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Ocean Economics Review of China

第一卷
Volume 1

姜旭朝 主编

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Route Selection by Tankers (Dirty) at the Suez Canal

Risto Laulajainen *

[Abstract] The Suez Canal, attached route alternatives with traffic flows and areas are described and theoretical break-even points derived. Logistically, route selection depends on relative distances, the level of spot rates and canal dues, the sensitivity to change growing with rising rate levels. The connection is diluted by the canal/pipeline owners' price differentiation and the charterers' capital costs; interest on cargo and change of its value during transit. Ship-owners are largely neutral to route choice as long as rates and main cost items are directly related to distance.

[Key Words] break-even, oil price, opportunity cost, traffic area, Worldscale

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* Risto Laulajainen is Professor of Gothenburg School of Business, Economics and Law, PO Box 630, SE-405 30 Gothenburg, Sweden, www.ristolaulajainen.com. E-mail: risto_laulajainen@geography.gu.se.

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1. Introduction

This article has grown out of a study on regional differences in worldwide freight rates, interpreted as tokens of market inefficiency. Their rationale is regional imbalances in the demand and supply of tonnage. Plotted against distance-weighted demand/supply balances, the regional rate levels can be approximated by a rising line, the Revenue Gradient (Laulajainen, 2007: Figure 2). This sounds very basic but its empirical verification can be cumbersome. One reason is physically diverging routes between loading and discharging areas, routes whose relative attractiveness is by no means clear-cut and subjected to fluctuating freight rates.

Routing choices in general have at least four origins: weather, intervening land masses, location on opposite sides of the globe and isthmuses cut by sea canals. A trip between Gothenburg and New York, for instance, rounds the British Isles either by a northern or southern route, depending on weather. The equidistance line for east and west bound trips from the northern Atlantic to the Far East has numerous possible locations, depending on the port of departure and the decision of whether to use a sea canal or not. This decision is influenced by the level of freight rates relative to canal dues and whether the vessel is laden or in ballast. Choice of route is left to the ship's master when plain nautics are involved, but when canals are a possibility, the chartering department will intervene and the choice is written down in the charter party.

The canal-owner, enjoying a partial monopoly, sets the fees so that revenues are maximized. The solution is complicated by the multitude of possible loading and discharging ports and the fluctuation of rate level (Abu-al-Hassan 1974, 36; Hansen and Khairy 1974, 120). Superficially, the charterer opts for inexpensive transport, cargo's capital cost included, which may—but need not—call for the shortest distance. The ship-owner strives for maximum net revenue in time unit, which leads to the concept of opportunity cost, the possibility of earning additional revenue by cutting the time used. When rates are low and cargoes rare, the opportunity cost is low and it is rational to select routes that minimize cash outlay and occupy the vessel for a long time, and vice versa. But in a rapidly moving market with local price anomalies and cargo legs lasting for 30 – 40 days, it is difficult to put a price on the opportunity cost and make a sound decision. No ship manager interviewed by this author has ventured to give a straight answer to the question: Would you prefer a Suez Canal or Cape route, today? There have always been qualifications. This being the case, analysts looking for logical rules for a computer program to simulate worldwide tanker movements are forced to conduct studies of their own. This is the overall problem. It disaggregates into several sub-problems:

- What are the route alternatives?
- What are their traffic flows?
- What is known about the costs?
- Where are the traffic area boundaries?
- How are the boundaries affected by changes in cost?

The problem in its general form is classical and one would expect a deluge of case studies. Exactly the opposite is the case. Two renowned bibliographies, the one covering Maritime Studies (McConville and Rickaby, 1995) and the other Operations Research (IAOR, 1971 - 1996) have very little to offer and most of it has been included in this article. Subsequent journal issues and three recognized standard works (Brooks *et al.*, 2002; Grammenos, 2002; Stopford, 1997) are equally mute. The explanation may be that worldwide studies of ship movements have not been in vogue and attached route selection has not been in great demand either (Sargent, 1930; Isserlis 1938 and Manners 1971 are rare exceptions). It is natural then to begin with the canals and attached trade flows. The empirical data is tankers carrying "dirty" cargoes (crude and heavy fuel oil) in 2004 (LMIU Movement Data, 2004). The data does not specify ballast legs but it is estimated that 95 percent of them were made through the Suez Canal (Mandryk, 2005). Freight rates were unusually high for much of the year which helps in discovering behavior patterns (Gibson Fixture Data, 2004).

