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Fuel surcharge practices of container shipping lines: Is it about cost recovery or revenue-making?

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Abstract

This paper deals with shipping lines' practices of levying a fuel surcharges on shippers, also known as the Bunker Adjustment Factor or BAF. Shipping lines have more than once argued that the increase in bunker prices, especially in the short term, is only partially compensated through surcharges to the freight rates. In contrast, shippers have always objected that the way BAFs are determined is opaque, without uniformity, and involves a significant element of revenue-making. The recent repeal of European-related liner conferences in the wake of EU legislation has forced many shipping lines to develop new methods for calculating fuel surcharges leading shippers to scrutinize the new practices regarding BAF and developed by individual carriers. This paper contributes to this issue in focusing on the relationship between fuel costs fluctuations and fuel surcharging practices. The central research questions put forward are as follows: How have shipping lines changed their practices regarding BAF, considering the end of the liner conference era in Europe? How can bunker costs be estimated for a specific service? Can it be concluded, as stated by shippers, that BAFs are used by shipping lines to generate additional revenue or are they only, as stated by shipowners, used to recover bunker costs and to cope with their unexpected fluctuations? To answer these questions, we apply a cost model to various routes and compare our estimates on fuel costs with the observed BAFs on a set of port-to-port liner services out of the port of Antwerp. The dataset relates to June-July 2008 (prior to the end of the conference system) and December 2008 (post liner conference era).

Conference theme: competition in the maritime sector

Keywords: liner shipping, fuel surcharge, pricing strategies, liner conferences

1. INTRODUCTION

For liner shipping activities, not least container shipping, bunker oil is a considerable expense. According to Germanischer Lloyd (LSE, 2008a) or to the World Shipping Council (LSE, 2008b), the fuel bill for a 8000 TEU ship accounts today around 50-60% of its operating costs, a 33% increase compared to three years ago. This impressive growth has led shipping lines to adapt their operating practices on bunker management (Notteboom and Vernimmen, 2009) using cheaper fuel grade alternatives, improving vessel design, reducing vessels' speed adding capacity or dropping the number of ports of call in order to keep a weekly frequency in services and hedging against future bunker price variations.

This paper focuses on another traditional way used by shipping lines to hedge against the risks for sharp and temporary fluctuations in bunker costs and to mitigate their impact on the overall freight rate: levying a specific surcharge on shippers known as the Bunker Adjustment Factor or BAF. BAF aims at passing the fuel costs on to the customer through variable charges and is controversial. Shipping lines have more than once argued that the increase in bunker prices, especially in the short term, is only partially compensated through surcharges to the freight rates and that it still affects their earnings negatively. In contrast, shippers' organizations such as the European Shippers' Council have always objected that the way BAFs are determined is opaque, without uniformity, and involves a significant element of revenue-making.

If the issue regarding BAF and its relevancy is not new (Menachof and Dicer, 2001), the concomitance of two events has made it even more salient today. On the one hand, the sharp increase in bunker costs between late 2005 and the summer of 2008 combined with the decrease in freight rates has led BAFs to unprecedented levels to a point where they had become a significant component in the overall costs to ship goods. For the second quarter of 2008, the base freight rate for a forty-foot container from Shanghai to Antwerp had reached around US\$ 1,400 USD, to which a BAF of US\$ 1,242 was added. On the other hand, the recent repeal of European-related liner conferences in the wake of EU legislation has forced many shipping lines to develop new methods for calculating fuel surcharges leading shippers to scrutinize the new practices regarding BAF and developed by individual carriers.

This paper contributes to this issue in focusing on the relationship between fuel costs fluctuations and fuel surcharging practices as part of carriers' pricing strategies. The central research questions put forward are as follows: How have shipping lines changed their practices regarding BAF, considering the end of the liner conference era in Europe? How can bunker costs be estimated for a specific service? Can it be concluded, as stated by shippers, that BAFs are used by shipping lines to generate additional revenue or are they only, as stated by shipowners, used to recover bunker costs and to cope with their unexpected fluctuations?

To answer these questions, this article is organized as follows. The next two sections discuss the viewpoints of shippers and shipping lines and zooms in on past (section 2) and current (section 3) practices of fuel surcharges. Section 4 presents a model aiming at calculating the bunker cost for a specific service that takes into account vessels (size, speed, engine type...) and service (days at sea, at port) as the main characteristics. Section 5 applies the model to

various routes and compares our estimates on fuel costs with the observed BAFs on a set of port-to-port liner services out of the port of Antwerp. Section 6 provides the conclusions and explores avenues for further research.

2. FUEL SURCHARGES IN THE LINER CONFERENCE ERA

In order to understand the factors considered by shipping lines in determining BAFs a distinction must be made between practices before (collective pricing) and after the liner conference era (individual pricing). Liner conferences have always played an important role in pricing issues linked to fuel costs. The system of collective rate-setting dates back to the first conference, the Calcutta Steam Traffic Conference, set up by British cargo lines in 1875, however, BAF was only introduced in 1974 following the first oil crisis when bunker prices rose from US\$ 20 per ton to over US\$ 100 per ton in three months (Menachof and Dicer, 2001:143).

In principle, carriers cover basic bunker costs, while BAFs only apply to changes above a certain level. Liner conferences came up with their own way of dealing with BAF in applying a surcharge adjusted on the first day of each month and based on the closing IFO 380 bunker price in Rotterdam on the last weekday of the previous month (table 1). The dollar price was then converted to Euros at the closing rate of exchange in London on the same day (last weekday). If the bunker price went below Euro 140 per ton, the surcharge was withdrawn.

Table 1: BAF surcharge percentage for bunker price classes

IFO 380 price level (euro per ton)	BAF surcharge	IFO 380 price level (euro per ton)	BAF surcharge
140 (Base level)	2.00%	216-220	6.50%
141-155	2.50%	221-230	7.50%
156-165	3.00%	231-240	8.00%
166-180	3.50%	241-250	8.50%
181-190	4.50%	251-255	9.00%
191-200	5.00%	256-265	9.50%
201-205	5.50%	266-279	10.50%
206-215	6.00%	271-280	11.00%

Surcharges were jointly fixed by conference members and abided by outside operators as well. The approach taken by the Far Eastern Freight Conference (FEFC), a liner conference for the Europe-Far East trade which ceased to exist in October 2008, represent a good illustration of such practices. When the FEFC introduced a BAF system in the aftermath of the oil crises of the 1970s, the underlying justification was that carriers operating within liner conferences could not otherwise adjust their prices promptly enough to counteract the effect of bunker price increases. When first introduced, the basis of the FEFC BAF calculation was

the prices paid by the member lines and reported by them to third party chartered accountants.

