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## Private Sector Participation in Asian Ports\*

### Summary

Asian container ports suffer from a number of problems including insufficient port and/or terminal capacity, inefficient management and bureaucratic administration. This may be due in part to the fact that the majority of the region's ports are controlled and/or operated by public entities.

To deal with these problems, port authorities of a number of countries in the region have launched programmes that aim to attract private capital into both the existing and new facilities. As a consequence, these schemes have kick-started a revolutionary new operating milieu where inter- and even intra-port competition is rife. In many instances, this has engendered the perception that organisational restructuring (including privatisation) is not only desirable, but necessary.

A key claim made with respect to organisational reforms is that the transformation of ownership from public to private sector will improve economic efficiency, as well as general welfare. Associated economic theories and existing empirical studies, however, fail to establish clear-cut evidence supporting this claim. Indeed, econometric analysis of the relative productive efficiency of the port sector pre- and post-privatisation seems to suggest that ownership itself does not seem to be categorically related to efficiency in port operations. It may well be the case, as proposed by the UN Conference on Trade and Development (UNCTAD, 1995a), that the apparent absence of a clear-cut theoretical and empirical relationship may reflect, to some extent, the unique socio-political situation in which these business entities undertake their economic activities.

Against this conceptual background, this paper analyses the administrative and ownership structures of the major container ports in Asia by relating them to the 'port function matrix' and assesses their relative efficiency.

**Key words:** port/terminal capacity, inefficient management, private capital, organisational restructuring, transformation of ownership, pre/post privatisation, port efficiency

### 1. Introduction

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Asian container ports suffer from a number of problems including insufficient port and/or terminal capacity, inefficient management and bureaucratic administration (Cullinane and Song, 1998). This may be due in part to the fact that the majority of the region's ports are controlled and/or operated by public entities.

To deal with these problems, the port authorities of a number of countries in the region have launched programmes that aim to attract private capital into both existing and new facilities. As a consequence, these schemes have kick-started a revolutionary new operating milieu where inter- and even intra-port competition is rife. In many instances, this has engendered the perception that organisational restructuring (including privatisation) is not only desirable, but necessary.

A key claim made with respect to organisational reforms is that the transformation of ownership from public to private sector will improve economic efficiency, as well as general welfare (Yarrow, 1986; Vickers and Yarrow, 1991). Associated economic theories and existing empirical studies, however, fail to establish clear-cut evidence supporting this claim (Vickers and Yarrow, 1988; Boardman and Vining, 1989). Indeed, econometric analysis of the relative productive efficiency of the ports sector pre- and post-privatisation seems to suggest that ownership itself does not seem to be categorically related to efficiency in port operations (Song and Cullinane, 2001). It may well be the case, as proposed by the United Nations Conference on Trade and Development (UNCTAD, 1995a), that the apparent absence of a clear-cut theoretical and empirical relationship may reflect, to some extent, the unique socio-political situation in which these business entities undertake their economic activities.

Against this conceptual background, this paper analyses the administrative and ownership structures of the major container ports in Asia by relating them to the 'port function matrix' (Baird, 1995; 1997) and assesses their relative efficiency.

## **2. Port Administration and Ownership**

There are a number of alternative forms of port administration and ownership since few ports can be described as either purely private or public. Moreover, it is often even difficult to identify the extent of either public or private sector involvement in a port. This situation does make it necessary, however, to distinguish between the alternative approaches to port administration and ownership.

### **2.1 A Conceptual Framework for the Classification of Port ownership and Administration**

UNCTAD (1995b) classifies the list of facilities and services that should be provided by ports for ships and cargoes: namely, infrastructure, superstructure, equipment, services to ships and services to cargoes. According to which entity (i.e. private, public

or joint) owns and provides those facilities and services, ports can be divided into two distinct types (Goss, 1990; Heaver, 1995; De Monie 1996).

In the *comprehensive* port, the public port authority provides all facilities and services within the port, thus having direct responsibility for the management and operation of port services and facilities. Independent (private) operators are prohibited from undertaking any port activity. This kind of port, therefore, can be said to be the 'totally integrated port'.

On the other hand, in the *landlord* port, the activities of the port authority are limited simply to providing and maintaining the basic infrastructure and essential services (e.g. fire services, security etc.), while all the other facilities and services such as the superstructure and stevedoring labour are provided by independent private (or public) companies. This port model can be referred to as the 'purely regulatory port'.

An alternative to this traditional framework for analysing port administration and ownership is proposed by Baird (1995, 1997) who refers to a *port function matrix*. The starting point for this conceptual framework is that, regardless of whether a port is in private or public hands, within the port area there will generally be three essential functions the port must fulfil and provide:

1. The *regulatory function* of a port can involve substantial powers being given to the port's public or private sector management, the majority of which will be of a statutory nature. In general, this function may be regarded as the primary role of a port authority (Nagorski, 1972).
2. In expediting a *landowner function*, ports control significant land areas. Irrespective of whether the land area of a port is large or small, however, the essential tasks involved would be to manage and develop the port estate, to implement policies and strategies for the port's physical development in terms of superstructure and (sometimes) infrastructure, to supervise major civil engineering works, to co-ordinate port marketing and promotion activities, to provide and maintain channels, fairways, breakwaters etc., to provide and maintain locks, turning basins, berths, piers and wharves, and to provide or arrange road and rail access to the port facilities.
3. The *operator function* is concerned with the physical transfer of goods and passengers between sea and land. In a *comprehensive* port, for example, the cargo-handling activity will be controlled by state-owned organisations. Conversely, in a *landlord* port, private companies will undertake this activity, while a mix of private and public companies may be involved as well.

