, many port cities have become shipping, logistics, trade or even finance centres. Because ports and port logistics industries can raise the locational advantage of port cities, manufacturing industries increasingly tend to be located in port cities (Chang et al., 2014). This phenomenon can be observed more often in developing counties, where manufacturing products are the main exported commodities. The two effects multiply to cause the rapid growth of port cities.

Currently, almost all port cities in China are regional economic and industrial centres. For the past 20 years, port cities have emphasized port development and the construction of shipping, logistics, financial and trading centres. From 2000 to 2015, because of rapid economic growth, investments in port and inland navigation channels increased by 34.4% annually in China. The number of port terminals along the coastline increased by a factor of three. "Booming city through port development" became the strategy for port cities to develop their social economies.

Although port expansion can encourage port development, large-scale port construction has also induced some negative impacts, such as overcapacity. Currently, the 18 key coastal ports in mainland China occupy 2251 km of coastal line, and the through capacity is 16 billion tons, while in 2015, the realized throughput was only 9 billion tons (State Oceanic Administration, 2015). According to statistics, the capacities of 21 ports are greater than demand, including 7 ports with huge overcapacity (China Transportation Paper, 2010). The second negative effect of over investment in ports is that port terminals are occupying an excessive amount of shoreline resources and reducing the coastal resources necessary for the

* Corresponding author.

E-mail address: yangzz@dlmu.edu.cn (Z. Yang).

¹ Collaborative Innovation Center for Transport Studies of Dalian Maritime University.

fishery industry and tourism, and the ecological condition has worsened. Furthermore, overinvestment has enlarged the asset liability ratio. For instance, the asset liability ratio of Dalian port increased from 36% in 2007 to 46% in 2015, and the ratio of Tianjin port rose from 37% in 2005 to 46% in 2015 ([China Ocean News, 2010](#)).

In fact, port demand and investment capacity have upper bounds, and port investment returns change depending on port cities' conditions. Thus, it is necessary to accurately forecast the port demand and investment return. It is also necessary to analyse the investing behaviours of rival ports and the investment equilibrium based on economic and industrial attributes. Here, we study the equilibrium of port investment in a multi-port region by distinguishing two types of investments: investment by the government of the port city and investment by the port company.

It is rational to assume that the port investment behaviour depends on the capacities and objectives of the investors, while the capacities and objectives differ in different port governance situations. To illustrate the over-investment in ports in a scenario in which the Chinese local government (through its owned port companies) is the decision maker regarding port planning, port construction and port business operation, we construct game models to simulate the competitive investments of the local governments and the port enterprises. In the models, the local governments pursue GDP growth when investing in ports, while the port enterprises tend to maximize their business profits.

2. Literature review

The studies on port competition can be classified into two categories distinguished by intra-port competition between terminal operators within a single container port and inter-port competition between operators/authorities in neighbouring ports ([De Borger et al., 2008](#); [Li and Oh, 2010](#); [Luo et al., 2012](#); [Ishii et al., 2013](#)). As [Talley \(2009\)](#) notes, the means of competing with other ports is improving port competitiveness. In the current literature, it is widely believed that retaining a lower port charge plays a crucial role in retaining a competitive edge in terms of short-term inter-port competition ([Ishii et al., 2013](#)). Furthermore, expanding port capacity will improve port competitiveness in long-term inter-port competition ([Talley, 2009](#)). Therefore, port pricing and capacity management have become the two main research directions. Our study is in the direction of capacity management.

There are numerous studies of port investment and expansion. Most have studied the investment amount or timing in terms of port capacity management based on game theory (e.g., [Veldman and Bückmann, 2003](#); [Chen et al., 2016](#)) or the programming model (e.g., [Devanney and Tan, 1975](#); [Noritake and Kimura, 1983](#); [Allahviranloo and Afandizadeh, 2008](#)). In these studies, the assumed purpose of port investment is to maximize the port companies' profit, with less attention on the fact that, in the real world, the purposes differ under different port governances, and thus the investment equilibrium changes accordingly. Moreover, for building the models, various assumptions and simplifications are used that limit their direct application in the real world.

Subsequent papers have explained the impacts of port ownership or governance on port investment and employed case studies. [Qiu \(2008\)](#) surveyed seaport ownership in China and observed that port localization in China accelerated its expansion. [Zheng and Negenborn \(2014\)](#) performed a comparative study of two types of port regulation modes, centralized and decentralized, and found that inter-competition under decentralization may result in larger port capacity. [Xiao et al. \(2012\)](#) developed optimal investment and pricing models for the three types of port ownership and governance systems and analysed the implications of the reform of port ownership on port service level and social welfare.

[Takahashi \(2004\)](#) studied the competition among governments that make decisions on investments in their public facilities considering local welfare. He found that the situation has an infinite number of equilibria associated with city size and investment cost. [De Borger et al. \(2008\)](#) held the view that local governments consider self-welfare only when making decisions on port capacity and the hinterland transport network. [Wu et al. \(2016\)](#) compared the upper bound of port investment by a government and port company and analysed specific situations based on the competition between the ports of Dalian and Yingkou, without examining the general final investment state. [Zheng and Negenborn \(2016\)](#) studied the optimal tariffs, port capacities and port efficiency under dual port regulation schemes in which central government and local government act either simultaneously or sequentially.

This paper contributes to the problem of port investment and pricing in the following ways:

The existing literature usually suppose that the relationship between the served cargos and port capacity is linear. However, if we consider the detailed attributes of the shipping network, port location and hinterland demand, a linear function cannot describe the relationship between port supply and real demand. Accordingly, we build a non-linear demand function that considers both competition and capacity and then construct an investment utility functions based on actual data, thus increasing the applicability of our model.

To illustrate the differences in investing behaviours between the two types of investors, we establish models to highlight and describe their behaviours. Additionally, we not only study the issue of investment amount but also emphasize investing effectiveness, i.e., whether to invest in port industry. We determine the decision space in which the government of a port city is willing to invest in its port and then use a mathematical model to describe the space and further prove that there is a pure Nash equilibrium solution. Finally, a solution method for the model is given under different situations.

In most previous studies, only two players exist in the game. Here, we address a more general case in which multiple investors compete. Although the increment of game players increases the complexity of the model, the model better addresses the actual case of a multi-port region. Moreover, few existing studies have addressed the precise determination

Download English Version:

<https://daneshyari.com/en/article/5110374>

Download Persian Version:

<https://daneshyari.com/article/5110374>

[Daneshyari.com](https://daneshyari.com)