Ocean shipping makes use of only two large canals, Panama and Suez. The capacity of *the Panama Canal* is constrained by the size of its locks which allow a maximum (Panamax) vessel of about 80,000 dwt, also in ballast. The actual limit can be still lower under lengthy dry periods because the canal's water supply comes from rivers. Rounding the Cape Horn is meaningful only for the southern Brazil-northern Chile range. This puts the canal in a strong competitive position for traffic between the American costs. Only the potential for "dirty" cargoes is modest there and the Trans-Panama Pipeline from Charco Azul to Chiriqui Grande offers some competition for eastbound traffic (Table 1). Traffic to the Far East would use larger ships, unable to pass the canal. It follows that the share of cargoes that can be thought to use the canal is less than 10 percent of all Panamax cargoes and these, in turn, account for less than 10 percent of the global workload of "dirty" tanker traffic (Laulajainen, 2008). The modest role of the Panama Canal combined with its steady grip of the available traffic, high rates or low rates, make it an uninteresting study object.

Table 1 **Panama Canal's orbit, 2004**

Direction	Panamax cargos		
	Canal	Pipeline	Pacific
Westbound	107		
Eastbound	42	14	
Pacific			172

Note: LMIU Movement Data (2004) records 167 passings.
Source: LMIU Movement Data (2004).

The situation at *the Suez Canal* is completely different. The canal is at sea level and without locks. Traffic is in convoys which meet at two bypasses. Passing in full cargo is possible for ships of about 220, 000 dwt, that is, also the smallest of VLCCs (www. eia. doe. gov). From 1977 the Canal's functions have been replicated by the Sumed Pipeline, a low-cost alternative to enlarging the canal and increasing its capacity (Griffiths and Hassan 1977). The pipeline accepts only northbound cargoes, runs from Ain Sukhna to Sidi Kerir, and has storage tanks for 4 – 5 days' throughput (Arab Petroleum Pipelines; www. eia. doe. gov). The canal is wholly-owned by the Egyptian State and the pipeline by co-owners Egypt and Middle East oil producers, excepting Iran.

The canal is at the apex of global trade flows and shortens the trip between northwest Europe and Mumbai by over 40 percent and Shanghai by 25 percent. The financial saving is far smaller than the saving in physical distance, however, because of canal dues. The American coastline, from New Foundland to the Amazon River, also uses it. Australia lies too far south and is better served by rounding the Cape of Good Hope. Panamaxes, Aframaxes and Suezmaxes use mostly the canal. Complications arise with VLCCs. Northbound, they have three alternatives:

- Unload part cargo in Ain Sukhna and reload it in Sidi Kerir (Sumed route).
- Round the Cape of Good Hope and ballast back via Suez (Cape-Suez

route).

- Round the Cape of Good Hope in both directions (Cape route).

The alternative, where they operate for the Sumed but do not pass the Suez Canal, is outside this discussion, as are voyages with a return cargo, making the Cape route the only meaningful alternative.

2. Traffic flows

The traffic flows are given at three levels of detail. The aggregate level focuses on the route alternatives and differentiates between northbound and southbound traffic by route and ship segment (Table 2). It does not detail loading and discharging regions. Regionalization happens at the intermediate level, which is cartographic, and comprises only northbound traffic (Figure 1). The detailed level provides a simplified trade matrix in two parts (Appendix 1). The upper part has a coarse regional framework whereas the lower part uses a finer regional mesh but is selective by ignoring scattered regions of minor importance. Northbound traffic is split into two, that loading in the Middle East Gulf (MEG) and the Red Sea and that loading in Singapore and Indonesia. The former also identifies the discharging region. Southbound traffic is split into loadings and dischargings only.

