(Q1a) Public service port characteristics:

Fully controlled by port authority / ministry of transport

- own, maintain & operate all assets, including port infrastructure and superstructure, build port,
- directly employs labor for cargo handling activities

Leadership is composed of public officials, recruited by state or federal government

Mainly focus on the realization of public interests

Mostly found in developing countries

Public, private / mixed provision of service

While tool port..

ownership of infrastructure

Partly controlled by port authority / ministry of transport i.e. maintains & operates most assets, including port infrastructure and superstructure and directly employs labor for cargo handling activities, except

- cargo handling on board vessel
- Apron / quay
- Port authority leaves superstructure to private cargo handling company who signs contract directly with cargo owner
- Its impeding success depends on the allocation of services & liabilities between the port authority and cargo handling company
- A good means of transition from tool port to landlord port.

Although public service port has strength of unity of command, disadvantage of public service port are:

- lack of internal competition leading to inefficiency
- operations not user or market oriented
- Underinvestment due to dependence on government budget (limited / tight)
- lack of innovation

Therefore ~~involving~~ tool port allow port to avoid duplication of facilities, but disadvantage of tool port still involve:

- conflict of interest due to split operation
- limited future expansion as private sector doesn't own major equipment
- Risk of underinvestment
- Lack of innovation

Q1(b) The advantage of landlord port:

- single entity to operate and likely to make long-term investment
- Market oriented which is the main goal of a company

3 different port pricing approach 1. Cost base pricing 2. Perf-based 3. Value-based.

1. Cost-based pricing (CBP)

A price base on the costs incurred in providing a service/facility. Fixed cost - cannot be avoided whether a service/facility is used/not. Variable cost can be avoided while marginal cost is incurred in providing a given service/facility for an additional time to the period originally intended. The cost based tariffs are used to achieve marketing objective & financial objective. Marketing objective - max the use of port user; Financial objective - covering the variable cost of these services.

Average cost pricing - based on adding total FC & VC, diving this sum by the projected demand for the service & facilities.

Type of port charges under CBP

Pilotage: service rendered by licensed marine pilot in guiding vessels in and out of the port. Navigation channel gaining access to the port area. Approaching channel in the port area.

Towage: service rendered by tugboat in towing/tugging the berthing of vessels. Increase the size of tugboat used & the time of use. 2 small (10-16t) tug boat for vessel >80m but <100m, 2 medium (17-24T) tugboat for vessel between 100-180m, 2 big (>24T) tugboat for vessel bigger than 180m.

Mooring: A special port charge for securing vessel during berthing & operations

8 stevedores for vessel <150m

10 for vessel 150<200m // 12 for vessel bigger than 200m

Equipment hire: Equipment rental cost involved in loading or unloading of cargoes by handling equipment at quay and terminal yard.

Stevedoring: related to labour costs involved in the process of loading/unloading of cargoes & other activities in terminal operation.

2. Performance based pricing (PBP)

Promote efficient behavior of the users of a facility throughout by using the facilities at optimal level.

-rebates from the published tariff can be offered to those ships that starts to work, for e.g one hour berthing & surcharges or fines can be applied to those that start after three hours.

Increase tariff when the level of utilization of facilities is above optimum & decrease tariffs when utilization is below optimum. PB tariffs are used to achieve operational objective & marketing obj.

Operational obj - max. the throughput of port facilities while limiting the level of congestion experienced by users. Marketing obj - minimize the loss of traffic owing to congestion

Q2) High performance indicators are higher value of key indicators / indexes to measure & control the operations performances of a terminal:

Operational level

Port rate: The total number of containers handled on a vessel during its port stay.

Total number of containers handle exclude restow, hatch cover movements, uncontainerized cargoes (UC)

Port rate (Gross) = No. of containers handled on vessel / port stay (Berth - Depart)

Units move per hour (mph)

Eg: ~~Berth @ 21 Mar 0500~~ Arrive @ 0400hrs, Berth @ 0500 on 21 March. starts operations @ 0800, 21 march, completed operation at 21 mar 2200, depart @ 0100, 22 Mar.

