Transportation Research Part E 69 (2014) 21–40

Contents lists available at ScienceDirect

Transportation Research Part E

journal homepage: www.elsevier.com/locate/tre

Centralization or decentralization: A comparative analysis of port regulation modes

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ARTICLE INFO

Article history:
Received 11 October 2013
Received in revised form 9 May 2014
Accepted 26 May 2014

Keywords:
Port regulation
Centralization
Decentralization
Asymmetric information
Bi-dimensional adverse selection
Dynamic games

ABSTRACT

This paper studies the comparison of two kinds of port regulation modes – the centralization mode and the decentralization mode – using principal-agent theory and dynamic game theory. The optimal tariffs, port capacities and port efficiency levels under these two regulation modes are determined. The theoretical results are applied to the container terminals in Port of Shanghai in China. Sensitivity analysis and comparative studies show that the tariff, port efficiency level, port service demand and social welfare are higher under the decentralization mode, while the impact to port capacity and port operator's profit with different port regulation modes is uncertain.

1. Introduction

As the interface between land and water transport, ports play a crucial role not only in transportation networks, but also in economical development. The monopoly status of ports in a given region makes it necessary for governments to regulate them, or to allow for competition between public and private terminals. However, the relationship between port and government has changed significantly since the 1980s. Decentralization, as one type of devolution, becomes more and more popular in port regulation (Brooks and Cullinane, 2007). Now port regulation modes in the world are diverse including centralization modes (e.g., Canada, Turkey), decentralization modes (e.g., USA, China, Australia, Italy, The Netherlands, Belgium) and mixed modes (e.g., South Korea, Japan). Some countries have experienced modes changing from centralization to decentralization, such as China and Australia.

It is the question under what circumstances which type of mode is most beneficial. In this paper we use port reform experiences in China to describe the different features of the two modes. This enables us to quantify the characteristics of port regulation modes. As Qiu (2008) mentions, the Ministry of Communication (MOC) in China controlled 38 major ports before 1984. This period is called the centralization stage in the history of China's port development. An important feature of this centralization system is the financial agreement between ports and MOC. MOC controlled all businesses in ports and ports acted according to plans regulated by MOC. All port revenues went to MOC. Meanwhile, MOC allocated investments to every port through a separate financial arrangement. However, port plans made by MOC were not appropriate and even outdated sometimes, because of the difficulty to collect information of every port in such a huge and diverse country. After the transitional semi-decentralization stage from 1987 to 2001, MOC decentralized all ports to municipal governments since

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http://dx.doi.org/10.1016/j.tre.2014.05.013
1366-5545/

the end of 2001. With the increasing demand for investments in port capacity expansion, funding from the government, state-owned companies, private and overseas corporations diversified port ownership. Co-existence of public and private terminals in one port is now common. Table 1 summarizes the characteristics of the two port regulation modes. The relations between the regulators and the port operators in both port regulation modes are illustrated in Figs. 1 and 2.

The comparison between the two port regulation modes has been studied extensively. Although several arguments have been used to support the decentralization mode (see, e.g., Cullinane, 2002; Estache et al., 2002, 2004; Qiu, 2008), most comparison results are uncertain. According to China's experience, decentralization raises huge funds for rapid port infrastructure expansion and enhances the industry efficiency, but causes sharp imbalances between container terminals and other types of terminals and excess capacities on container terminals at the same time (Cullinane and Wang, 2007). Investments in container ports by local governments are expected to increase annually irrespective of possible future excess. As the result of uncoordinated devolved municipal decision-making, container port construction has exploded, especially in the Yangtze Delta and the Pearl River Delta areas. The above issues are sometimes treated as the drawbacks of the decentralization reform in 2011 and therefore, cause opposition against the decentralization regulation mode in the Chinese port industry. Systematic studies on port centralization and decentralization modes and the comparison of their impacts on the national port industry are therefore necessary, especially using formal quantitative models. The aim of this paper is to set up models that quantify the port regulation modes, and that provide optimal tariffs, and capacities and efficiency levels under the centralization mode and the decentralization mode. Our models can subsequently be used to evaluate the impacts of the port regulation modes on port industry.

The rest of this paper is organized as follows. In Section 2 we provide a literature review and point out the contributions of our work. In Section 3, we present the basics of the model proposed. In Section 4 and 5, we study the centralization and decentralization regulation modes, and determine the optimal regulated tariffs, capacities and efficiency levels under these two modes respectively. In Section 6, we apply our model to the Port of Shanghai in China. Finally, conclusions and directions for future research are summarized in Section 7.

2. Literature review

There are numerous studies on port regulation or governance, especially focusing on port reform and devolution. Brooks (2004),Brooks and Cullinane (2007), Brooks and Pallis (2008),Baltazar and Brooks (2007) examine port governance structures, frameworks and models in detail. Wang et al. (2004) discuss the port governance policies and practices in China. Defilippi and Flor (2008) use Matarani Port in Peru as a case study to analyze the rationale of the regulatory framework of the Peruvian transport infrastructure. Qiu (2008) makes a comprehensive survey on coastal port reforms in China and summarizes its three experienced stages: Centralization, semi-decentralization and decentralization. Sauri and Robuste (2012) define a regulation tool with incentive mechanism characteristic to encourage a private terminal operator and a stevedore company to reduce tariffs and increase terminal's productivity.

Most studies on port pricing and capacity decisions are for a single decision maker. Bennathan and Walters (1979) propose a port pricing and investment formula taking into account profit maximization and social welfare maximization. Talley (1994) proposes the "cost axiomatic approach" for port pricing with consideration of both efficiency and fairness based on the Aumann-Shapley pricing mechanism of cooperative game theory. Holguin-Veras and Jara-Diaz (1999) use price differentiation theory to determine the optimal space allocation and pricing for priority systems in container ports. Bergantino and Coppejans (2000) use Samuelson formula to present a port pricing mechanism for allocating common maritime infrastructure cost. Strandenes and Marlow (2000) discuss how changing port pricing influences port competitiveness. They propose that port pricing strategies should give incentives to increase port efficiency. Jansson and Shneerson (1982) and Noritake and Kimura (1983) determine the optimal berth number and investments in a seaport using queuing theory. Allahviranloo and Afandizadeh (2008) examine the optimal port investment criteria by fuzzy integer programming. Luo et al. (2012) examine the necessary condition for a port to make its capacity expansion decision. On these studies, few of them consider information asymmetry among the different players.

Table 1
Characteristics of port centralization and decentralization regulation modes.

Regulation mode	Centralization mode	Decentralization mode
Regulator	Central government	Local government
Regulation measures	Central government makes regulation contract with port operator and usually has strong power to enforce direct control	Local government has an indirect impact on port operator's behavior via competition between the public terminals he controls and private terminals
Information	Central government has poor information on port operator's cost and operation efficiency	Local government has better information on port operator's cost and operation efficiency because he takes part in the operation of public terminals
Revenue	All revenue should be turned over to the central government	Private terminal operator can keep her profit, and just pays rental fees to the local government
Transfer payment	Port operator gets transfer payment from central government	Private terminal operator cannot get any transfer payment