According to which of these three functions are the responsibility of public or private organisations, the matrix presented in Table 1 makes it possible to ascertain the extent of the influence exerted by public and private sectors within any given port. The matrix also suggests the four main patterns (as defined by choice of port administration, ownership, management and operation) into which a government is able to organise its port industry.

Table 1. Port Function Matrix

| Port Models           | Port Functions |           |          |
|-----------------------|----------------|-----------|----------|
|                       | Regulator      | Landowner | Operator |
| <b>PUBLIC</b>         | Public         | Public    | Public   |
| <b>PUBLIC/private</b> | Public         | Public    | Private  |
| <b>PRIVATE/public</b> | Public         | Private   | Private  |
| <b>PRIVATE</b>        | Private        | Private   | Private  |

Sources: Baird (1995b, 1997)

According to Table 1, port administration and ownership models are divided into four types of port administration: the *PUBLIC port*, the *PUBLIC/private port* with the public sector dominant, the *PRIVATE/public port* with the private sector dominant, and the *PRIVATE port*.

A *PUBLIC port* can be regarded as synonymous with a *comprehensive port*. It is a port in which all three functions are controlled by the government or public authority. In the *PUBLIC/private port*, the operator function is controlled by the private sector, with both the regulatory and landowner functions remaining in the hands of the government. This type of port, therefore, can be interpreted to be a variant of the *landlord port*. In the *PRIVATE/public port*, both the landowner and operator functions are in private hands, while the regulatory function remains within the public sector. Finally, in the totally *PRIVATE port*, all three essential functions are controlled by the private sector.

## 2.2 The Economics of Efficiency and Port Privatisation

Engendering greater competition in the market is the main mechanism by which enhanced efficiency might be achieved under a policy of deregulation. Baumol, Panzar and Willig (1982) provide a comprehensive explanation of the process and conditions under which this might prove to be the case. Although deregulation policies have been commonly applied in many industries and across many countries (especially to the land-based transportation sector), the perceived wisdom, however, is that privatisation is the most important policy for improving the efficiency of the ports sector.

This is the case even though it is by no means categorically proven that there exists a direct causal link between the degree of private sector involvement and economic efficiency (see the differing conclusions drawn from the analyses conducted by Millward, 1982; Millward and Parker, 1983; Vickers and Yarrow, 1988; Boardman and Vining, 1989; Hutchinson, 1991; Parker, 1994). Perhaps the most obvious conclusion to draw from this morass of contradictory evidence is, as Liu (1995) attests in relation to the ports sector, that the best way forward is to undertake a specific empirical analysis to determine the relative efficiencies of alternative forms of ownership.

## 3. The Asian Situation

As an obvious corollary of burgeoning international trade and the rapidly increasing seaborne cargoes associated with this, Asian ports have played a pivotal role in national and regional economic development (Haynes, Hsing and Stough, 1997; Robinson 1998). Table 2 shows that, in terms of annual container throughput measured in TEUs<sup>1</sup>, 10 Asian ports are ranked among the top 20 container ports in the world and that the top four positions are held by ports in Asia. Fleming (1997) and Robinson (1998) provide plausible explanations as to why these Asian container ports have emerged as both regional and international load centres.

Table 2. Container Port Traffic League

(Units: TEUs p.a.)

Notes: <sup>1</sup> Figures in brackets represent the rank position for 2001.

| Rank <sup>1*</sup> | Port                | 2002       | 2001       | Country     |
|--------------------|---------------------|------------|------------|-------------|
| 1 (1)              | Hong Kong           | 18,600,000 | 17,900,000 | China       |
| 2 (2)              | Singapore           | 14,800,000 | 15,520,000 | Singapore   |
| 3 (3)              | Busan               | 9,434,307  | 8,072,814  | Korea       |
| 4 (5)              | Shanghai            | 8,610,000  | 6,340,000  | China       |
| 5 (4)              | Keelung             | 8,493,000  | 7,540,524  | Taiwan      |
| 6 (8)              | Shenzhen            | 7,613,754  | 5,076,435  | China       |
| 7 (6)              | Rotterdam           | 6,500,000  | 6,102,000  | Netherlands |
| 8 (7)              | Los Angeles         | 6,105,863  | 5,183,520  | USA         |
| 9 (9)              | Hamburg             | 5,373,999  | 4,688,669  | Germany     |
| 10 (11)            | Antwerp             | 4,777,387  | 4,220,780  | Belgium     |
| 11 (12)            | Port Klang          | 4,530,000  | 3,759,512  | Malaysia    |
| 12 (10)            | Long Beach          | 4,524,345  | 4,462,971  | USA         |
| 13 (13)            | Dubai               | 4,194,264  | 3,501,820  | UAE         |
| 14 (14)            | New York/New Jersey | 3,700,000  | 3,314,272  | USA         |
| 15 (18)            | Qingdao             | 3,410,000  | 2,640,000  | China       |
| 16 (15)            | Bremen/Bremerhaven  | 2,998,598  | 2,915,169  | Germany     |
| 17 (20)            | Osaka/Layo          | 2,954,571  | 2,488,332  | Japan       |
| 18 (19)            | Yokohama            | 2,900,000  | 2,555,841  | Japan       |
| 19 (16)            | Elsinore            | 2,750,000  | 2,800,000  | DK          |
| 20 (21)            | Laem Chabang        | 2,749,194  | 2,367,430  | Thailand    |