Container handled = 2000 TEUs. Port rate (Gross) = $\frac{\text{No. of container handled}}{\text{port stay}} = \frac{2000}{20} = 100$ mph

Net port rate = $\frac{20}{14} = 142$

QC rate: The total no. of containers handled on a vessel with a total operating time operated by a no. of QCs. Σ no. of containers handled on vessel / Σ QC operating time.

Unit move per hour (mph)

PR will ↑ if more QC are assigned to the operations. PR is not ≠ sum of indi QC rate since start time & completion time of each QC may be different.

eg. QC1 started @ 21 Mar 1300 & ended 21 mar 1900 with 300 moves

QC2 started @ 21 Mar 1500 & ended 21 Mar 2100 with 300 moves

$\frac{300}{6} = 50$

50 + 50 = 100 QC rate = 100 mph PR = 75 mph.

RTG rate: The rate to reflect the productivity of RTG. Σ RTG movement / Σ RTG operating time

Unit move per hour (mph)

eg. operating time 1200-1230. Inbound 1xTEU 2xRTG, outbound 1xTEU 2xRTG, Tranship 2xTEU 2xRTG

RTG = $\frac{6}{0.5}$ = 12 mph.

Prime mover turnaround time: The average time required for an external prime mover to complete a round trip for container collection / container delivery upon entering the container terminal.

Σ (completion date time - document hand-in date time) / No. of external prime movers

Unit minute per prime mover.

Q2 Terminal handling capacity level

Quayside : Maximum capacity of a terminal to handle vessels at quayside

QC utilization = peak week load (move) / maximum QC fleet capacity (move per week)

Berth utilization = peak week berth demand (meter-hour) / weekly berth capacity (meter hour)

Unrealistic to achieve 100% berth utilization due to unlikely of having total length of vessel which is equal to the quay length and shorter the length between ~~the~~ vessel risk is higher

eg. Annual TP requirement = 1.0m TEUs

TEU per box ratio = 1.63

Weekly TP peak factor = 1.25

Loading factor per vessel call = 500 moves

QC rate = 30 mph

Port rate = 70 mph

No. of QC = 8

Quay length = 700 m

M+ unmooring time = 2hrs

Avg vessel length = 200 m

Avg vessel berthing clearance = 30 m

$$\text{QC utilization} = \frac{\text{Peak Wk WL}}{\text{Max QC Fleet Cap}}$$

$$= \frac{\left(\frac{1000\,000/1.63}{52}\right) \times 1.25}{8 \times 30 \times (24 \times 7)}$$

$$= 36.6\%$$

$$\text{Berth utilization} = \frac{(200+30) \times \{(14748/70) + \{(14748/500) \times 2\}\}}{700 \times (24 \times 7)}$$

$$= 52.7\%$$

Landside : The capacity at stacking yard to store all the containers being handled by quayside and gate traffic

Stacking demand = annual throughput (TEU) X Dwell time (Day) / 365 days

Usually, stacking demand for different containers types are determined separately as the dwell times are different

Equipment : Support quayside and stacking yard operations ; support restows moves required in digging out the designated containers. Should design to have sufficient equipment to support operations during peak hour of the peak day.

Gatehouse : Should design to have sufficient traffic lanes at both the in-gatehouse and out-gatehouse when external prime movers enter and leave the terminal.

The determination of the no. of traffic lanes is based on the design criteria that it can meet the peak hr demand.

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Q3) Inland port is: A site located away from traditional, land, air and coastal borders with the vision to facilitate and process their international trade through strategic movement in multimodal transportation assets and by promoting value added services as goods move through the supply chain

- A dry port is an inland intermodal terminal directly connected to seaport by rail where customers can leave/pick up their units as if directly to a seaport
- is an intermodal terminal situated inland
- usually with rail connection to a seaport with scheduled and reliable services
- Other services that are available at freight terminals and at seaports eg storage of containers, container maintenance, customs clearance, inspection, consolidation, forwarding etc.
- Act as an intermodal cargoes transfer facility with value added services e.g. interface between rail and truck for the transportation of containers to and from the seaport.
- Allow traditional loading and unloading operations at seaport to be moved inland.

