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## Measuring the Perceived Leasing Price of Empty Container in Shipping System

Hao Hu

*University of Wollongong, hh502@uowmail.edu.au*

Bo Du

*University of Wollongong, bdu@uow.edu.au*

Mehrdad Amirghasemi

*University of Wollongong, mehrdad@uow.edu.au*

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# Measuring the Perceived Leasing Price of Empty Container in Shipping System

## Abstract

The container shipping activity has increased significantly with the growth of world economy and global trade. However, due to the imbalance of global trade, there is always an imbalance between import and export containers, which results in that some ports have a surplus of empty containers while the others have a deficit. At a surplus port, storage cost and repositioning cost for shipping companies increase inevitably; while at a deficit port, shipping companies have to lease or purchase empty containers to meet customers' demand. Empty container repositioning is one of the most effective ways to solve such imbalance problem, however the repositioning cost has increased from \$11 billion in 2003 to \$16 billion in 2012. To reduce the related expense for container repositioning, a significant body of studies have been done on container fleet management, and most of them considered the price of leasing empty container given as input parameters. However, leasing price plays an important role as a variable in the decision of container leasing activities by shipping companies...

## Keywords

container, perceived, shipping, system, leasing, price, empty, measuring

## Disciplines

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# Measuring the perceived leasing price of empty container in shipping system

H. Hu, B. Du and M. Amirghasemi

*SMART Infrastructure Facility, University of Wollongong, NSW, Australia,  
Email: [bdu@uow.edu.au](mailto:bdu@uow.edu.au)*

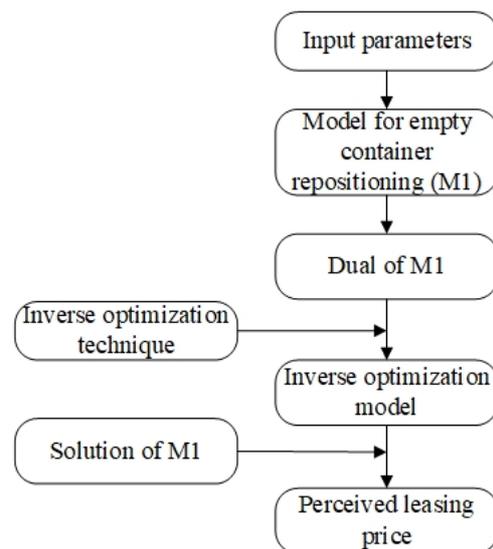
**Abstract:** The container shipping activity has increased significantly with the growth of world economy and global trade. However, due to the imbalance of global trade, there is always an imbalance between import and export containers, which results in that some ports have a surplus of empty containers while the others have a deficit. At a surplus port, storage cost and repositioning cost for shipping companies increase inevitably; while at a deficit port, shipping companies have to lease or purchase empty containers to meet customers' demand. Empty container repositioning is one of the most effective ways to solve such imbalance problem, however the repositioning cost has increased from \$11 billion in 2003 to \$16 billion in 2012. To reduce the related expense for container repositioning, a significant body of studies have been done on container fleet management, and most of them considered the price of leasing empty container given as input parameters. However, leasing price plays an important role as a variable in the decision of container leasing activities by shipping companies.

Container leasing was often ignored to simplify the models, and to our best knowledge, only a few researches have measured the perceived container leasing price considering owned containers or long-term leasing only. Moreover, the process of delivering containers to consignors and consignees was often ignored. To fill in the gap, this study aims to measure the time-varying perceived leasing-in price taking both long-term and short-term leasing activities into account. It is assumed that long-term leased-in container will be treated as owned container and for short-term leasing, and containers would be returned to lessor at designated port after emptied.

The process of measuring the perceived leasing prices is described in terms of the formulation of models, as shown in Figure 1. Firstly, considering the turn-around time of containers in inland transportation, a model with the objective to minimize the relevant cost for empty container repositioning and cargo routing is formulated. The constraints ensure leased-in empty containers and laden containers must be transported to the destination and describe the flow balancing of containers on vessels and the change of empty container inventory at ports. Based on the initial model, the solution without leasing activities can be obtained and its dual model can be derived. It is assumed that the original leasing price is sufficiently small negative so that by following inverse optimization technique the objective of inverse optimization model can be described as minimizing the adjustments of original leasing prices to make the solution without leasing activities be the optimal solution. Then according to the primal-dual complementary slackness conditions, the inverse optimization model for measuring the perceived leasing prices is built. Based on the solution of inverse optimization model, for liner carriers, it is economic to lease in empty containers when realistic leasing price is lower than perceived leasing prices and it is better to reposition empty containers when realistic leasing price is higher.

A real-world shipping network with four routes connecting Asia and West Coast of North America was employed to measure the perceived leasing price. By comparing the perceived short-term prices between ports along different routes, we found that the perceived leasing price at a deficit port was various for different routes and it was related to the schedule of vessels deployed along the routes. Compared to the fixed perceived leasing price, time-varying perceived leasing price was more practical since it changed with the inventories at both original and designated ports.

**Keywords:** *Empty container repositioning, perceived leasing price, inverse optimization*



**Figure 1.** The process of measuring the perceived leasing prices