Source: Containerisation International, March 2003, p. 91

As far as the administrative and ownership structures of Asian container ports

<sup>1</sup> Twenty-foot Equivalent Unit; a standard size of container used, amongst other things, for denoting the container carrying capacity (size) of ships and the handling capacity and throughput of ports.

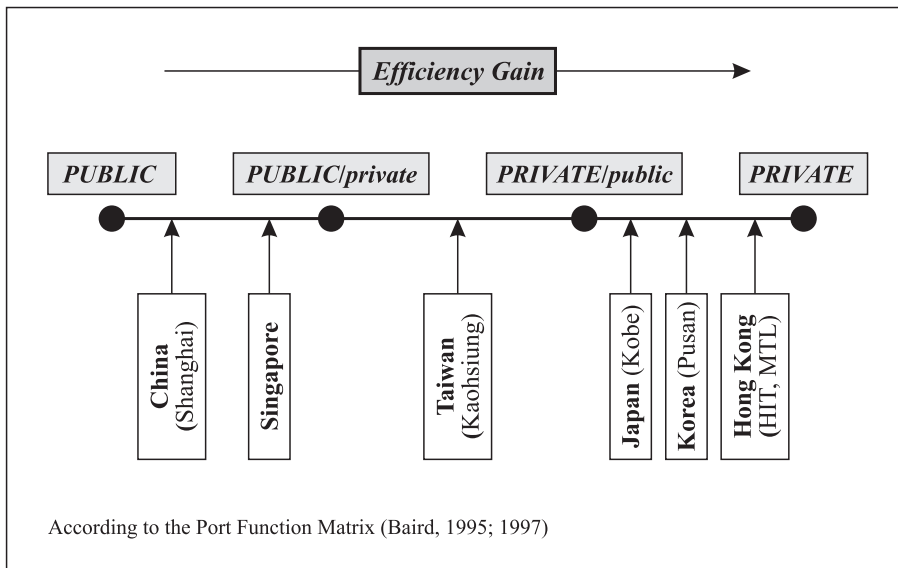
are concerned, Cullinane and Song (2001) conclude that, in terms of the taxonomy developed by Baird (1995; 1997), ports and terminals in Asia have tended to move away from something akin to a pure PUBLIC model and towards the PUBLIC/private model of port administrative and ownership structures. While it has become almost commonplace for the terminal operator function to fall within the purview of a private sector organisation, the current situation is that landowner and regulatory functions are often maintained under public sector control, whether at national or at regional level.

We can describe the selected major ports/terminals in the region as illustrated in Figure 1. Hong Kong's main container operators – Hong Kong International Terminals Ltd (HIT) and Modern Container Terminals Ltd (MTL) – are closest to the PRIVATE port, while Korea's Pusan and Japan's Kobe ports are located somewhere between the PRIVATE and the PRIVATE/public model. Taiwan's Kaohsiung port can be allocated somewhere between the PRIVATE/public and the PUBLIC/private port, while Singapore and Shanghai ports are closest to the PUBLIC port.

Based on the administrative and ownership characteristics of the major Asian ports presented in Figure 1, the following hypothesis is established for empirical investigation.

*'The economic efficiency of container ports/terminals improves as ownership moves along the continuum towards greater private sector participation (i.e., in line with a movement away from the PUBLIC port to the PRIVATE port)'*

Figure 1. The Hypothesis for Port Administration, Ownership and Efficiency



#### 4. An Application to Asian Container Ports

## 4.1 Definition of Variables

Dowd and Leschine (1990) argue that the productivity of a container port/terminal depends on the efficient use of labour, land and equipment. Terminal productivity measurement, therefore, is a means of quantifying the efficiency with which these three resources are utilised.

It was originally intended that the basic economic inputs of capital and labour would fulfil the data requirements of the study. This was the approach adopted in Song and Cullinane (2001) where the focus was the productive efficiency of Korean and U.K. container terminals. Unfortunately, across the Asian region in general, this sort of cost data proved impossible to collect from secondary sources. In contrast with the situation in the U.K., for example, accounting conventions within the region have a general tendency not to require the publication of costs at a high enough level of detail to allow their identification.