Advantage of the Inland port: Move the time consuming loading and unloading of cargoes inland, away from the congested seaport to improve port productivity; Speed up the flow of cargoes between vessels and land transportation networks, eg. a high-capacity rail link system to the inland port; close proximity to different stakeholders in the supply chain, eg shippers and consignees, free up land area at the seaports, reduce air emission.

Not applicable to SG as SG is a land-scare country, there is already easy transportation of cargo to seaport directly. No need to separate capture cargoes from shippers, unable to speed up cargo flow between vessel and land transportation network for eg Rail link not feasible, unlikely to capture cargoes from neighbouring country such as Malaysia - Port of Tanjung Pelepas (PTP) is of too close proximity to Singapore seaport, let alone inland port, there is no reason to divert cargoes to Singapore. PSA is strategically planned to be where it is located by MPA so having inland port is a waste of resources. SG is a transhipment hub, has to be by the quay & not inland.

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Q4) The amount of containers the portusers chooses to be handled at each port, which is denoted by TEUx and TEUy for port X and Y respectively. The portuser has allocated a budget of 'B' dollars to be spent on such services and the respective generalized cost of using the services of port X and Y can be expressed as Cx and Cy. The budget constraint is assumed to take the linear form of $B = C_x\ TEU_x + C_y\ TEU_y$. C is the respective generalized cost of using the services of the port. Qualitative in nature include: Reliability, reputation etc while Quantifiable in nature includes: Storage costs, Maritime access etc..

The port user's level of utility is represented by the function: $U = f(TEU_x, TEU_y)$. The marginal rate of substitution is represented by

$$MRS_{xy} = -\frac{dTEU_y}{dTEU_x}\Big|_{U=constant}$$

Hence, the port user aims to maximise expenditure: $B = C_x \times TEU_x + C_y\ TEU_y$ such that: $U \geq f(TEU_x, TEU_y)$
The expenditure minimization condition is given by: $-\frac{C_x}{C_y} = \frac{dTEU_y}{dTEU_x}\Big|_{U=constant}$

and the condition of diminishing marginal rate of substitution will provide the necessary and sufficient condition for expenditure minimization. In graphical fig 1, E represents the point where expenditure of the port user is minimized at the level of utility, U. The expenditure minimizing port user chooses to engage the services of both ports and the number of containers handled by port X and Y in terms of TEUs are shown as Xo and Yo respectively, whereas fig 2 shows the expenditure minimizing solution where the port user chooses to engage only the service of port X.

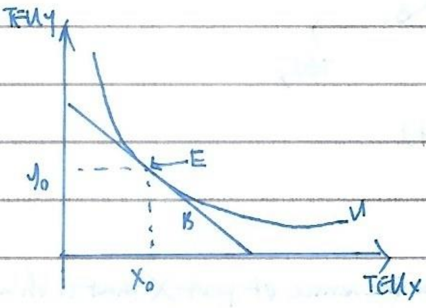


Fig 1

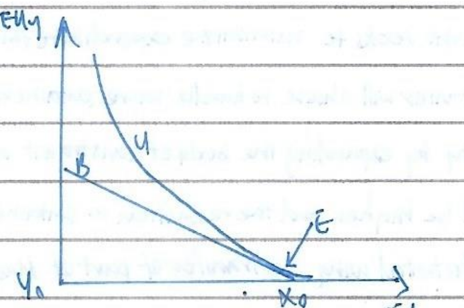
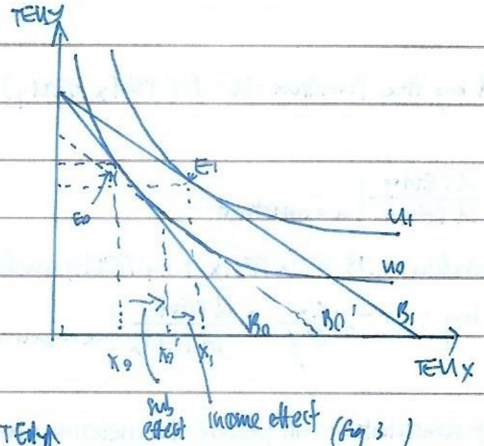
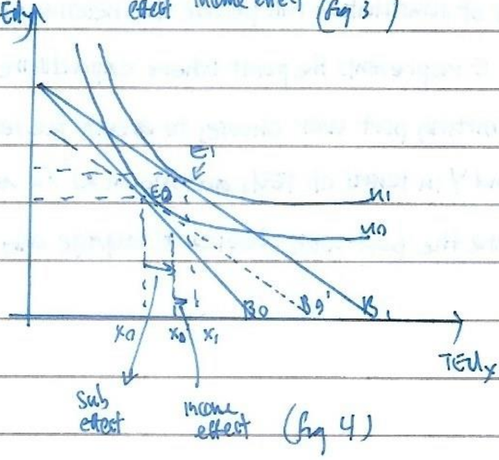


