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## The productive efficiency of ports: Lessons from the Pacific Rim Seaport's

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**Working Paper 2007-03**

The Productive Efficiency of Ports:  
Lessons from the Pacific Rim Seaport's  
Corporatization and Strategic Management

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## TABLE OF CONTENTS

I.	Research Objective .....	5
II.	Research Activities.....	5
	Tasks Completed.....	5
	Research Participants.....	6
III.	Results and Findings of the Research.....	7
IV.	Research Dissemination for Conferences, Journals and Book.....	9



# **The Productive Efficiency of Ports: Lessons from the Pacific Rim Seaport's Corporatization and Strategic Management**

David E. Dowall and SangHyun Cheon

## **I. Research Objective**

This research is to evaluate whether and how global port reform efforts since the early 1990s — strongly pursued in many Pacific Rim countries such as Australia, New Zealand, Singapore, China and many other ports in Latin America — contribute to higher productivity. The research, as the basis of Mr. SangHyun Cheon's Ph.D. dissertation (the graduate student researcher conducting this research), theoretically aims to understand the ways port institutions, such as port ownership and corporate structure, influence port productivity. In order to examine the question, this research reviewed, compared, and created a database of port governing and managing models of more than 150 important global container ports. The research is particularly motivated by the belief that the lack of empirical data and research on the global seaport sector prevents a comprehensive view of the productivity of container ports, and several institutional models in Pacific Rim countries can suggest (1) factors to effect better port efficiency in port management and (2) innovative and flexible mechanisms of port management by leading performers.

## **II. Research Activities**

In order to examine the question, a combination of quantitative and qualitative methods was adopted: first, an empirical and historical survey on ownership and corporate structure of global seaports; second, non-parametric mathematical programming models (Data Envelopment Analysis and Malmquist Total Factor Productivity Index) to benchmark port efficiency and efficiency changes; and third, multivariate analyses to examine the roles of port institutions on port productivity. This research aims to adopt multidisciplinary perspectives from infrastructure planning, maritime and production economics, industrial organization, and business strategy and public management.

**Tasks Completed.** This research reviewed literature on port economics and management, influence of institution and privatization on organizational performance, infrastructure productivity and strategy,

public sector management, and comparative evaluations of performance.

This research surveyed institutional structures for 154 global-scale container ports and major national gateway ports in the world for the year 2004, and 98 ports for 1991. Specifically, port institution data collected consists of two different aspects: (a) port ownership and (b) corporate structure of port authorities/managers in 1991 and 2004.

In order to identify institutional features under the consideration of rich historical and larger environmental contexts, the data were collected through multiple methodologies: (1) review of secondary literature for the understanding of broader economic and policy contexts, (2) survey of primary literature or port documents such as port planning reports and online websites, and (3) brief telephone interviews with port planners. Site visits were conducted to collect data on capital inputs and outputs and other institutional features of global ports and to have methodology training (e.g., Los Angeles Public Library; British Library; Drewry Consulting and Informa Maritime & Transport in London, UK; 2005 Conference of the International Association of Maritime Economists in Cyprus; 2005 Summer Conference of the Transportation Research Board in Boston; the 2006 JRI International Seminar for Inter-port Competition: Issues and Methodologies held in Incheon, Korea; the 2006 Pacific Rim Council's Urban Development Forum held in Jeon ju, Korea).

Based on the port input and output data, the research implemented Data Envelopment Analysis, a non-parametric mathematical programming technique to benchmark container ports' productivity, based on intertemporal and contemporaneous approaches with both constant and variable returns-to-scale assumptions. Furthermore, Malmquist Total Factor Productivity Index for the ports was also estimated to compare how port efficiency has changed over time and by different regions and where the sources of efficiency changes can be attributed.

Finally, the research implemented multivariate statistical analyses and modeling to portray some general implications on the roles of port institutions on port productivity and other environmental and external factors that influence port efficiency.

**Research Participants.** The research also pursued an objective of multidisciplinary efforts, collaborative works, and the triangulation of methods allowed the researchers to better understand problems and better interpret conflicting empirical evidence. The research creates institutional networks with the participants: collaborators, contributors, consultants, and commentators in the following:

- Principal investigator: Professor David Dowall
- Graduate student researcher: Mr. SangHyun Cheon
- Collaborators, Contributors, Consultants, and Commentators: Professor Dong-Wook Song (*University of Hong Kong*, Hong Kong), Ms. Jane Degerlund (Researcher, *Containerisation International*, UK), Mr. Dean Davidson (Researcher, *Drewry Consulting*, UK), Mr. Chris Sayers (*Productivity Commission of Australia*, Australia), Dr. Berk Kruk (Senior Port Specialist, World Bank), Dr. Jan Hoffman (*United Nations Committee on Trade and Development*), Mr. Sabine Knapp (*Erasmus University*, The Netherlands), Mr. Peter Galbrich (Researcher, *Institute of Shipping Economics and Logistics*, Germany), Professor Sophia Everett (*Melbourne University*, Australia), Professor José Tongzon (*National University of Singapore*), Mr. Kyoung Marvin Shin (Massachusetts Institute of Technology, Political Science)

### III. Results and Findings of Research

For most global seaports, port-managing institutions mirror the historical development of national and regional political structures and economic systems. Yet since the early 1980s, with the rise of globalization and the development of rationale for port reforms, two distinct general trends have occurred: (1) increasingly decentralized corporate structures and administration have gained momentum, especially in East Asia, South Asia, Oceania and Europe, and (2) increased contracting, leasing, and concessions for container terminal levels and other cargo and vessel services in most of regions in the world. As a result, many public service ports were transformed to landlord ports. While boundaries for the adaptation of port institutions have expanded in the past decade, there are still different levels of vigilance and flexibility on institutional reform and innovation in differing parts of the world. Regions and countries like South Asia (Singapore, Malaysia), Oceania (New Zealand, Australia), East Asia (China) and some Central and South American countries are more enthusiastic about innovation in port institutions. Several northern and southern European countries (Antwerp, Rotterdam) and Korea have followed their predecessors after periods of testing the new institutional models. Finally, some Pacific Rim countries, like the US and Japan and other countries in the African continent, so far show only low levels of interest in reforming their port management and operation models. In the early twentieth century, the US and Japan achieved some institutional



innovation by adopting decentralized landlord models or municipal management. Yet this has inhibited them in recent years from moving strategically forward to the new models.