However, because the prices reported remained confidential, the system was felt to be too opaque by customers. Lines accordingly changed the system in order to base the BAF calculation on independent indices shown in the Marine Oil Bunker Market Report – published to subscribers and in the shipping press by Cockett Marine Oil Ltd. The BAF system as applied by the FEFC changed over the years from a percentage of the freight on a 90-day average to a lump-sum based on a monthly calculation. This new system aimed at reflecting more closely the changes, both upwards and downwards, that occur in the volatile bunker market, with a lag effect in the application of the BAF. For instance, the February figures, after a month's notice period, were only applicable in April and the BAF calculation was monitored twice per week, to coincide with the publication of the Cockett report. It used a weighted average for fuel loaded in Asia, the Middle East and Europe throughout the month, and then averaged to provide the monthly BAF. An example of the calculation of the BAF per TEU is presented below:

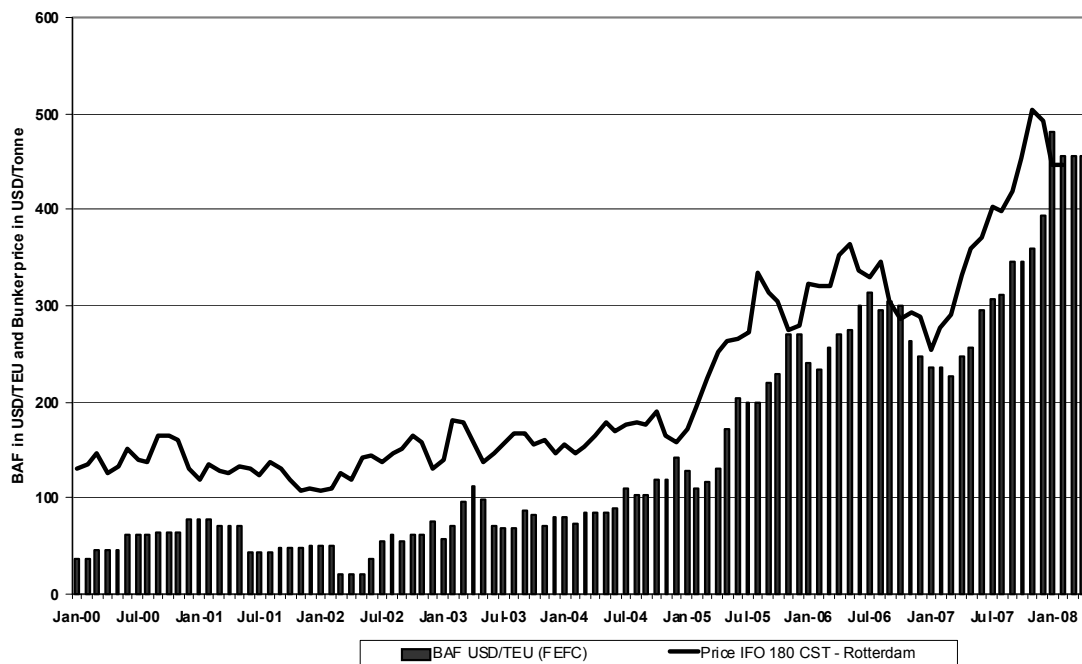
$$BAF = \frac{I_t - I_b}{I_b} \cdot C_b$$

With:

- I_t Average weighted index (bi-weekly)
- I_b Base index
- C_b Base Bunker cost per TEU

The fixing of BAFs by liner conferences has always been a source of contention in shipping circles, particularly in times of high fuel prices. Research commissioned by the European Shippers' Council (ESC) into bunker surcharges applied by liner conferences more than once created a growing disquiet as BAFs were found to be higher than actual fuel costs in some cases. Meyrick and Associates (2008) concluded for instance that the level of the BAF applied by the FEFC and Trans-Atlantic Conference Agreement (TACA) in early 2008 would involve a significant element of revenue-making. The model estimated that the 'true' cost-recovery BAF per TEU for March 2008 was 67 US\$ lower than the real FEFC BAF of US\$ 456 per TEU. For the TACA, the difference was even more emphatic: an estimated 'true' cost-recovery BAF of US\$ 185 per TEU versus an actual TACA BAF of US\$ 607 per TEU (a difference of some US\$ 422 per TEU in March 2008). These studies strengthened the belief of the European Shippers' Council (ESC) that shippers are being overcharged when it comes to fuel surcharges set by liner conferences. Cariou and Wolff (2006) reached a similar conclusion. Investigating if a Granger causal relationship exists between the bunker adjustment factor (BAF) charged by members of the FEFC and bunker prices on the Europe/Far East container trade (Figure 1), the authors conclude that from 2000 to 2004, a causality can be established but that an increase in fuel price by 1 would lead to an increase in BAF by 1.5.

Figure 1: Bunker price in Rotterdam (US\$ per ton) and FEFC's BAF (US\$ per TEU)



Source: authors based on data from Drewry Shipping Insight, ISL Shipping Statistics and Market Review and FEFC website

A survey commissioned by the European Liner Affairs Association (ELAA) went even further by stating: ‘The general perception, especially from non-forwarder accounts, is that there is hardly any correlation with the underlying costs and that the surcharges are meant as an additional money maker for the lines’ (MEL, 2005: 5). The growing disquiet among shippers fuelled the demand for more transparency in the calculation of fuel surcharges.

The position of shippers in relation to the Bunker Adjustment Factor (BAF) was made very explicit in a document of the European Shippers’ Council’s submission to DG Competition of the European Commission on the review of Council Regulation 4056/86:

‘Shippers do not accept the ocean carriers’ claim that they operate in a unique environment and they are a special case deserving special protection from market forces. Shippers face similar business risk when trading in global markets; they are unable to pass on additional costs incurred through the use of surcharges. [...] Bunker Adjustment Factors (BAFs) are being assessed as a collective surcharge by all members of a liner shipping conference whereas each carrier has its individual policy for fuel buying and consequently the prices vary accordingly. Moreover, it has never been demonstrated that the BAF increases reflect the true additional fuel costs. [...] The absence of transparency in the imposition of surcharges has led shippers to call for their abolition. The method by which surcharges are calculated is complex and because of averaging of surcharges within a conference, surcharges are unrelated to the actual costs experienced by individual shipowners. Surcharges are used as a means of obtaining additional revenues.’ (ESC, 2003: 20).

In its response to a later information note published by the European Commission's DG Competition on 'Issues raised in discussions with the carrier industry in relation to the forthcoming Commission Guidelines on the application of competition rules to maritime transport services', the ESC further argued that *'The fuel element of a contract with the shipper should solely be the decision of each individual carrier, based on their own individual costs, their own pricing strategy, and consideration of and with their individual customers'* (ESC, 2006:20).