Instead, an alternative approach was adopted which utilises certain physical characteristics of the terminals as the required input data. This is related to output data in order to assess relative efficiency. Thus, terminal quay length ( $X_1$ ), terminal area in hectares ( $X_2$ ) and the number of pieces ( $X_3$ ) of cargo handling equipment (including gantry cranes, ship-shore gantries, yard cranes, and mobile cranes etc) were employed. Such an approach has the advantage that the data on these measures of physical container terminal capacities are available within the public domain and precedents do exist where they have been used in this way (e.g., Notteboom, Coeck and van den Broeck, 2000; Tongzon, 1995).

For the econometric estimation of efficiency, data on outputs from the container terminal sample are also required. In Song and Cullinane (2001), the *terminal output* ( $Y$ ) was defined as the turnover derived from the provision of container terminal services but excluding property sales. Again, because of the range of accounting systems employed by the sample of terminal operators, separating out the revenue attributable to different sources proved to be an intractable problem. In parallel with the solution proposed for the data requirements on production inputs, the readily accessible, physical measure of annual container throughput in TEUs was adopted as the basis for measuring the productive output of container terminals ( $Y$ ). This approach also has its precedents (e.g., Bernard, 1991; Notteboom, Coeck and van den Broeck, 2000) though it would be preferable to use (but impossible to collect information on) the actual number of boxes handled.

## 4.2 Data Sources

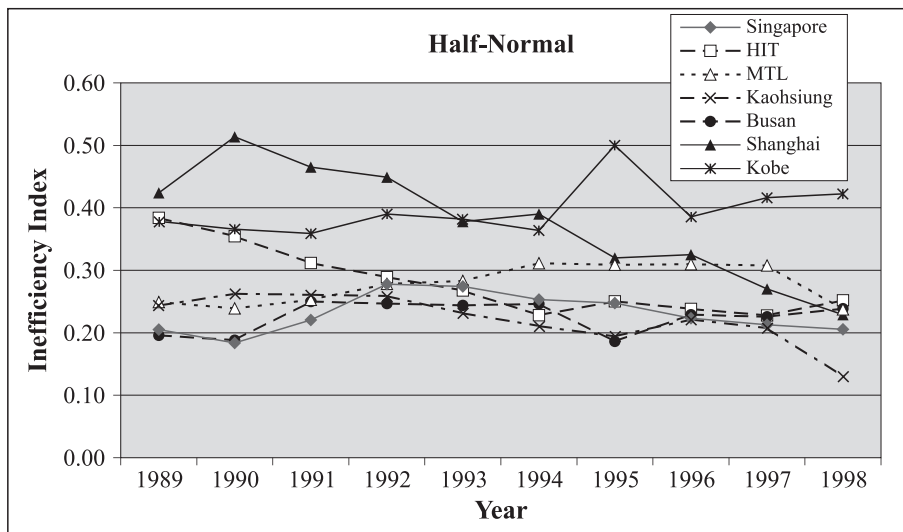
The sample comprised fifteen container ports or terminals in Asia, namely: Singapore; HIT, MTL, Sealand (all three in Hong Kong); Kaohsiung, Keelung (Taiwan); Pusan (Korea); Shanghai, Dalian, Yantian (China); Tokyo, Yokohama, Kobe (Japan); Port Klang (Malaysia); and Manila (Philippines). In virtually all cases, annual data

were collected for the 10-year period from 1989 to 1998. In the case of the recently developed Yantian container terminal, however, data are only available for the 6 years from 1993 to 1998. The data was collected mainly from the Containerisation International Yearbook (various issues) but was validated and, in certain instances supplemented, by approaching each of the terminals directly. This process yielded a total of 146 observations.

### 5. Estimating the Productive Efficiency of Asian Container Ports

The overall inefficiency level of terminal operators over the sample period is shown in Figure 2.

Figure 2. Overall Productive Inefficiency Levels



Rather than analysing the efficiency level of each terminal operator as it varies over time, it is useful to consider each operator’s average efficiency level over the whole sample time period.

Under all three approaches employed for modelling terminal efficiency, the average efficiency level of Kaohsiung is consistently highest, followed by Pusan, Singapore, Keelung and MTL’s Hong Kong terminal. The container ports of Kobe in Japan, Manila in the Philippines and Yantian, Shanghai and Dalian in the Chinese mainland are consistently the most inefficient ports in the sample.

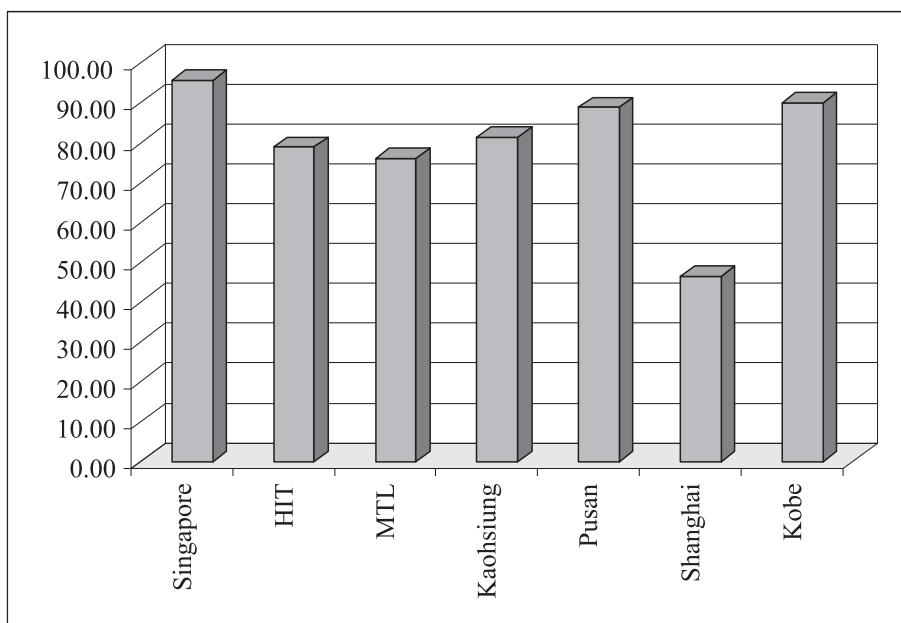
One intriguing implication which can be drawn from this result is that the ef-