Table 2　　Tanker (dirty) cargos by route, 2004

Segment	Northbound					Southbound		Tonnes (mill.)	
	Cape	Suez	Sumed	AS	SK	Cape	Suez	Cape	Suez
Panamax	1	12			3	5	10	0	1
Aframax	5	40		17	258	11	48	0	24
Suezmax	11	89	3	14	224	4	42	1	43
VLCC	337		156	274	87	78		94	160
Total	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	n. a.	96	228

Notes: Sumed means the same vessel before and after the pipeline. Cargos to Ain Sukhna (AS) and from Sidi Kerir (SK) by different vessels. Tonnes northbound, 0 below 0. 5.

Source: LMIU Movement Data (2004).

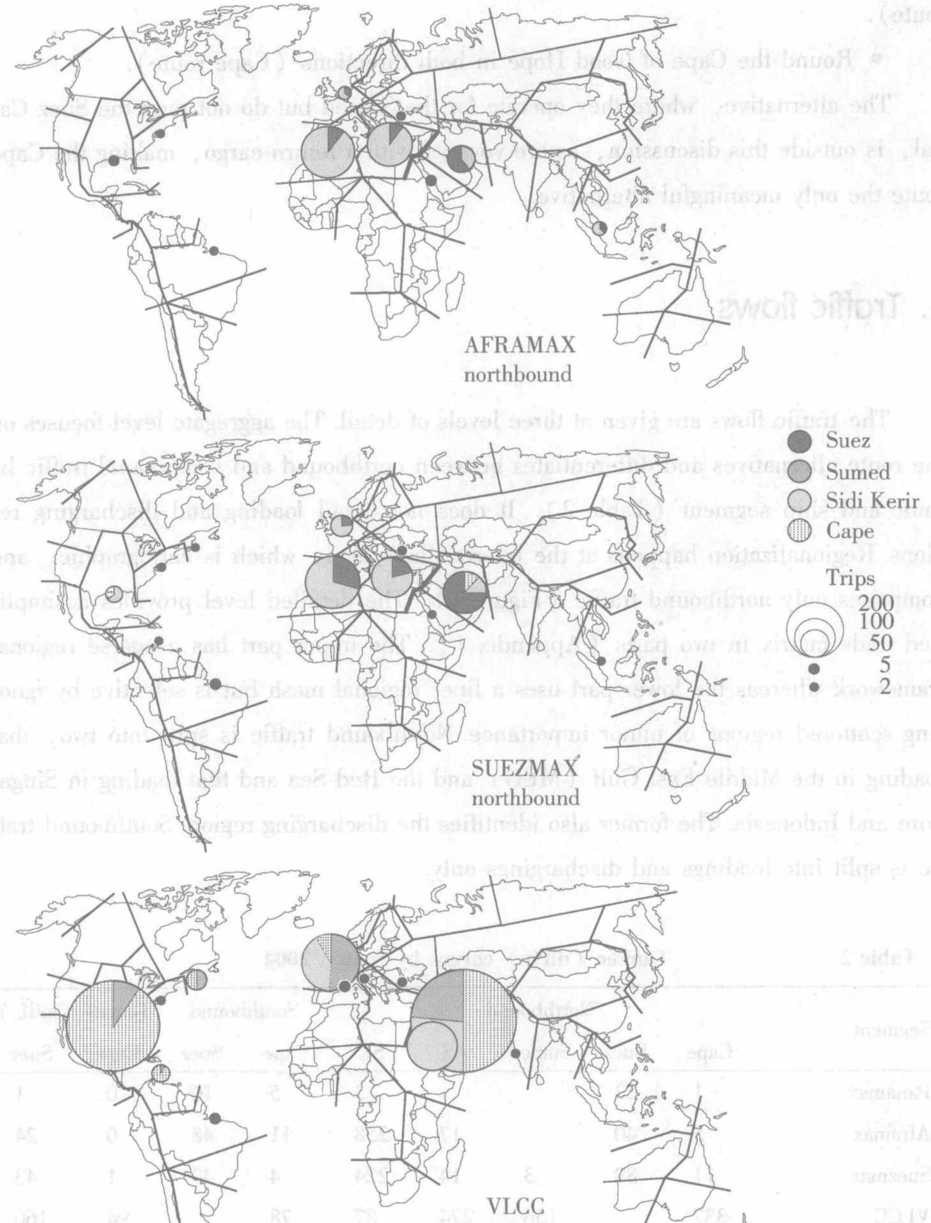

Figure 1 Northbound cargos on the Suez and Cape routes, 2004

Legend: Sumed means the same vessel before and after the pipeline. Sidi Kerir means different vessels: arrival to Ain Sukhna and departure from Sidi Kerir. Markers on the eastern side of the canal indicate loadings, on the western side dischargings.