3. FUEL SURCHARGES AFTER THE LINER CONFERENCE ERA

Liner shipping conferences were outlawed in Europe on October 18, 2008. Liner shipping companies have lost their privileged status under EU competition law due to the withdrawal of the liner conference block exemption, which generously authorized horizontal price-fixing and similar agreements between liner shipping companies through Regulation 4056/86 of 1986. Where the liner consortia block exemption does not apply, all cooperative activity should be carefully and individually assessed under the competition provisions of the EC Treaty. The dismantling of liner conferences meant that container shipping lines calling at European ports were banned from discussing freight rates and other additional surcharges such as bunker and currency surcharges and from publishing common tariffs. The same applies for conference business plans and the exchange of confidential information on market shares, volumes or prices between lines. Carriers are now negotiating rates individually with shippers. The loss of the conference structure has thus resulted in the disappearance of the commonality amongst pricing structures and surcharges among conference lines.

On July 31 2008, the FEFC operating on the Asia-Europe trade, the world's second-largest liner conference after the trans-Pacific, issued its last notice on BAF ahead of the European ban on shipping conference activities. The 17 member lines of the FEFC advised shippers of a 13.5% increase in their BAFs on shipments to Europe with effect from September 1 through to October 17, 2008. The FEFC ceased to exist along with other rate-setting groups in trades with Africa, South America, the Indian sub-continent, the Middle East and Australasia. Some, including the Trans-Atlantic Conference Agreement, had already ceased operations earlier than October 2008.

In the European post conference era, carriers will still be allowed to exchange trade data, a task that will be handled by the European Liner Affairs Association (ELAA), an industry lobby group that is transforming itself into a trade association to manage the exchange of information. The ELAA is planning to publish regularly the price of fuel over time in the most common locations for bunkering, as well as publicly available information on average fuel consumption for different standard vessel types so that an average cost per TEU can be calculated. This would increase transparency as to the cost of fuel, and would facilitate individual negotiations on compensation for fluctuating bunker costs.

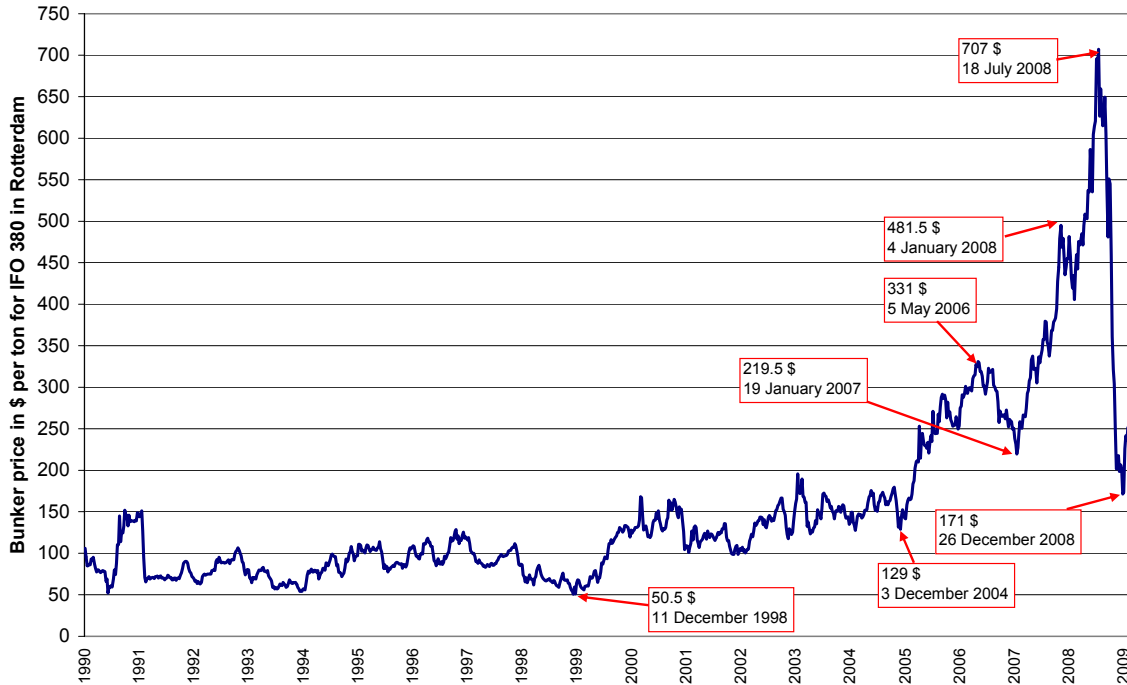
Now that Europe has made an end to the conference system, the question arises as to how long it will survive in other parts of the world, especially in Asia where conferences still are an accepted way of doing business. A number of shipping lines have already taken steps to

end their membership in non-European liner conferences. For example, at the end of November 2008 MOL resigned from the Transpacific Stabilization Agreement (TSA) and the Canada Transpacific Stabilization Agreement (CTSA). The reason is directly linked to the changing pricing and commercial practices following the end of liner conferences in Europe: *'With the European Union's abolition of liner anti-trust immunity, it has become extremely difficult to align the business processes of our entire organization when its regional divisions must operate to differing standards. [...] We concluded MOL and its customers would be better served by conducting business independently from transpacific liner agreements'* (press statement by Masakazu Yakushiji, Executive Vice President, MOL Liner Division, MOL website, 28 October 2008). Also other shipping lines are redesigning business processes and make them applicable throughout their worldwide network.

The leading ocean carriers prepared the abolition of shipping conferences in Europe well in advance. After the European Union voted in 2006 to end liner shipping's block exemption from the EU competition rules, many shipping lines have taken action to become increasingly independent operators. This was further stimulated by the weakening of liner conferences as a result of carrier defections and, more recently, by slowing trade growth, overcapacity, and competition from independent carriers. On top of this, liner conferences faced major difficulties in getting internal consensus on rate adjustments. The FEFC even failed to implement two general rate rises in early 2008 as well as a peak-season surcharge scheduled for August 2008.

The disappearance of liner conferences took place in a period when ocean carriers were facing slowing traffic growth and tumbling freight rates due to the credit crisis and the economic downturn. Westbound rates from Asia to Europe decreased significantly to an average \$350 per TEU in October 2008 from \$1,400 in October 2007. Some carriers accepted even lower rates in an effort to fill their ships, to improve capacity utilization and to reverse the downward trend of the base freight rates. A number of shipping lines even took actions to suspend loops mainly on the Europe – Far East and Trans-Pacific trades. For instance, NOL/APL cut 25% of its liner service capacity on the Asia-Europe trade. At the same time, however, fuel costs soared to unprecedented heights in the summer of 2008 after decades of manageable price volatility and soon after plummeted from US\$ 700 per ton in July 2008 to about US\$ 200 per ton at the end of November 2008 (see Figure 2).