Fig 2

the overall change in demand can be decomposed into income and substitution effects where substitution effect is measured by the change in the relative price ratio of handling one TEU at the two ports while income effect is measured by the change in demand attributed to the change in purchasing power. It is also assumed that port services are normal (i.e. non-inferior) goods.
Graphical illustrations of substitution and income effects for gross substitutes and complements in fig 3 and fig 4

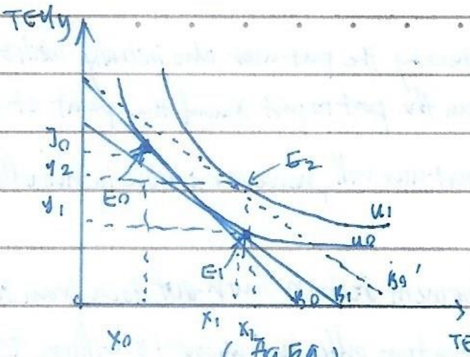


(fig 3)

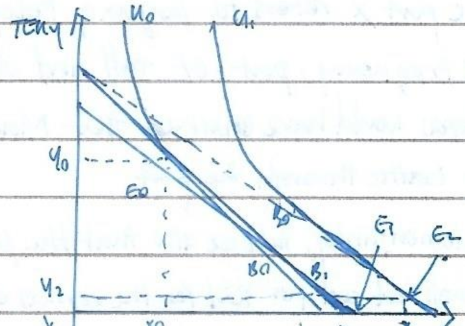


(fig 4)

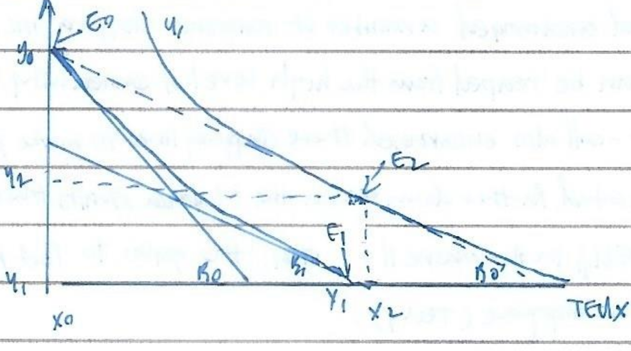
The impact from lower generalized cost per TEU for the service of port X that is shown in fig 5a ~~and~~, fig 5b and fig 5c. will be used to illustrate the impact of these developments on competition between container ports. Suppose the port user will initially utilises the services of both ports. With reference to fig 5a, budget constraints pivots from B0 to B0' due to the reduction in Cx. For a port user who seeks to minimize expenditure for the same level of utility, equilibrium solution is at E1. Hence, the port user will choose to handle more containers at port X rather than port Y. Alternatively, the port user can maximize utility by expanding the budget constraint and the equilibrium solution will be at E2. Container throughput for Port X will be higher and the reduction in containers handled at port Y for the port user will be less severe. This scenario can be illustrated using the transfer of part of Maersk Sealand's container traffic from Rotterdam to its new container terminal in Bremerhaven ~~that~~ Maersk Sealand cited poor service conditions at Rotterdam as the primary motivating factor. This can be translated as a decline in Cx from the carrier's perspective where port X refers to Bremerhaven.



(Fig 5a)



(Fig 5b)



(Fig 5c)

However, the reduction in C_x might be so great as to persuade the port user to bypass port Y altogether with E_1 representing the expenditure minimizing equilibrium holding utility constant (Fig 5b). If the port user aims to maximize utility with the new budget constraint, the equilibrium solution will be at E_2 where some container will continue to be handled through port Y.