efficiency of a container port or terminal appears to be very closely correlated to its size as measured in terms of throughput; a result which is validated by previous empirical work (for a review, see Cullinane and Khanna, 1999). Another possible interpretation might be that there is an inverse relationship between the degree of centralised government control which is exerted over a port or terminal and its level of efficiency. This second inference would appear to potentially validate general and economic expectations that greater private sector participation will lead to enhanced efficiency.

Figure 3 shows the 'time-invariant terminal operator-specific efficiency' for the seven major Asian container ports/terminals in the sample. As distinct from the results achieved when considering the previous cross-sectional model, Singapore is measured at the highest level of productive efficiency, with Pusan second, Kobe third and Kaohsiung fourth out of the major ports in the region. The mainland Chinese port of Shanghai again appears as the least efficient operator. The main difference in results compared to the cross-sectional model is the dramatic improvement in the measured efficiency level of Kobe and indicates very clearly the abnormal effect of its earthquake upon the data collected and the results produced by the ensuing analysis.

*Figure 3. Major Asian Container Port/Terminal-Specific Time Invariant Efficiency*



## 6. Conclusions

Although not wholly conclusive, the results provide evidence of the efficiency rankings of a selection of container ports and terminals within the Asian region. One major intervening variable which might well have influenced the results achieved within this study is the dichotomous positions of some of the sample ports/terminals with respect to the level of market regulation of container terminal operations, particularly on the supply side.

Whilst recognising that there could well be other influential intervening variables, simultaneously controlling for each of the individual effects of both private sector participation and market deregulation will allow greater fine tuning in policy assessment and/or formulation. On the basis of purely a subjective appraisal of the results obtained, however, there does seem to be some support for the notion that greater privatisation within, and/or deregulation of, the market does seem to be closely associated with enhanced productive efficiency. This empirical investigation, however, yields no definitive and irrefutable link between the degree of private sector participation and the level of productive efficiency.

Although there certainly appears to be some justification for the belief that there exists a positive relationship between the two, the most persuasive inference to be drawn from the analysis is the consistency with which large throughput operations appear to outperform their smaller counterparts in terms of efficiency; a factor which is likely to further reinforce the existing dominant market positions of certain ports and terminals in the region.