Figure 2: Bunker price for IFO 380 in Rotterdam (US\$ per ton)



Source: authors based on data Clarksons Research Services Ltd

Shipping lines are challenged to charge customers for the fluctuating fuel costs. In turn, customers are asked to absorb a sizable increase in their freight costs, and carriers recognize that this requires an easily justifiable, transparent process. The combination of strong fluctuations in fuel costs and a downward pressure on the freight rates has resulted in a reversal of the significance of base freight rate versus fuel surcharges as illustrated in table 2.

Table 2: Base freight rate and BAF for the maritime transport of one forty foot container (FEU) from Shanghai to Antwerp (excluding CAF, THC and other surcharges)

	Typical freight rate	Typical BAF
Q1 2007	2100 US\$	235 US\$
Q2 2008	1400 US\$	1242 US\$
Sept 2008	700 US\$	1440 US\$

Source: authors based on market figures

One of the concrete outcomes of this trend is the introduction of new formula to charge customers for the fuel costs incurred. The fact that the conference system was disbanded means that those individual carriers who choose to still charge a BAF need their own independent method of calculating the charge. Each carrier came with its own decisions on whether or not to charge a BAF and if so, on how the calculation method and resulting quantum will be.

Maersk Line started for instance the introduction of a new formula for BAF in early 2008 with the aim of creating more transparency. The formula used in the web-based ‘Maersk Line BAF Calculator’ builds on factors such as fuel consumption, transit time and imbalances in container flows (press communication Maersk Line, 21 January 2008) such as:

$$BAF = \frac{TS_t \cdot (P_t - P_{t-1})}{(F_t \cdot TI_t)}$$

With:

- F_t Average fuel consumption per FEU
- P_t Bunker prices per ton in t (monthly or quarterly)
- TS_t Trade specific constant
- TI_t Trade Imbalance factor

In preparation to the end of the European Conferences, *Delmas/OTAL* (part of CMA-CGM group) also developed its Bunker Adjustment Factor (BAF) calculation formula. The BAF levels used by the shipping line are announced at the beginning of each month and applied for the following month. The new BAF replaced the one previously issued by the Europe West Africa Trade Agreement (EWATA) since September 2008 and considers various elements such as:

- The average reference fuel oil price
- The average fuel oil consumption of the line's ships per full TEU carried.
- The average fuel oil price for the month t-1 for the calculation of the BAF applicable for the month t+1.

A final example relates to *OOCL*. Also this shipping line ensured legal compliance by developing its own independent pricing and surcharge structure based on its own costs and operational requirements. OOCL constructed its own BAF formula to reflect the market conditions and is unique to OOCL. It is based on trade, trade lane and service loop and also considers vessel size and round voyage capacity. In general terms, the formula is as follows:

$$BAF = \frac{F_t \cdot (P_t - P_b)}{T_t}$$

With:

- F_t Total fuel consumption
- P_t Current bunker price per ton
- P_b Base bunker price per ton
- T_t Projected cargo loaded onboard

OOCL made a policy decision not to disclose the actual values for each component in the formula, calculating it on a monthly basis, taking the average bunker price during that period. If the bunker price has moved beyond the agreed band of US\$ 25 (either up or down), then it will trigger a recalculation of the total BAF payable in the following month. OOCL uses a neutral third party provider of bunker price information (Platts) for all the major locations around the world. OOCL selected a number of representative vessels for the purposes of

calculating fuel consumption, a more manageable way than taking into account the actual consumption data of all their operating vessels.

Table 3: Illustration of upside and downside risks of fuel price changes – Transatlantic to/from US West Coast

Trans-Atlantic - US West Coast	Bunker price US\$ per ton	BAF US\$ per TEU	
	613	590	
	588	555	
	563	521	
	538	486	
	513	452	
Current level (assumption)	488	417	} Band of US\$ 50
	463	383	
	438	348	
	413	314	
	388	279	
	363	244	

Source: data OOCL

The introduction of the new formula had an impact on the level of the base freight rates and of the BAF. The new calculation led to a BAF that is lower compared to the liner conference environment; whilst conferences used base bunker prices from around 1990, OOCL now started to use a base price from 2005. This resulted in a doubling of the base bunker price in the new formula and a reduction of the bunker price for OOCL’s customers. OOCL shifted the difference into the ocean freight to maintain a revenue neutral position, whilst BAF is now more reflective of the prevailing fuel price conditions.

The disappearance of European-related liner conferences has also had an impact on liner conferences that still operate on non-European routes. These liner conferences have also responded to the demand for transparency by changing the way BAF is calculated. For example, in September 2008 the Westbound Transpacific Stabilization Agreement (WTSA) changed how it calculates bunker fuel surcharges in the U.S.-Asia freight market. The new formula went into effect for dry cargo in October 2008. WTSA began the process of modifying its surcharge formula by eliminating steps to arrive at a complete ‘average of averages’ that reflects the cost impacts of rising fuel prices on multiple, different container services. The new bunker surcharge formula tracks a single marine fuel (i.e. IFO 380). It also eliminates the weighted average of weekly prices at eleven load ports and, instead, uses a straight average of Hong Kong and Los Angeles prices for the West Coast; and Hong Kong and New York prices for the East Coast surcharge. The fuel price data for the three ports are obtained from the publicly available website Bunkerworld. A second set of changes involved straightforward components for constructing fuel cost impacts from changes in fuel prices. These include:

- Vessel effective capacity
- Westbound allocation of deadweight capacity after eastbound empty repositions
- Maximum capacity for loaded containers before reaching a ship’s weight limit

- Daily fuel consumption
- One-way steaming time (excluding time in port)

Averages for the above components vary for West Coast and East Coast services, but are constant for each service. The formula also adjusts effective capacity to allow for the deadweight impact of empty returns. The new calculation method thus makes separate calculations for West Coast and East Coast services.

As can be seen from former discussions, if most shipping lines had implemented a more transparent system regarding BAF, one of the main issues for shippers would be related to the absence of transparent information on some specific elements considered within the BAF calculation. If the level of current bunker fuel price is not an issue since data can be easily found, information on the selection of the base bunker price, on the vessel utilization rate and on the fuel consumption per vessel are more problematic. The next section presents a methodology focusing on the latter element namely the estimation of the total fuel cost for a specific service.