In terms of port efficiency, ports across the world have improved their efficiency over time based on three distinctive sources: improvement in management of capital inputs, production scale adjustment, and technological progress. In general, the larger-scale ports are more efficient. They have moved more strategically to become efficient by driving rapid technological development and adopting better capital management practices. Some of the most efficiently managed ports can be found in the Pacific Rim regions: East Asia (China), South Asia (Singapore, Malaysia), and Central America as well as some in non-Pacific Rim regions such as the Middle East (Dubai). Australia and New Zealand have undertaken substantial efforts in port reform and though their levels of improvement over the last decade show promise, their relative levels of port efficiency have not yet outpaced ports in other regions. This may be due to the size of their hinterlands, an inherent limitation.

The research also shows that, while influences from external environments still play an important role in shaping port efficiency, they are neither determining nor predominant. The roles of efficient capital management and capital investment supported by institutional restructuring are not minimal but substantial for the operation of ports over the medium-to-long term. Given the current globalized shipping market and scopes of port activities, the strategies to combine institutional restructuring and capital investment can suggest the potential to partly overcome the limitations of the external conditions, as can be found from examples like the Port of Dubai and the Port of Singapore. However, a strategy focusing only on aggressive capital investment in technological progress has limitations in that it is relatively easier for other ports to replicate. As a result, it could lack the potential to increase relative competitiveness.

Ports' patterns of efficiency change can be different, based on how the different sources of efficiency act in improving ports' overall total factor productivity and compensate for the deterioration of other sources of efficiency. These characteristics of efficiency change are influenced not only by market advantages and hinterland conditions, but also from strategic efforts to combat or to reap the benefits of these conditions. These characteristics can be recognized by the fact that many ports located in regions having small hinterland accessibility and higher level of inter-port competition (e.g., Oceania, Middle East) have tried to capture the efficiency improvement more aggressively by reforming their institutional and management practices rather than changing their production scales.

Finally, observing generally lower efficiency of publicly operated ports, the research concludes that port productivity is shaped not just by the intensity of spatial inter-port competition, but also by the capacity of port authorities to implement innovative institutional practices, given the globalized, competitive world trade system. Many global container ports in the contemporary era should certainly have the institutional flexibility to respond to external challenges and to overcome external limitations. According to planners in globally competitive port authorities, medium- and long-term strategic planning scenarios are essential for achieving flexibility, which ultimately leads to higher productivity for leading ports. In terms of policy making, crafting appropriate scenario levels for inter-port competition are a meaningful tools for inducing better port productivity and addressing organizational inertia.

#### **IV. Research Dissemination for Conferences, Journals, and Book**

The research project team is seeking to publish a series of papers at conferences and journal papers as detailed below.

The project team has set up the following matrix for publishing outlets, given the context and content of the research analysis:

ANALYSIS FRAMEWORK AND METHODS		PORT INSTITUTIONAL FRAMEWORK (ACCORDING TO GEOGRAPHY)			
		Asia	Europe	America	World*
A. Review and Survey of Port Ownership and Corporate Structure		A	B	C	D
B. Port Efficiency Benchmarking Techniques	Intertemporal DEA	E	F	G	H
	Contemporary DEA	I	J	K	L
	Malmquist Index	M	N	O	P
C. Multivariate Analysis Combining A & B	Combinations**	Q	R	S	T

\*Oceania, the Middle East, and Africa are included as one of these three sub-regions, depending on the context of analysis.

- **World Conference Transportation Research 2007 Paper:** The research team will present a paper based on (P). If this paper receives good reviews, the paper will be included in an edited book
- **International Association of Maritime Economists 2007 Paper:** The research team seeks to publish a paper based on (D), based on the empirical results of the review and survey of port ownership and the corporate structure of world ports. After the conference, an upgraded version of this paper will be submitted for publication in the journals *Maritime Policy and Management*, or *Transport Reviews*, or *Journal of Transport Geography*.
- **Three journal papers** from (Q), (R), and (S) with respect to the sub-regions are currently being produced targeted toward *Transportation Research A and E*, *Applied Economics*, *Journal of Industrial Economics*, or other reasonably demanding journals.
- **One journal paper** from (T) is targeted to the most desirable journal. A potential outlet is *World Development* or *Journal of Productivity Analysis*.
- Papers presently being written:
  1. “Transformations of Ownership and Corporate Structure of World Seaports, 1991–2004.” To be submitted to *Maritime Economics and Logistics*.
  2. “Benchmarking of Relative World Port Efficiency and Sources of Temporal Efficiency Changes Since 1991.” To be submitted to *Transportation Research Part E*.
  3. “Institutional Environment, Structure, and Practice for Port Productivity: Inter-port Competition, Corporatization, and Terminal Ownership.” To be submitted to *World Development*.
- Finally, when the future of all four papers is known, the research team will begin working to produce **a single book** that encompasses everything. The research team has a good relationship with publishers like Palgrave Macmillan, Elsevier, and Edward Elgar.