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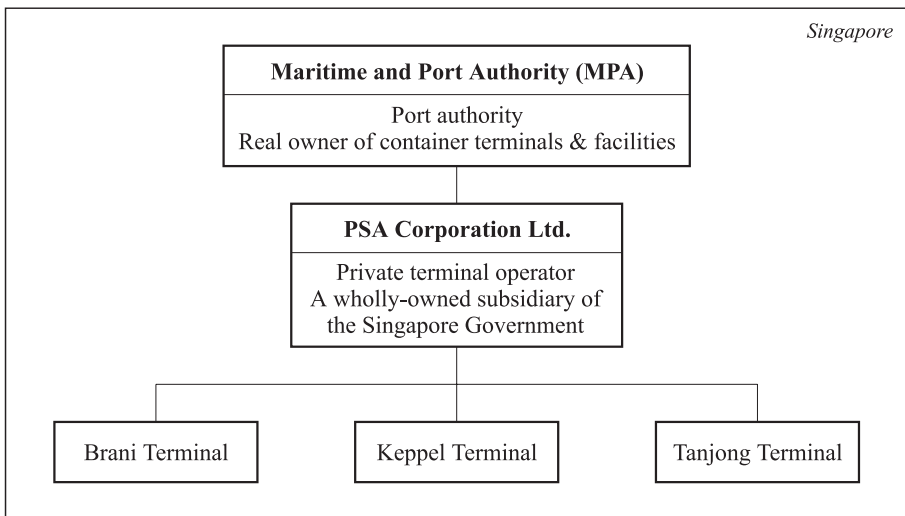
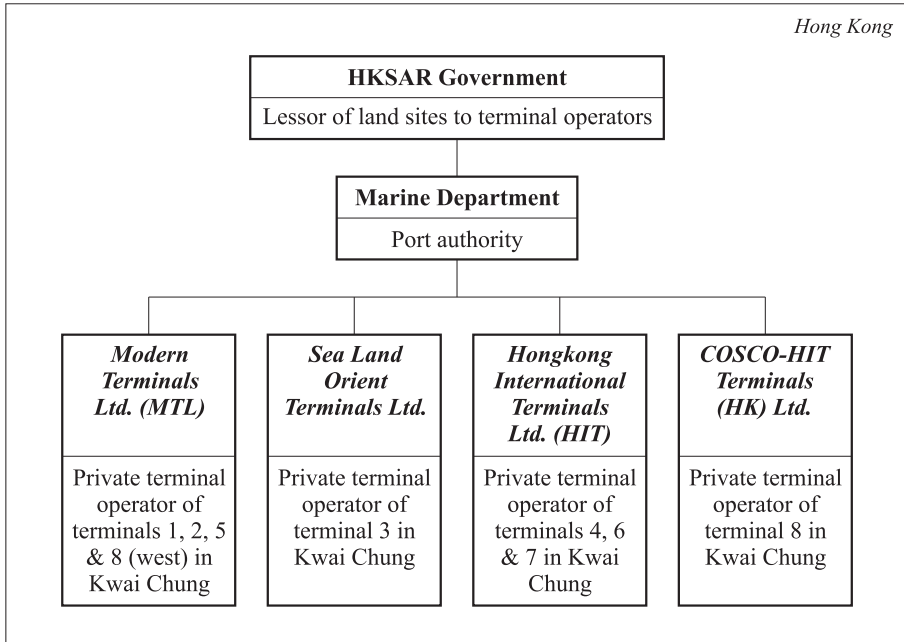
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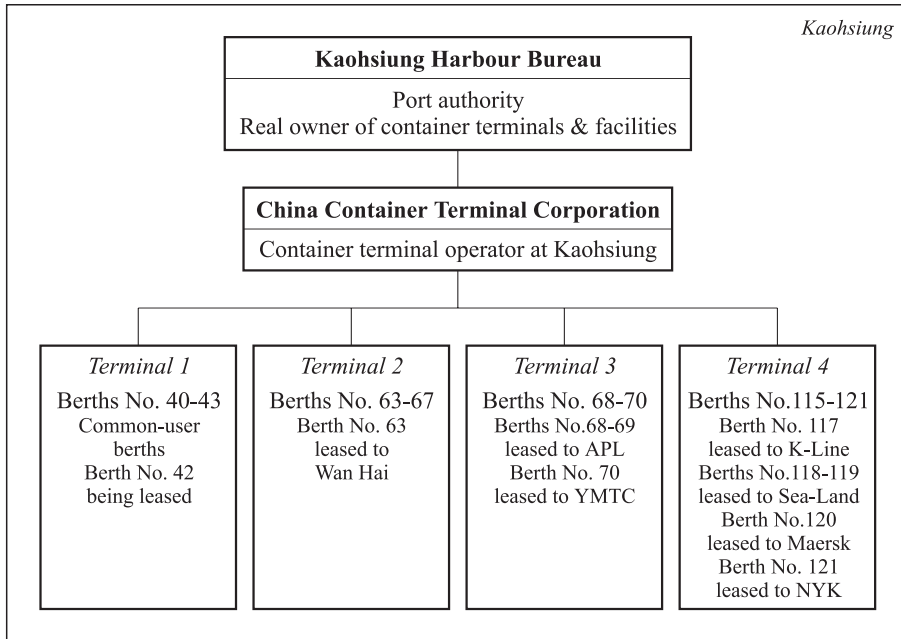
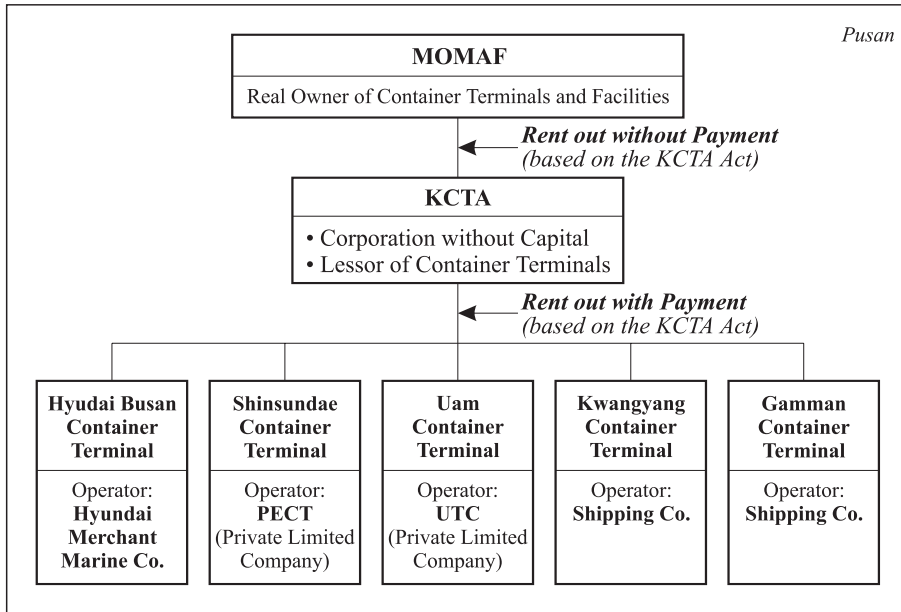
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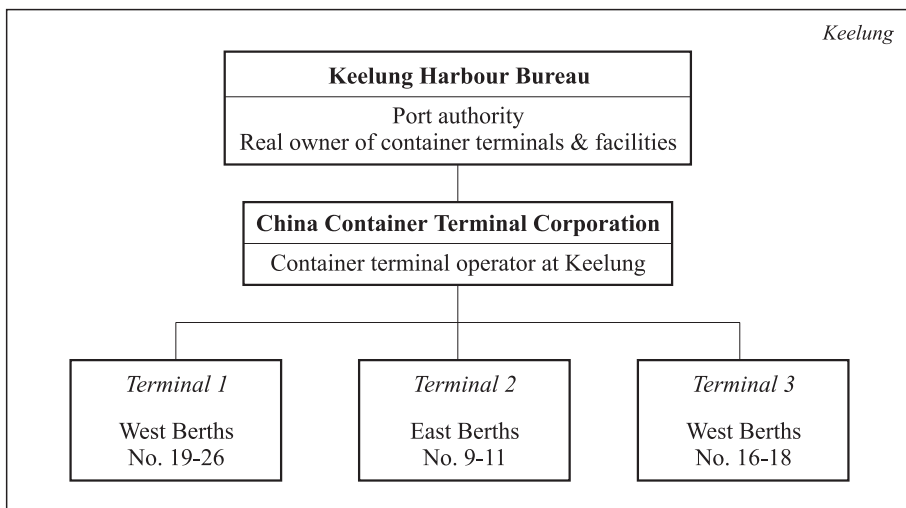
