Regulation and Port Productivity Overview of Global Port Benchmarking - A Focus on Hong Kong and South China Region

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Regulation and Port Productivity Overview of Global Port Benchmarking
(A Focus on Hong Kong and South China Region)

John J. Liu and T. L. Yip
Department of Logistics and Maritime Studies
Faculty of Business
The Hong Kong Polytechnic University
Hong Kong, China

Background

Globalization and trade liberalization in the past decades have profound impacts on port industry. Governments are increasingly realizing that, ports have become the most dynamic link in international transport networks and, as a result, inefficient ports can easily wither gains from trade liberalization and export performance. Port authorities have been trying to improve port efficiency through adopting new technologies and deregulation. The disappearance of national boundaries of port hinterlands, the increasing containerization, and the trend of deregulation force container ports to face keen competition, because of the diminishing product differentiation and government power. Competition leads to an increasing pressure on ports to control their costs, offer competitive user charges, and improve quality of services to shipping liners and shippers.

A port benchmarking project is conducted to study the port productivity for major container ports in the world. The project addresses one fundamental question: what are the best practices to improve port efficiency (productivity) for a port. By collecting data from ports around the world, empirical models have been developed to compare port performance under different (regulation) scenarios. The results from this benchmarking project will be the foundation for a port to design appropriate regulatory tools.

Port Benchmarking of Technical Efficiency

The production and cost theories in economics makes it possible to estimate production and cost functions empirically, and thus to investigate the productivity and technology change of a port. The port production function can be written as:

\[
\text{Port production} = \text{function (Infrastructure, Superstructure, Port characteristics)}.
\]

The quantity to indicate port production may be port throughputs (TEU, tonnage), ship arrivals or other outputs. The superstructure denotes cargo handling equipment, storage facilities etc. The port characteristics covers water depth, port groups, continental region etc.

The findings are summarised as follows (Yan, Sun and Liu, 2008):

1. Port facility operators with deeper water terminals and larger numbers of calling liners is more efficient.
2. More terminals in a port reduce the efficiency.
3. Port groups are more efficient.
4. Ports are more efficient in the Far East Asia in general.

Several factors that may impact on the port efficiency are being addressed, e.g. Multiple outputs - the effect of port facility mix (container, bulk and tanker). We further discuss the implication of Port globalisation and Container flows

Implication 1: Globalisation on ports

From the port benchmarking study, ports groups are found more efficient. One of the main impacts of globalisation has been the integration of transport facilities provided by service organisations around the world. In the port sectors, there exist some of the prominent operators who provide services on a global scale.
The effect of this port globalisation can be seen when some statistics are studied. Figure 1 shows the top seven container terminal operators. Hutchison Port Holdings (HPH), PSA Corporation and APM Terminals (Maersk Sealand) occupy the top 3 places since 1991. All top terminal operators have not only increased throughputs but also market share. The market share of leading operators increased from 19.6% in 1991 to 46.7% in 2004.

**Figure 1: Throughputs of top seven container terminal operators (ranked in 2004)**

![Figure 1: Throughputs of top seven container terminal operators (ranked in 2004)](image)

*Source: Drewry Shipping Consultants*

**Figure 2: Market share of top seven container terminal operators**

![Figure 2: Market share of top seven container terminal operators](image)

*Source: Drewry Shipping Consultants*
The structure of the container terminal industry has changed. Global and regional players are becoming increasingly dominant. Shipping lines have extended investment in ports.

**Implication 2: Asian ports are more efficient**

From the port benchmarking study, Asian ports groups are found more efficient compared against ports in other continents. The estimates of container flows on the three major containerised routes are illustrated in Figure 3. For the port sector, this trade pattern has resulted in 3 major effects. Firstly, terminals in Asia have to cope with the severe imbalance of trades and large volumes of empty containers have created an inventory problem. Secondly, terminals have to handle more containers than their counterparties in Europe and USA. Thirdly, terminals in the Far East attract more port investments.

**Figure 3: Estimated container flows on major trade routes in 2006**

![Diagram showing estimated container flows on major trade routes in 2006.](image)

*Unit: Million TEUs*

**Implication 3: Ownership has little impacts on technical efficiency**

This is little evidence that port privatization has significantly enhanced growth. Investment in port infrastructure does not often lead to port traffic (e.g. Vancouver Fraser Port in Canada). Port privatization is very often opposed by port labour, for examples, French Port (Lloyds List, 6 June 2008); Piraeus port of Greece (Seatrade, 2008). It is because privatisation implies restructuring, salary reduction and layoff. The government may face considerable political controversy soon after the plan of port privatization has been announced.