Source: LMIU Movement Data (2004).

Overall, the role of Panamaxes is subdued because available cargoes are too large for them. Practically all *northbound* shipments originate from MEG or the Red Sea and end in the Continent or US Gulf (USG). Most Red Sea loadings take place in Yanbu, the end point of the East-West pipeline. Shipments to the Continent arrive by the Suez/Sumed route, those to North America mostly by the Cape route. There is no differentiation by age, as might be expected, so that older ships, which are less-attractive but have lower capital costs, would select the Cape route. Shipments to North America and north-west Europe are preferably made by VLCCs, those to the Mediterranean by Suezmaxes (West Med) and Aframaxes. That coincides with the proven principle of using large vessels on long routes and small vessels on short ones. *Southbound* shipments originate primarily from the Continent and, to a lesser degree, the US Atlantic coast and USG. Most end in Singapore, followed by Far East Proper and India. The role of the Black and Baltic Seas as loading regions is surprisingly large. The gradation of ship size on the Continent is again evident: smaller units close to Suez. VLCCs exclusively use the Cape route because the Sumed route does not operate southbound. The large number of southbound shipments may be a surprise. The main explanation is crude qualities: North Sea and North African crudes are low-sulfur, whereas MEG crudes are mostly medium-to high-sulfur. The former are needed for blending with the latter. Other explanations include the desire to differentiate sources and the uneven geographical distribution of production and refining capacity at oil companies.

3. Rates and dues

The analysis of alternative routes is conducted by comparing transportation costs from loading to discharging regions and evaluating the sensitivity of traffic volume to variation in cost. This necessitates familiarity with pricing principles and a few tangible figures.

Most tanker rates are expressed in the Worldscale (WS) system (Fuglesang 2001). The rest are given by an all-inclusive lump sum in US dollars, common in traffic with and within India, China and the Caribbean. This study uses only WS-rates, either genuine or ones converted from lump sums. Worldscale annual reference rates, called flat rates and noted WS-100, are given in US$/tonne (Mt, metric ton) for a vessel of 75, 000 tonnes (about 73, 500 tonnes pay-cargo) between given port pairs or their combination on a round voyage basis (WS Book 2004). In reality, only one-quarter of all cargo sequences (ballasting – loading – cargoing – discharging) follows this pattern (Laulajainen and Johansson 2006, Table 2). The bunker consumption is 55 Mt/day at sea, 5 Mt/port visit and 100 Mt/voyage. The flat rate is a total of bunker costs at sea and in port, usual port charges and a notional "hire element" intended to cover other operational costs, capital costs and possible profit/loss. A flat rate does not include canal dues, special charges applicable only at certain terminals, or special taxes (fixed and variable differentials). Bunker prices and port charges are collected by surveys during the preceding year. In flat rate conditions, all routes give the same daily hire element. Comparability is the WS-system's *raison d'être*. Spot rates (market rates) are quoted in relation to flat rate but are only broadly comparable with each other. Comparability deteriorates further when flat rate parameters, for example cargo size or bunker costs, change. For comparability, it is necessary to subtract known cost items from the gross revenue and divide the net revenue by the number of days to arrive at an approximate Time Charter Equivalent (TCE). Laulajainen and Johansson (2006) offer a compact analysis.

Flat rates do not include Suez Canal dues. For them, the vessel's dwt is first converted to Suez Canal tonnage (SCNT) with multipliers derived from LMIU Vessel Data (2004) (Appendix 2). Of the four size classes, only the two largest are relevant here. The dues consist of a tonnage-related fee and a lump sum. The fee declines with ship size, whereas the lump sum increases. Vessels pay, in addition, a smaller, dwt-based lump sum, the size of which depends on whether they are on a round voyage and laden, or just ballasting.