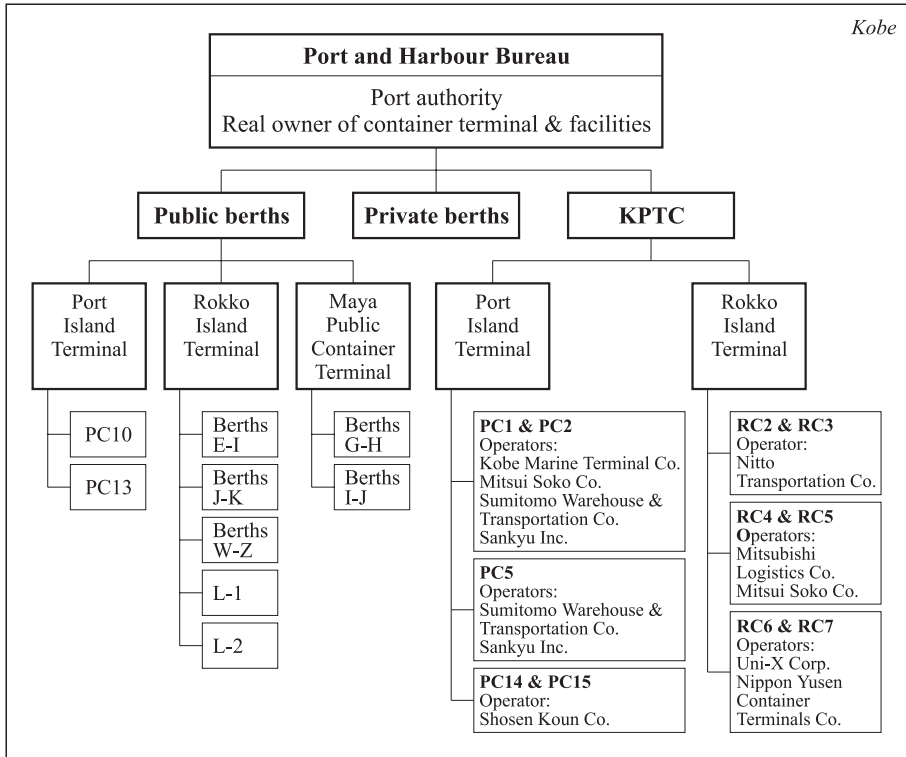
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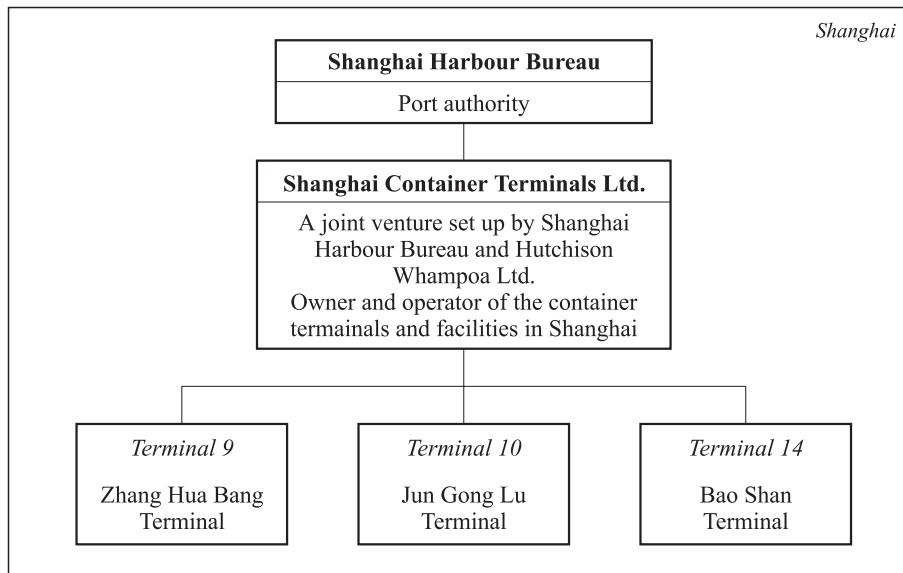
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**Appendix A:  
Administrative/Ownership Structure of Important Container Ports in Asia**











