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Optimal concession contracts for landlord port authorities to maximize fee revenues with minimal throughput requirements

Shi-Miin Liu [a], Hsiao-Chi Chen [a,*], Wenqing Han [b], Yen-Hung Lin [a]

[a] Department of Economics at National Taipei University, New Taipei City 23741, Taiwan, Republic of China
[b] Jinhe Center for Economic Research at Xi-An Jiaotong University, China

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ABSTRACT

This paper investigates optimal concession contracts offered by a landlord port authority to competing terminal operators given minimum throughput requirements. Three contract types considered are fixed-fee, unit-fee, and two-part tariff. We find that the unit-fee contract is always the best, and the port authority becomes better off by imposing minimum throughput requirements. These results remain true when demands for and/or costs of port's services are uncertain, when terminal operators compete in service prices, when operators' congestion costs are considered under specific conditions, when dissimilar contracts are offered to different operators, or when there are more than two operators.

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1. Introduction

Facing the fast changing environments in the world economy and various global and regional issues during the past few decades, many port authorities especially in Europe and Asia have adjusted their roles from directly providing cargo-handling services, investing in terminal equipment, and hiring dock labor to the landlords.[1] Landlord port authorities retain the control and ownership of the port organizations, but can provide ports' services together with private sectors. For instance, landlord port authorities lease their facilities, lands, managing jobs, and/or terminals to private companies. These changes allow port authorities to cope with competitive market conditions more efficiently and effectively. However, whether the role shifts really benefit them will crucially depend on the design of the concession contracts. Thus, it is important to investigate optimal concession contracts for landlord port authorities.

Among the recent studies on optimal concession contracts for port authorities, such as Saeed and Larsen (2010a), Cruz and Marques (2012), Chen and Liu (2014, 2015) and Chen et al. (2017), none of them considers an often observed real-world phenomenon. That is, the clause about minimum throughput requirements is included in more than 90% of the concession contracts offered by landlord port authorities in Europe, as surveyed by Notteboom and Verhoeven (2010) and Notteboom et al. (2012). Similar requirements are also seen in concession contracts of non-Europe ports. For instance, according to the report of Traffic World in 2006, the port authority of Virginia expects the CMA CGM group to surpass its minimum throughput requirement of 55,000 containers. Moreover, the port authority of New York and New Jersey asks

* Corresponding author.
E-mail address: hchen@mail.ntpu.edu.tw (H.-C. Chen).

[1] As documented by Notteboom and Winkelmans (2001), the port authorities in continental Europe including Spain, Portugal, Italy, and Belgium are landlords. The ports of Los Angeles, New York, and Portland in the US, and the ports of Busan, Kaohsiung, Parkistan, and Singapore in Asia are landlords as well.

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the Maher terminal operator to load and unload at least 420,000 containers annually.[2] Imposing the minimum throughput guarantees can enhance the use and productivity of the lands around the ports, raise employment in port areas, and stimulate economic growth in ports' hinterlands. Thus, allowing port authorities to consider the minimum throughput requirements when designing their concession contracts is meaningful and practical. Nevertheless, little theoretical work takes this important factor into account, and investigates how it affects the contract choices of port authorities. Thus, this paper aims to investigate this issue.

A two-stage game is constructed to characterize the interactions between a landlord port authority and two terminal operators.[3] In the first stage of the game, the port authority announces a contract and the minimum throughput requirement to maximize its fee revenues.[4] Then, given the contract and the minimum throughput requirement, two terminal operators choose the cargo-handling amounts to maximize their profits independently and simultaneously in the second stage of the game. We use the subgame perfect Nash equilibria to represent optimal behaviors of the port authority and two terminal operators. As in Saeed and Larsen (2010a), Chen and Liu (2014, 2015), Chen et al. (2017), we consider the two-part tariff, the unit-fee, and the fixed-fee charging schemes in our model.[5]

Our set-up is quite suitable for port authorities mainly governed by international management companies.[6] For these private companies, ports' fee revenues are their major concerns. To successfully renew or extend their leases with (local) governments to operate ports, these firms also have strong incentive to promote the economy around the port areas by increasing throughput of the harbor. Even the ports are managed by (local) governments, their authorities need to consider the profitability and the throughput simultaneously to generate enough funds to maintain ports' sustainable growth.[7]