Realistic route alternatives do not differ dramatically from each other if full canal dues are paid (Table 3). These, however, are negotiable and, consequently, classified information. To enhance competitiveness with the Cape route, they are differentiated by region and adapted to fluctuating spot rates (Bäcklund 2006; Porter 2005; 2006), as are Sumed rates. Much of the Sumed traffic originates from the owners. Examples highlight the limits of economic reasoning.

Table 3　　Two Aframax rating examples at WS-100, 2004

		Cape-Cape	Cape-Suez	Suez-Suez
Quoin Island – Rotterdam		66 days	52 days	38 days
Flatrate	19.46 C	1,751,400		
	15.64 CS		1,407,600	
	11.82 S			1,063,800
Suez dues			165,280	366,499
Total		1,751,400	1,572,880	1,430,299
Quoin Island – Houston		74 days	66 days	58 days
Flatrate	21.70 C	1,953,000		
	19.62 CS		1,765,800	
	17.55 S			1,579,500
Suez dues			165,280	366,499
Total		1,953,000	1,931,000	1,945,999

Notes: Cargo 90,000 tonnes. Rate differentials (see text), except canal dues, ignored.
Source: WS Book (2004).

4. Traffic areas by plain logistics

Plain logistical analysis, one based exclusively on freight rates and canal dues, is rather straightforward. It is conducted for vessels smaller than VLCC and the relevant alternatives comprise the Cape – Cape, Cape – Suez and Suez – Suez routes, northbound and southbound. Most of the analysis applies to a 90,000 cargo-tonne vessel (Aframax), larger than the reference unit above. The difference is not very relevant. Noteworthy is that, although flat rates ($/tonne) differ between the routes, the WS spot rates do not. It means that a percentage change in rate level between two ports is independent of the route.

The broad picture is that traffic between North Atlantic and Asia's southern and eastern coasts benefits from the Suez Canal, whereas more southern ports prefer the Cape route. The canal's traffic area must consequently be sought from a broad east-west zone in the northern mid and low latitudes. Regions within this zone are included in the analysis and estimated by Reference Ports (Figure 2; Appendix 3). Flat rates with distances and canal dues are taken from the WS Book (2004) and compared with each other at different spot rate levels. Differentials, except canal dues, are not considered because they are often politically rather than logistically motivated, or constrained only to parts of individual ports.

The analysis focuses heavily on two "port" pairs, North Sea and Quoin Island in the mid-latitudes, and Bullen Bay (Curaçao) and Singapore in the low latitudes. Quoin Island and Singapore are the main Reference Ports for northbound trips, whereas North Sea and Bullen Bay are for southbound ones. Actually, Quoin Island is a place in the Hormuz Sound conventionally used for measuring distances from the Gulf's numerous loading ports. Since the Gulf is 500 nm long, this is a considerable simplification. North Sea loadings are approximated by three alternative ports/terminals. Such approximations originate in the first case from the widely dispersed ports, and in the second case from the impossibility to find a single port which would have flat rates to all the discharging ports selected. Similar simplifications also exist in other regions.

The actual analysis consists of route comparisons by port pairs conducted at WS-50 intervals for the range WS-50 to WS-350, which covers most Aframax spot rates (Gibson Fixture Data 2004). Full canal dues are included. If the Cape route is cheaper, that happens irrespective of the ballasting alternative, Cape or Suez. Therefore, and for better legibility, the cartography differentiates the route alternatives only by their cargo legs (Figure 2). A ballast leg through the canal becomes a competitive advantage as from WS-100. Relative distances explain most of boundary dynamics within a segment. When the Suez Canal is taken as a reference point, distances increase from Rotterdam to Come by Chance and further to LOOP/Houston, to decrease thereafter. Distances to Mumbai are shorter than to Kolkata and Singapore which are equidistant. The other ports are beyond Singapore. Via Cape, Quoin Island is closer than Singapore to all the destinations relevant here. For *northbound* traffic, the Suez route is superior to the Continent in almost all situations and also becomes the preferred alternative to North America at WS-150 if loading takes place in MEG. But if loading takes place in Singapore, then rates must increase to WS-200 for the same effect. For *southbound* traffic, the switch from the Cape route to the Suez route also happens between WS-50 and WS-100 when the loading port is in the North Sea. But if it is in the Caribbean, the switch takes place much later. The Cape route's position is obviously strongest when rates (and opportunity cost) are low.