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## Sudjelovanje privatnog sektora u azijskim lukama

### Sažetak

Azijske kontejnerske luke muče poteškoće poput nedostatnih lučkih odnosno terminalskih kapaciteta, nedjelotvorne uprave i birokracije. Razlog tome možda djelomično leži u činjenici da na tome području većinu luka kontroliraju i njima upravljaju javna društva.

Stoga su lučke uprave u više zemalja potakle programe koji bi privukli privatni kapital u postojeće i nove objekte. Ti su programi posljedično potakli stvaranje revolucionarno novoga okruženja oživljene konkurencije kako između tako i unutar luka. U mnogim je slučajevima uočeno da je reorganizacija (uključujući privatizaciju) ne samo poželjna, već nužna.

Glavna tvrdnja glede organizacijskih reformi jest da će se pretvorbom javnoga vlasništva u privatno unaprijediti gospodarska učinkovitost i opći standard. Međutim, ekonomske teorije s time povezane te postojeća empirijska istraživanja ne pružaju jasne dokaze koji bi potkrijepili tu tvrdnju. Naprotiv, čini se da ekonometrijske analize odnosno proizvodne učinkovitosti lučkoga sektora prije i nakon privatizacije sugeriraju da sam oblik vlasništva nije kategorički povezan s učinkovitošću lučke djelatnosti. To bi moglo značiti, kao što je predloženo na Konferenciji UN o industriji i razvoju (UNCTAD, 1995a) da očigledan nedostatak jasne teorijske i empirijske povezanosti može do izvjesne mjere odražavati jedinstvenu društveno-političku situaciju u kojoj ti gospodarski subjekti obavljaju svoju aktivnost.

Na temelju takve pojmovne podloge, u ovome se radu analizira upravni i vlasnički ustroj najvećih kontejnerskih luka u Aziji, u odnosu prema 'matrici lučkih funkcija' te se procjenjuje njihova odnosna učinkovitost.

**Cljučne riječi:** lučki/terminalski kapaciteti, neučinkovita uprava, privatni kapital, reorganizacija/restrukturiranje, pretvorba vlasništva, prije/poslije privatizacije, lučka učinkovitost

## Partecipazione del settore privato nei porti asiatici

### Sommario

Numerosi problemi assillano i porti contenitori asiatici tra questi l'insufficienza di capacità portuale e/o capacità dei terminali, l'inefficienza di gestione e le numerose pastoie burocratiche. Ciò in parte è dovuto al controllo e/o alla gestione degli enti pubblici della maggioranza dei porti regionali.

Per risolvere con efficacia tali problemi le amministrazioni di alcuni paesi della regione hanno messo in atto dei programmi per incentivare il capitale privato ad investire sia nelle strutture preesistenti che in impianti ed attrezzature nuove. Di conseguenza tali progetti hanno provocato nell'ambiente un rivoluzionario scossone operativo stimolando la concorrenza tra porto e porto e perfino nell'ambito dello stesso porto.

In molti casi ciò è valso a rafforzare la percezione che la ristrutturazione organizzativa (compresa la privatizzazione) sia non solo desiderabile ma assolutamente necessaria.

Le riforme strutturali e organizzative intraprese hanno rafforzato il convincimento che con il trasferimento di proprietà dal settore pubblico a quello privato si possa incrementare l'efficienza economica e portare un miglioramento generale del benessere. Tuttavia le teorie economiche che trattano il problema e gli attuali studi empirici non danno con chiara evidenza sostegno a tale tesi. Le analisi econometriche sulla relativa efficienza produttiva del settore portuale ante e post privatizzazione sembrano suggerire che la proprietà in sé non sia porre in relazione in modo perentorio all'efficienza delle attività portuali. Ciò potrebbe significare, secondo da quanto esposto nella Conferenza dell'ONU per le attività industriali e lo sviluppo (UNCTAD, 1995a) che l'apparente mancanza di una evidente relazione teorica ed empirica possa riflettere, in qualche misura, l'eccezionale situazione socio-politica in cui tali entità economiche intraprendono le proprie attività.

Divergendo da questo retroterra concettuale, il lavoro analizza le strutture amministrative e proprietarie dei maggiori porti per contenitori dell'Asia mettendoli in relazione alla "matrice di funzione portuale" e valutandone la relativa efficienza.

**Parole chiave:** trasferimento di proprietà, settore pubblico, settore privato, concorrenza interportuale e intraportuale, "matrice di funzione portuale"