4. ESTIMATION OF THE FUEL COSTS ON A SPECIFIC SERVICE*

A first step when analyzing the relationship between fuel surcharges and actual fuel costs consists in determining the fuel consumption per TEU carried. Earlier work on this issue has been presented by Buxton (1985) and Cullinane and Khanna (1999) who introduced formula for the estimation of the daily fuel costs per TEU or ton based on parameters such as engine power and the specific fuel consumption (S_{FOC}). In this paper, we add to these previous works by explicitly taking into account the characteristics of liner services (number of ports of call, roundtrip distance, etc). The Total Fuel Consumption (TFC_j) in US\$ for a specific route/service j of T days (round trip) by i ($i=1 \dots n$) vessels is the sum of the fuel costs for main and auxiliary engines when the vessels are at sea (t_1), maneuvering in port or transiting through canals (t_2) and hotelling (t_3).

$$TFC_j = \sum_{i=1}^n \sum_{t=1}^3 (P_m \cdot FC_{mit} + P_a \cdot FC_{ait}) \quad (1)$$

With:

- TFC_j Total Fuel Cost for a specific service j in US\$
- t_1 Time when the vessel is at sea
- t_2 Time when the vessel is maneuvering or transiting through canals
- t_3 Time when the vessel is hotelling (waiting and when at berth)
- P_m Bunker price for the main engine (m)
- P_a Bunker price for the auxiliary engine (a)
- FC_{mit} Fuel consumption for main engine (m) per day for vessel i under status t
- FC_{ait} Fuel consumption for auxiliary engine (a) per day for vessel i under status t

When the vessel is at sea (t_1), the fuel consumption for the main engine (m) and vessel i (in grams/mile) can be estimated as:

$$FC_{mil-grams/nm} = \frac{m_s \cdot L_F \cdot S_{FOC} \cdot P_e}{v_0} \quad (2)$$

With:

- m_s Sea-margin to consider weather conditions and expressed as a %
- L_F Load factor expressed as a % of the Maximum Continuous Rate
- S_{FOC} Specific Fuel Oil Consumption in g/kW-hr
- P_e Installed Engine Power in kW given for a TEU size and design speed v_0
- v_0 Design speed in nautical mile (nm)

We assume a sea-margin of 15% (MAN B&W Diesel A/S 2008) and a load factor of 80% (Endersen et al., 2003; EPA, 2000; Corbett and Koehler, 2003). Furthermore, and whatever the vessel's status is (t_1 , t_2 , t_3), the fuel consumption for the auxiliary engine (FC_{ait}) is considered as 10% of the consumption of the main engine (Endersen et al., 2003; EPA, 2000; Corbett and Koehler, 2003). To estimate S_{FOC} and P_e for a vessel i at a given design speed v_0 , we used information on containerships extracted from the Lloyd's Fairplay Ship Database (Lloyd's Maritime information Services, October 2008). The initial sample is made of 4,834 containerships that were rearranged to consider only fully cellular containerships delivered, on order or pending¹ and more than 2,000 TEU². The final sample is made up of 2,259 containerships whose main characteristics are presented in Table 4.

Out of the 2,259 containerships, 33.8% are between 2,000 and 3,000 TEU and 70.1% are less than 5000 TEU. The mean vessel size is 4,332 TEU, the mean age around eight years and the mean speed 23.04 knots. Out of the 2,259 containerships, 97% are using two stroke-slow speed engines for which a value of 171 g-kW-hr is used as a proxy of S_{FOC} (MAN B&W Diesel A/S, 2008). In order to consider the impact of a change in the vessel's size on fuel consumption, we estimated (OLS) the relationship between installed engine power (P_e) and vessel size (in TEU).

$$\text{Log}(P_e) = 1.996 + 1.013 \cdot \text{Log}(teu) \quad R^2=0.83 \quad (3)$$

Combining equation (2) in (3) and assuming as stated previously, a sea-margin of 15%, a load factor of 80%, a S_{FOC} of 171 g-kW-hr so that $C=m_s \cdot L_F \cdot S_{FOC}=1.15 \times 0.8 \times 171=157.3$, the total fuel consumption at sea for the main engine in grams/day and at a given speed v_0 can then be estimated as:

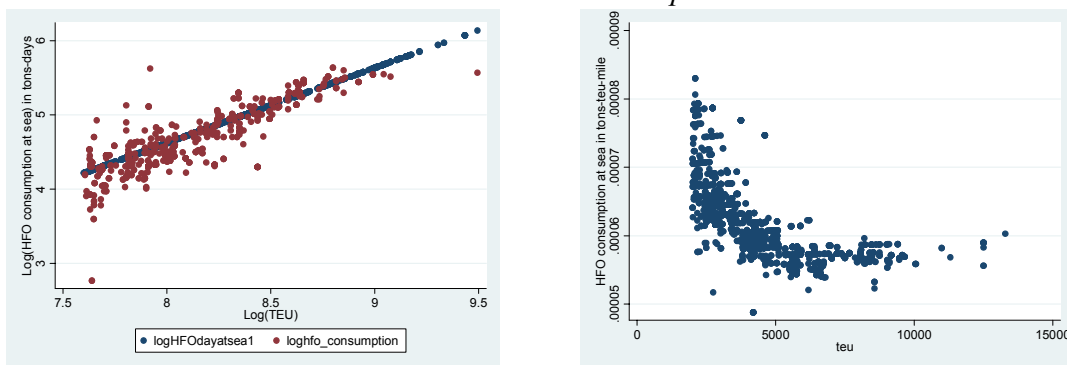
$$FC_{mil} / \text{at } v_0 = 24 \cdot C \cdot e^{1.996} \cdot teu^{1.013} = 3,775 \cdot e^{1.996} \cdot teu^{1.013} \quad (4)$$

¹ Vessels lost and scrapped are not considered.

² 23 Containerships (Fully Cellular with Ro-Ro Facility), 4 Containerships (Fully Cellular), Inland Waterways, 22 General Cargo Ships, 7 Container/Ro-Ro Cargo Ships and 2 Replenishment Dry Cargo vessels were not considered.