**Promoting Port Investments**

The port industry is by nature capitalistic, because it requires expensive infrastructure and huge capital to be completed. The government has to promote port investment so as to secure sources of funding for port projects and developments, e.g. Table 1. An appropriate financing scheme not only determine the approach for investments but also enhance a competitive advantage for port development.
One of port privatisation problems is that the port ownerships may be eventually transferred to foreign ownership that the government does not want, e.g. Dubai Ports World (DPW) intended to acquire P&O in 2006. Port privatisation may not create or improve port infrastructure and facilities to benefit the local economy (Baird and Valentine, 2007).

In the past, port projects are funded or subsidised by the public sector. Today, the involvement of the private sector in the port industry has increased significantly in both developed and developing countries. However, port infrastructure projects have rarely financed by commercial banks but international lending institutions such as the World Bank, and Asian Development Bank. As the private sector involvement in port projects has increased, the World Bank (2007, p. 98) has enumerated seven elements which are shaping the nature of the private sector involvement in ports:

1. Expected yield
2. Debt / equity financing structure
3. Sponsorship
4. Legality of contracts
5. Transparency
6. Fair and open bidding procedures
7. Feasibility studies (technical, financial, economic and environmental)

The World Bank (2007) further discussed a large variety of funding schemes. The most prominent of these schemes are the various forms of “leasing” and “concession arrangements”.

1. Leasing – is a method by which an agreement is made for the right to use an asset (e.g. land, equipment) over an agreed period of time in return for payment. Payment can be a single one-off transaction or made in a series of instalments. The two dominant forms of leasing agreements are “lease contract” and “leasehold agreement”. The main methods of lease payment are ‘flat rate’, ‘minimum/maximum rate’ and ‘shared revenue’.
2. Concession arrangement – government maintains the ownership of the port land, but grants the concessionaire the right to fiancé, build and operate a facility or some equipment, for public use, for a stated period of time. The concessionaire not only covers the costs of investment but assumes all commercial risks. The major advantage of concession arrangement is to increase private financial participation in the development of the port without changing the structure of the port status.

Other private participation schemes are: management contracts (e.g. dedicated terminals), joint ventures, and BOT (build, operate, transfer) agreements (IAPH 2001; Ernst & Young 1994).

An alternative financing scheme is Initial Public Offer (IPO). The liquidity of the stock exchange offer a better debt position and raise equity for future expansions, especially the currency risk (interest rate) are high (e.g. Tianjin port, Dalian port, Santos Brazil).

China approach to finance port projects

There are several characterise of China port policy:

1. The government (national or province) does not manage the terminals directly.
2. Foreign Direct Investment (FDI) is conducted in the form of joint venture. Foreign companies were in effect restricted to holding less than 50% share of joint venture.
3. Foreign companies act as both investors and managers. Local authorities act as mainly landlord of the terminals. The joint venture offers easier access to new technologies (for the benefits of China) and to new markets (in favour of foreign companies).
References:


### Table 1: Examples of port privatization projects in Europe

<table>
<thead>
<tr>
<th>Date</th>
<th>Year</th>
<th>Company Name</th>
<th>Country</th>
<th>Area</th>
<th>SIC</th>
<th>Sector</th>
<th>% for Sale</th>
<th>Value Transaction of US$ million</th>
<th>Method of Sale</th>
<th>Market Area</th>
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<tr>
<td>01/02/1983</td>
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<td>Associated British Ports Hldgs</td>
<td>United Kingdom</td>
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<td>51.5</td>
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<td>Domestic</td>
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<td>26/07/2003</td>
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<td>25.5</td>
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</table>

Key: PO = Public offer, PS = Private sale
Source: Privatization Barometer
Regulation and Port Productivity
Overview of Global Port Benchmarking
(A Focus on Hong Kong and South China Region)

John J. Liu and T.L. Yip
(Hong Kong PolyU)
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Key Factors in Port Productivity

- **Port technology**: Output, Growth, and Innovation
- **Input factors**: Tangible (capital, labor), Intangible (usable knowledge, IT factors)
- **Efficiency**: Total factor productivity (TFP) heterogeneity (technical, political, and market)
- **Regulation**: Ownership, Legal system, Government quality, Governance system
The puzzling IT-revolution: lagging and stepwise

- Robert Solow (1987): "you see the computer revolution everywhere except in the productivity data"
- Alan Greenspan (1996): Negative trends in measured productivity observed in many services industries seemed inconsistent with the fact that they ranked among the top computer-using industries

Practices in Port Regulation: Best, or Not?