Our results show that the unit-fee scheme is always the best for the authority whatever operators' marginal service costs and their service differentiation levels are. This differs from Chen and Liu's (2014) and Chen et al.'s (2017) results of the two-part tariff contract when the less efficient operator's marginal service costs are small, and the unit-fee contract when the opposite occurs. We further discover that if the minimum throughput is required, the port authority will not become worse off. Moreover, our results remain true when demands for and/or costs of port's services are uncertain, when operators compete in service prices, when operators' congestion costs are considered with specific conditions on operators' marginal congestion and service costs, when dissimilar contracts are offered to different operators, or when there are more than two operators. Thus, port authorities can refer to our findings to choose their best contracts under the minimum throughput requirements.

The rest of this paper is organized as follows. Section 2 reviews relevant literature. Section 3 presents the model. Optimal behaviors of the terminal operators are derived in Section 4, and optimal concession contracts are obtained in Section 5. Properties of the optimal concession contracts are explored in Section 6. Extensions of our model are demonstrated in Section 7. Finally, conclusions and policy implications are drawn in Section 8. All the proofs can be found in the Appendix at web-site http://web.ntpu.edu.tw/∼hchen/.

2. Literature review

The relationships between this study and relevant literature are as follows. Trujillo and Nombela (2000) provide a formal definition for concession contracts, which include payments, obligations, and risk allocations between port authorities and their terminal operators. However, we only focus on contracts' payment parts. De Monie (2005) specifies three types of concession contracts according to ports' traffic volumes. Our unit-fee and fixed-fee contracts are special cases of De Monie's (2005). Button (1979), Jansson and Ryden (1979), and Strandenes and Marlow (2000) all urge port authorities using two-part tariff schemes to charge their users. They also describe how unit-fee and fixed-fee rates in the two-part tariff schemes should be determined. On the other hand, Ferrari and Basta (2009) show that two-part tariff contracts are not efficient because of not adjusting with the consumer price index. Different from these four works, our issue is whether the two-part tariff scheme is optimal for landlord port authorities when they try to maximize fee revenues under minimum throughput guarantees. On the other hand, Marques and Fonseca (2010) propose several indicators to measure the performance of Portuguese seaports' regulation, while Cruz and Marques (2012) investigate the risk-sharing of several Portuguese concession contracts. Parola et al. (2012) discuss how concession fees are affected by the throughput, cargo types, and passenger

[2] Please see the United States Court of Appeals for the Third Circuit, No. 14-3626, 2015.

[3] To our knowledge, many landlord ports have more than one terminal operator. For instance, Busan port has four, New Busan port has five, Karachi port in Pakistan has three, port of Seattle has four, port of New Jersey has three, and port of Rotterdam has more than four terminal operators. Moreover, our results remain true when more than two terminal operators exist as shown in Section 7.5.

[4] It is natural and plausible for landlord port authorities to offer optimal fee charging schemes to their competing tenants, such as ports in Parkisten (see Saeed and Larsen, 2010a). In addition, since the port of Los Angeles has no support from government's tax revenue, its incomes mainly come from the tenants.

[5] Ferrari and Basta (2009) point out that the port authorities in Italy often use unit-fee contracts. Saeed and Larsen (2010a) discloses that different concession contracts are adopted in various regions of Pakistan. For instance, the Karachi port authority collects fixed fees from its terminal operators, the port authority in Muhammad Bin Qasim charges unit fees for terminal operators handling a cargo amount more than 150,000 TEUs, and the Gwadar port authority usually employs a two-part tariff contract. Moreover, to the authors' knowledge, most port authorities in China choose unit-fee contracts.

[6] For instance, the authorities of Hong Kong port in China, Jebel Ali port in Dubai, Kelang port in Malaysia, Tanjung Pelepas port in Malaysia, and Tanjun Priok port in Indonesia are principally run by private international management companies, while the Singapore port is operated by its government and some private company together.

[7] For instance, the authorities of Shanghai port and Shenzhen port in China, Kaohsiung port in Taiwan, Hamburg port in Germany, Keihin port in Japan, and Los Angeles port and New Jersey port in USA are mainly managed by (local) governments.

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