Results from our estimations on FC_{mi1} are presented in tons/day in table 4. Figure 3 compares our estimates (equation 4) with the initial data from Lloyd's Fairplay Ship Database (in logarithm), the correlation coefficient being equal to 0.88 (based on 595 observations for which information on the fuel consumption for the main engine is given). Figure 4 presents estimates on economies of scale on fuel consumption at sea expressed in tons per mile (equation $4/(24.v_0.teu)$). It appears from figure 4 that if economies of scale on fuel consumption exist, their effect is mainly visible for vessels increasing from 4000 to 6000 TEU³. Above 6000 TEU, the additional marginal reduction in fuel consumption in tons per TEU-mile is rather limited. This result is mainly due to the reduction in the mean design speed for bigger vessels (23.6 kt for 10000+ compare with 25.1 for 9000-10000 for instance) that counterbalances the impact of the increase in number of TEU. This result would be, of course, different if 25 knots is taken as the initial design speed such as in MAN B&W Diesel A/S (2008). Considering the limited number of vessels more than 10,000 TEU in our sample (17 containerships only), we will assume an initial design speed of 25 knots for this category in the remainder of this paper.

Figure 3. Fuel consumption with vessel size Figure 4. Economies of scale on fuel consumption



To estimate the fuel consumption when a vessel is maneuvering or transiting through canals ($FC_{mi2} + FC_{ai2}$), we use equation (4) but without considering a sea-margin (equal to 1) and for a load factor of 15% (EPA, 2000; Corbett and Koehler, 2003). The fuel consumption per day when the vessel is maneuvering or transiting through canals (t_2) can then be estimated at 16.3%⁴ of the fuel consumption when the vessel is at sea (t_1). As previously, 10% is added for the auxiliary engine's consumption. When it comes to fuel consumption during port operations ($FC_{mi3} + FC_{ai3}$)⁵ we used a proxy of 5% of the fuel consumption at sea for the main engine and (10% \times 5%) for the auxiliary engine as previously.

³ One should, however, keep in mind that we only focus on fuel consumption at sea and the choice of the optimal size of vessel also considers other costs (capital, manning, insurance, port dues...) and demand elements.

⁴ $16.3\% = (1 \times 0.15) / (1.15 \times 0.8)$

⁵ The fuel consumption at port also varies with the use of bow thrusters and with the number of reefers carried but was not considered in this paper..

Table 4. Main characteristics of the sample and results from estimations

	2000-3000	3000-4000	4000-5000	5000-6000	6000-7000	7000-8000	8000-9000	9000-10000	10000+	Total #
Number of vessels #	764	350	469	285	146	60	122	46	17	2259
Mean size (TEU)	2530	3432	4385	5491	6505	7372	8293	9307	11660	4332
Mean design speed (nm) - v_0	21.2	22.4	23.9	24.5	25.3	25.1	24.9	25.1	23.6	23.04
Mean age (year)	10.1	11.6	6.5	5.2	4.4	4.7	1.9	1.4	0.6	7.8
Mean main engine (kW)	20699	26741	38616	49243	57764	61436	64353	67259	66580	36084
Engine type										
- Two Stroke/Slow speed (%)	93	98	99	97	99	98	99	100	100	2184
- Other (a) (%)	7	2	1	3	1	2	1	0	0	75
Fuel consumption in tonnes/day (b)	80	102	142	199	229	233	255	N/A	N/A	121
Fuel consumption in grams//teu/mile	62	55	56	62	58	52	51	N/A	N/A	0.000051
	Estimations on fuel consumption at sea for various speed									
FC_{mil} in tonnes/day (c)	78.1	106.4	136.4	171.3	203.4	230	260	292	367 (d)	134.8
Vessel speed (knots)										
18	47.0	54.9	52.8	57.9	68.8	77.8	87.9	98.8	124.1	66.0
19	56.1	65.6	63.1	69.3	82.2	93.0	105.1	118.1	148.4	78.9
20	66.5	77.7	74.7	82.0	97.4	110.1	124.5	139.8	175.7	93.5
21	78.1	91.3	87.8	96.4	114.4	129.4	146.2	164.2	206.4	109.8
22	-	106.4	102.4	112.3	133.4	150.8	170.5	191.5	240.7	128.0
23	-	-	118.5	130.1	154.5	174.7	197.5	221.8	278.7	148.3
24	-	-	136.4	149.7	177.8	201.0	227.2	255.2	320.7	-
25	-	-	-	171.3	203.4	230.0	260.0	292.0	367.0	-

(a) Not Specified

(b) HFO consumption is only available for the main engine and for 594 observations.

(c) Estimation from equation (4) for main engine and at the mean size in TEU and design speed v_0 of the category.

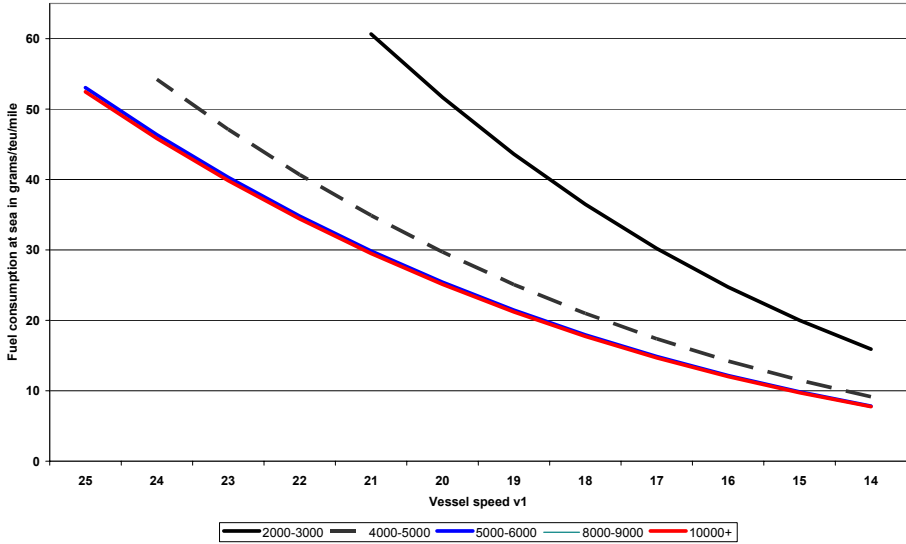
(d) Due to the limited number of observations for vessels more than 10,000 TEU (17 vessels), we assume that the design speed for this category is 25 knots (Man B&W Diesel A/s, 2008)

As stated above, former estimates on fuel consumption at sea (FC_{mi1}) only hold considering an installed power engine (P_e) for a given design speed v_0 . In order to analyze the impact of a reduction in the commercial speed from a design speed v_0 to an actual speed of v_1 , we investigated the relationship between P_e and v_0 . The results (on 2245 observations for which v_0 and P_e were given, $\text{Log}(P_e) = 3.311 \cdot \text{Log}(teu)$ with $R^2 = 0.99$) are close to the traditional assumption of a cubic relationship between these two variables. We assumed that the variance in load factor of the engine does not affect fuel consumption and used former estimates so that for a commercial speed v_1 , the fuel consumption is:

$$FC_{mi1} / \text{at } v_1 = FC_{mi1} / \text{at } v_0 \cdot \left(\frac{v_0}{v_1}\right)^{3.3} \tag{5}$$

Estimations are reported in table 4 for various vessel' categories and for speeds varying from $v_1 = 18$ knots to the design speed v_0 . Figure 5 illustrates the impact of a speed reduction on fuel consumption at sea in grams per TEU-mile for four vessel categories.