- **Privatization**: Really the best for ports? Then something else must be missing in Hong Kong, as the records in recent years showed.
- **Either public or private, but not joint (mixed)**: What about Shanghai?
- **Container ports**: Throughput = Efficiency?
- **Income difference**: Explainable by technology difference? Regulation/policy difference? Or system heterogeneity?
The pending issues in Port Efficiency:

- "Two intrinsic characteristics of the port industry – the individual heterogeneity in production technology and the time-varying nature of technical efficiency, have been generally ignored." (Yan, Sun, and Liu, TRB 2008): Natural conditions and business environment

- **Drastic difference in income across countries is not due to technical differences and differences in endowments of natural resources.** (Prescott, 1997): Income HK = 10 x Shenzhen

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**Development of Total-Factor Port Efficiency Assessment Tools at C.Y. Tung ICMS (since 2005; HK PolyU)**

- Initial grant (HK$1.26 million) on Regional Port Competition: December, 2005
- 1st Port Forum on Port Benchmarking: April 27 - 29, 2006; PolyU HK
- Initial meeting on collaboration on N.E.T.S at Institute for Water Resource of US-ACE: November 8 – 9, 2006; Alexandria, VA; by Keith Hofseth (IWR), Wesley Wilson (Oregon), Jia Yan (PolyU), and John Liu (PolyU)
- Further funding and donation to ICMS (over HK$10 million) from Tung Foundation
- 2nd Port Forum, IFSPA-2007 (International Forum on Shipping, Port, and Airport): May 10 – 12, 2007; PolyU
- 2nd Special Session on Port Benchmarking: IAME-Athens, July 4 – 6, 2007
Development of Total-Factor Port Efficiency Assessment Tools at C.Y. Tung ICMS
(Continuing on …)

- PolyU Niche Area: Consortium of Shipping and Maritime Studies (CSMS) – Services and Management; ($12 M five-year grant, approved 15 November, 2007)
- Keynote presentation: Conference on Global Maritime and Intermodal Logistics (Singapore), December 17 – 19, 2007
- Special Session at IAME 2008-Dalian: 2-4 April, 2008 (Dalian, China)


Website for Port Performance Benchmarking, and Port-adapted Logistics Index (PortAL Index): Under construction

BACKGROUND AND OUTLOOK

- **Asymmetric port competition:** Port-focal logistics and supply chain management (as opposed to firm-focal logistics and SCM)

- **Logistics and Port Index:** TFP, Mutual risk system; Financial, Economic, Social, Security, and Environmental risks …

- **CSMS grant ($2.07m):** “Port-Adapted Logistics (PortAL) Index - An Interactive Dynamic Efficiency Assessment System (IDEAS)”
Production Frontiers under Inputs

- **Frontier:**
- **Maximum possible output** by a certain production technology over a given period time, with minimized input cost over a given set of input possibilities (production possibility set)

Deterministic Frontier Model

- Deterministic inefficiency
- Expected Performance
Stochastic Frontier Model

Analysis 1997-2004

- Technical Efficiency of Container Operators from 1997 to 2004
- An Econometric Analysis to the World’s Major Ports
Objectives

- To study the production efficiency of container port industry
- To develop corresponding econometric tools

Features should be incorporated in an empirical model

- Controlling for individual heterogeneity: Clustering effects (by port, country, region, and port groups);
- Controlling for the technical change;
- Time varying efficiency and time persistence in efficiency change;
### Output Variables

- 1. Container Throughput (TEUs)
- 2. Cargo Throughput (tones)
- 3. Vessel Arrivals/Departures
- 4. Ship Turn Around Time

### Input Variables

- 1. Cargo handling equipments: Quay crane, Yard crane, Mobile crane, Forklifts, etc;
- 2. Terminal infrastructure: number of container berths, Length of quay lines, Terminal area, etc;
- 3. Labor inputs: Working hours, number of full-time workers;
- 4. Storage facilities: storage area, reefer points
Port characteristics