This scenario can be illustrated using the case for Busan where container shipping lines Mediterranean Shipping Company (MSC) and China Shipping Company Ltd (CSCL) chose to relocate their transhipment hubs from Busan to other major ports in mainland China in 2003. The carriers cited high port charges at Busan and increasing cargo volumes at mainland Chinese ports as the main reasons that influenced the decision to relocate. The effect translates into lower overall costs of calling at the affected mainland Chinese container ports (C_x).

Fig 5C present another plausible scenario whereby the port user who initially utilizes the services of only port Y decides to shift its entire throughput from the port to port X and the point of equilibrium changes from E_0 to E_1. Under the case of utility maximization, the port user will, however choose to handle containers through both ports and equilibrium will be at E_2

The shifting of Maersk Sealand's transhipment hub in South-east Asia from Singapore to Tanjung Pelepas can be used to illustrate the case. The relocation affected about 1.8 million TEUs. Maersk Sealand cited lower costs and the opportunity to have dedicated facilities in Tanjung Pelepas as the main attraction for hubbing at the port (i.e. lower Cx where port X refers to Tanjung Pelepas).

However, the strong connectivity in service frequency, port-of-call and shipping lines offered by Singapore as compared to Tanjung Pelepas would have ensured that Maersk Sealand continue to tranship a significant share of its container traffic through the port.

To illustrates inter-container port complementarity, suppose also that the port user initially utilizes the services of both ports, a reduction in the generalized cost per TEU for the services of port X will result in the budget constraint pivoting from B_0 to B_1 (see fig 6a). Hence a reduction in Cx led to an increase in Port Y's throughput. The case of port Klang and Singapore can be used to illustrate this scenario. Enhance service reliability and terminal productivity and higher base load at Port Klang from the late 1990s lowered the costs of calling at the port, i.e. Cx, and encouraged a number of container shipping lines to call direct at the port, the substantial economies that can be reaped from the high level of connectivity in term of service frequency, number of shipping lines and port-of-call also encouraged these shipping lines to make parallel calls at the neighbouring port of Singapore located further down on the Malacca straits thereby generating greater traffic for the port (i.e. higher TEUy) in the above illustration, the gains to Port Klang's throughput (TEUx) are greater than those for Singapore (TEUy).

In fig 6b, the reduction in Cx which led to higher container volumes for Port X can also encourage the port user to commence usage of port Y's services for its traffic. The case for the port of Hamburg can be used to depict this scenario. Hamburg has been striving to become the premier container hub for the northern, east central and eastern European economies through attempts to improve hinterland and maritime access to ports located in these regions. The result of these actions could be to lower Cx where Port X is represented by Hamburg. Container shipping operators are thereby encouraged to initiate feeder services and mainline operators are motivated to extend shipping services to call at ports previously excluded from the port-of-rotation thereby generating higher throughput for these container ports (TEUy). Coupled with greater social and political stability experience by the economies in central and eastern Europe.

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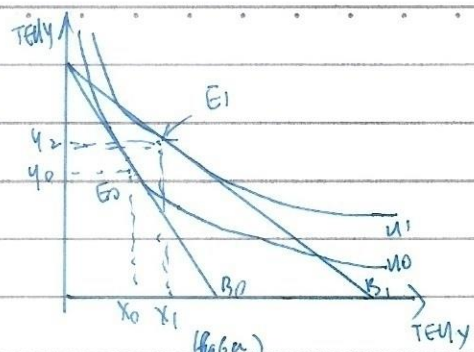
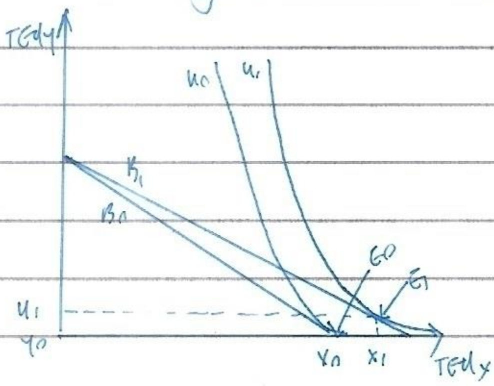


(fig 6a)



(fig 6b)

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