Figure 5. Example of the impact of the decrease in vessel speed from the initial design speed v_0 to v_1



Source: authors' calculations

It appears that vessels in the range between 5,000 and 10,000+ TEU give similar and better results in terms of fuel cost per TEU-mile. Table 5 compares our estimates on fuel cost at sea for the main engine (FC_{mi1}) with a study by Germanisher Lloyd for 5000, 8000 and 12000 TEU containerships (Notteboom and Vernimmen, 2009). These estimates were obtained for a bunker price (P_m) of US\$ 350 per metric ton (IFO 380 Singapore) in July 2006.

Table 5. Comparison of our estimates with Germanischer Lloyd (GL) figures on fuel costs per day at sea - end of July 2006

	5000 teu		8000 teu		12000 teu	
Speed knt	Estimates	GL	Estimates	GL	Estimates	GL
14	8,848	12,200	13,430	16,000	18,956	20,700
16	13,747	16,800	20,866	21,600	29,453	27,500
18	20,278	23,100	30,778	29,000	43,444	36,500
20	28,709	31,800	43,575	39,400	61,508	48,700
22	39,320	43,700	59,681	52,200	84,242	64,400
24	52,399	59,300	79,531	69,400	112,261	83,600
26	68,239	82,800	103,574	96,100	146,199	114,700

Next section will use a similar methodology to estimate the total fuel cost for specific O/D relations to be compared with the BAF charged by various shipping lines.

5. ESTIMATION OF THE FUEL COSTS FOR SPECIFIC O/D RELATIONS AND COMPARISON WITH BAF

The case-study developed in this last section focuses on the estimation of BAF for containers exported via the port of Antwerp to a specific overseas port of discharge. The total price to be paid by the line's customers consists of a base freight rate and a series of surcharges such as the BAF, the CAF (currency adjustment factor), the THC (Terminal Handling Charges), port congestion surcharges (if any) and often also container-equipment related surcharges (e.g. demurrage charges, detention charges, equipment handover charges, equipment imbalance surcharge, special equipment additional for an open top container or heavy container, etc.). The case-study focuses on the BAF while the base freight rate emerges later in the analysis.

We distinguish two periods of analysis:

- The first period is June-July 2008, corresponding to a period when the bunker price per ton reached its peak (see figure 2) and the liner conference system still existed. As such, the case-study for the first period provides a snapshot of fuel surcharge practices in the liner conference era at a time when fuel costs reached unprecedented heights. The BAFs observed in this case-study relate to the fuel surcharges applicable on the first of July 2008. The bunker price applied throughout the analysis is US\$ 585 per ton for the fuel grade IFO 380 and US\$ 1125 for marine diesel oil (MDO). These figures relate to the average bunker price in Rotterdam in the month of June 2008. The choice of Rotterdam is mainly based on its proximity to the loading port Antwerp, although the authors are aware of the fact that Rotterdam is among the cheaper bunker ports worldwide. Using the bunker price in Rotterdam as a basis might therefore slightly underestimate the actual bunker costs for shipping lines;
- The second period considered in this study is December 2008, corresponding to a post liner conference period when the bunker price per ton reached around US\$ 200 after a few months of price erosion. As such, we are able to analyze the changes in the fuel surcharge practices after the abolition of (European) liner conferences and at a time when fuel costs were much lower compared to the first case. The average bunker price in Rotterdam throughout November 2008 was US\$ 220 per ton for IFO 380 and US\$ 535 for MDO. These prices underline the sharp decline in fuel prices between the first period of observation and the last one.

We collected data on 117 port-to-port relations with Antwerp as the port of loading. The names of the shipping lines included in the dataset are not disclosed for confidentiality reasons. The port pairs considered are all connected via direct line-bundling services, meaning that no transshipment takes place at intermediate hubs along the route. The port bundles have been aggregated to eight service areas of the port of Antwerp: Africa, the Baltic and Iberian feeder markets, the Far East, India/Pakistan, Latin and South America, the Near East and the East Mediterranean, North America and Oceania.

Table 6 summarizes the main characteristics of the dataset. The average one-way distance relates to the distance from Antwerp to the port of discharge, including the diversion distance to call at en-route ports of call. The nautical distances were calculated using the Dataloy distance tables. In a few cases, up to seven ports of call are positioned between the loading port Antwerp and the port of discharge. At the other extreme, Antwerp sometimes acts as the last port of call in Europe while the port of discharge is positioned as the first port of call in the overseas service area. The average number of ports of call between Antwerp and the ports of discharge on the respective line-bundling services equals 3.05 with a standard deviation of 1.85. Table 6 also depicts the average transit times between Antwerp and the overseas destinations (including the sailing time, port time at intermediate ports of call on the liner service and canal transit time) and the average vessel size per trade route. Both elements are key variables in determining the fuel consumption per container carried (see previous sections).

Table 6. Main characteristics of the set of O/D relations considered in the case-study (port of loading is Antwerp)

Port of loading = Antwerp	Observations	Average one-way distance	Average transit time (in days)	Average vessel size
Region of port of discharge		(a)	(b)	
	no.	nm	days	TEU
Africa	15	4731	17	2525
Baltic - Iberian Atlantic feeder	10	1314	5	1350
Far East	24	11183	28	7563
India / Pakistan	9	7165	21	3963
Latin and South-America	23	5765	17	3700
Near East / East Med	17	3488	13	3535
North America	12	5096	17	3242
Oceania	7	13136	43	2922
	117			

Notes:

(a) Including the deviation distance to call at en-route ports of call on liner service

(b) Including total sailing time, total port time at intermediate ports of call on liner service and canal transits

The commercial speed of the vessels was determined using shipping lines' information on total transit times and port time. We decomposed the real transit time on a port-to-port basis into total sailing time, average port time per intermediate port of call and canal transit time. After applying different values for the commercial speed of the vessel, the simulation exercise revealed that the following aggregated commercial speeds gave the best results:

- Vessels larger than 4000 TEU: 22 knots
- Vessels between 2000 and 4000 TEU: 20 knots
- Vessels smaller than 2000 TEU: 19 knots

The total vessel consumption for each port-to-port relation was calculated by combining the sailing time, the vessel speed and the vessel size with the figures provided earlier in table 4 and by adding the fuel consumption linked to the total port time (also in intermediate ports of call) and the canal transit time. The fuel cost for the auxiliary engine was also taken into account as suggested in the previous section, i.e. consumption of MDO fuel on the basis of 10% of main engine consumption. For each port-to-port relation we estimated the degree of utilization of the vessel's slot capacity (slots used excluding empty containers) based on industry information. The average degree of utilization for all observed liner services out of Antwerp equals 75% in June/July 2008 and 71% in December 2008. By combining vessel size and degree of utilization, it is possible to determine the TEUs loaded with pay cargo per port-to-port relation.