- 1. Depth of Water
- 2. Number of ship calls
- 3. Ownership structure
- 4. Number of Operators
- 5. Corporate law system and many social economic variables

Overview of Data

- The basic unit is operator.
- Time period is between 1997 and 2004.
- We focus on the top 100 container ports in the world (ranked in 2005)
- Data was collected from different sources:
  - Containerization International Yearbooks,
  - World Bank, and
  - a subscribed data base: Containerization International Intelligence
Fig. 1 Container Throughput from 1999 to 2002

Fig. 2 Cargo handling equipments at quay side from 1999 to 2002
Fig. 3 Cargo handling equipments at yard from 1999 to 2002

Fig. 4 Number of berths from 1999 to 2002
Fig. 5 Quay length (m) from 1999 to 2002

Fig. 6 Terminal area (sqm) from 1999 to 2002
Fig. 7 Storage Capacity (TEUs) from 1999 to 2002

Fig. 8 Reefer points (electric) from 1999 to 2002
**Findings**

- Port facility operators with deeper water terminals and larger numbers of calling liners is more efficient.
- More terminals in a port reduce the efficiency.
- Port groups are more efficient.
- Ports are more efficient in the Far East Asia in general.
Top Terminal Operators

- DPA
- Durogate
- Cosco
- P&O Ports
- APM
- PSA
- HPH

More and more market share
Container Flows

![Diagram showing container flows between Asia, Europe, and USA with unit Million TEUs]

Alternative financing

- IPO
  - Initial Public Offers
- Real Options
Port Governance in China

- Definition of “port governance”
  - “Port” as a corporation
  - The port governance specifies the distribution of rights and responsibilities among the different participants in the corporation.

- Port Development in China
  - Centralization (pre 1984)
  - Decentralization (1984-2001)
  - Corporatization (2001-)
Port Governance (2)

- Centralization (pre-1980)
  - Planned economy
    - Provided the basic port service
  - High level of centralization
    - Ministry of Communications (= Transport Bureau)

Port Governance (3)

- Centralization (pre-1980)

  ![Diagram]

  - Ministry of Communications
  - Terminals
Port Governance (4)

• Decentralization (1984-2001)
  – 1978 “Open door policy”
    • The limitation on the water transport price was removed in the late of 1990s gradually.
    • The market became gradually free competition.
  – Dual leadership (or ownership)
    • Ministry of Communications (= Transport Bureau)
    • Local authorities

Port Governance (5)

• Decentralization (1984-2001)

```
            Ministry of Communications
               ↓
            Local Government
               ↓
            Terminals
```
Port Governance (6)

- State-owned enterprises (SOE)
- Foreign participation
  - 1990s, Hutchison Port Holdings (HPH) started operations in Shanghai, Yantian, Ningbo and Zhuhai.

Port Governance (7)

- Corporatization (2001-)
  - China’s entry into WTO
  - 2004 “Port Law”
  - Central Government = Regulator
  - Terminals = Market player
Port Governance (8)

- Corporatization (2001-)

```
Local Government

Corporation JV

Terminals
```

Port Law of China

- Dated 28th June, 2004
- Definition of ports
  - Fishing ports
  - Commercial ports
    - First generation port
    - Traditional role of port (ship/shore interface)
Port Law of China (2)

• Implications
  – The Chinese central government will no longer retain any ownership of ports
  – The public ports will be transferred to local government.

Ownership

• Hongkong International Terminals (HIT)
  – Solely owned by
    • Hutchison Port Holdings (HPH)

• Yantian Port Holding
  – Stock No. 0000088
  – Joint venture of
    • Hutchison Port Holdings (HPH)
    • Shenzhen Yantian Port Group
China Approach

- The government (national or province) does not manage the terminals directly.
- Foreign Direct Investment (FDI) is conducted in the form of joint venture. Foreign companies were in effect restricted to holding less than 50% share of joint venture.

China Approach (2)

- Foreign companies act as both investors and managers. Local authorities act as mainly landlord of the terminals.
- The joint venture offers easier access to new technologies (for the benefits of China) and to new markets (in favour of foreign companies).
Port Privatisation

- Port privatization may not create or improve port infrastructure and facilities to benefit the local economy.
- Investment in port infrastructure does not often lead to port traffic.
Summary

• The Port Benchmark Study shows that:
  – Global terminal operators are more efficient.
  – Asian ports are more efficient.
  – Ownership has little impacts on technical efficiency.