Tables 7 and 8 bring together the main results of the analysis, figures 6 to 9 presenting various comparisons. All data relates to the transport of one FEU. The figures for BAF and the base freight rate were collected from freight forwarding companies and liner agencies in Antwerp. Unfortunately, we were not able to collect BAF-data for December 2008 on the Europe-Far East trade as shipping lines massively used all-in rates without imposing a separate BAF.

Table 7. Case-study results – June/July 2008

Port of loading = Antwerp	Average fuel costs per FEU carried (a)	Average BAF per FEU 1 July 08	Difference BAF - fuel cost per FEU carried	Standard Deviation	Minimum difference BAF - fuel costs	Maximum difference BAF - fuel costs	Ratio BAF versus fuel cost per FEU carried	Base freight rate per FEU 1 July 08	Ratio BAF versus base freight rate per FEU carried
Region of port of discharge	US\$	US\$	US\$	US\$	US\$	US\$	Ratio	US\$	Ratio
Africa	562	1329	767	168	512	1087	2.36	1798	0.74
Baltic - Iberian Atlantic feeder	194	217	22	96	-61	210	1.12	829	0.26
Far East	825	1003	179	202	-187	550	1.22	93	10.82
India / Pakistan	610	847	236	58	135	319	1.39	592	1.43
Latin and South-America	529	1308	778	340	144	1337	2.47	1628	0.80
Near East / East Med	341	611	270	118	0	401	1.79	1184	0.52
North America	491	1195	705	118	462	882	2.44	371	3.22
Oceania	1336	1453	116	122	-91	302	1.09	1628	0.89

Note:

(a) based on bunker price of US\$ 585 per ton of IFO 380 for main engine and US\$ 1,125 per ton of MDO for auxiliary engine (average bunker prices for June 2008 in Rotterdam)

Table 8. Case-study results – December 2008

Port of loading = Antwerp	Average fuel costs per FEU carried (a)	Average BAF per FEU 15 Dec 08	Difference BAF - fuel cost per FEU carried	Standard Deviation	Minimum difference BAF - fuel costs	Maximum difference BAF - fuel costs	Ratio BAF versus fuel cost per FEU carried	Base freight rate per FEU 1 Dec 08	Ratio BAF versus base freight rate per FEU carried
Region of port of discharge	US\$	US\$	US\$	US\$	US\$	US\$	Ratio	US\$	Ratio
Africa	233	484	251	78	141	404	2.08	1582	0.31
Baltic - Iberian Atlantic feeder	80	200	101	98	45	307	2.49	718	0.28
Far East	342	N.A.							
India / Pakistan	253	645	86	142	292	649	2.55	558	1.16
Latin and South-America	219	1154	54	594	-272	1630	5.26	1194	0.97
Near East / East Med	141	527	117	91	259	573	3.73	1024	0.51
North America	203	586	52	261	-197	672	2.89	511	1.15
Oceania	554	1139	64	91	458	717	2.06	1675	0.68

Note:

(a) based on bunker price of US\$ 220 per ton of IFO 380 for main engine and US\$ 535 per ton of MDO for auxiliary engine (average bunker prices for November 2008 in Rotterdam)

Figure 6: BAF, fuel costs and base freight rate per FEU – port-to-port relations with loading port Antwerp – figures relate to the situation in June-July 2008

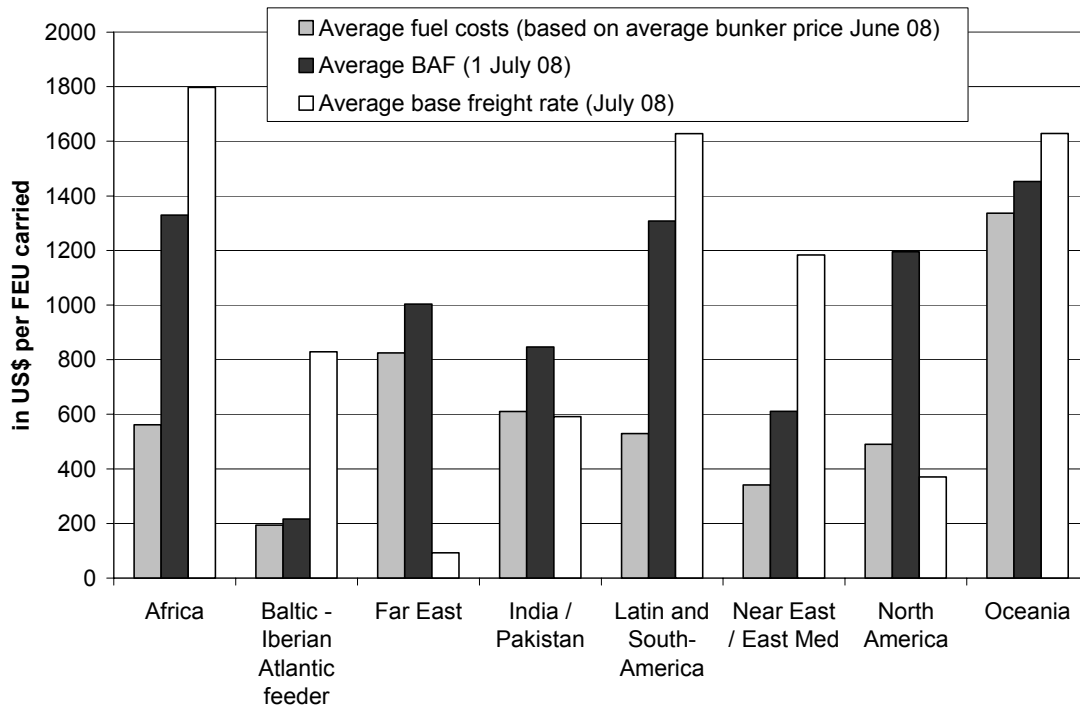


Figure 7: BAF, fuel costs and base freight rate per FEU – port-to-port relations with loading port Antwerp – figures relate to the situation in December 2008

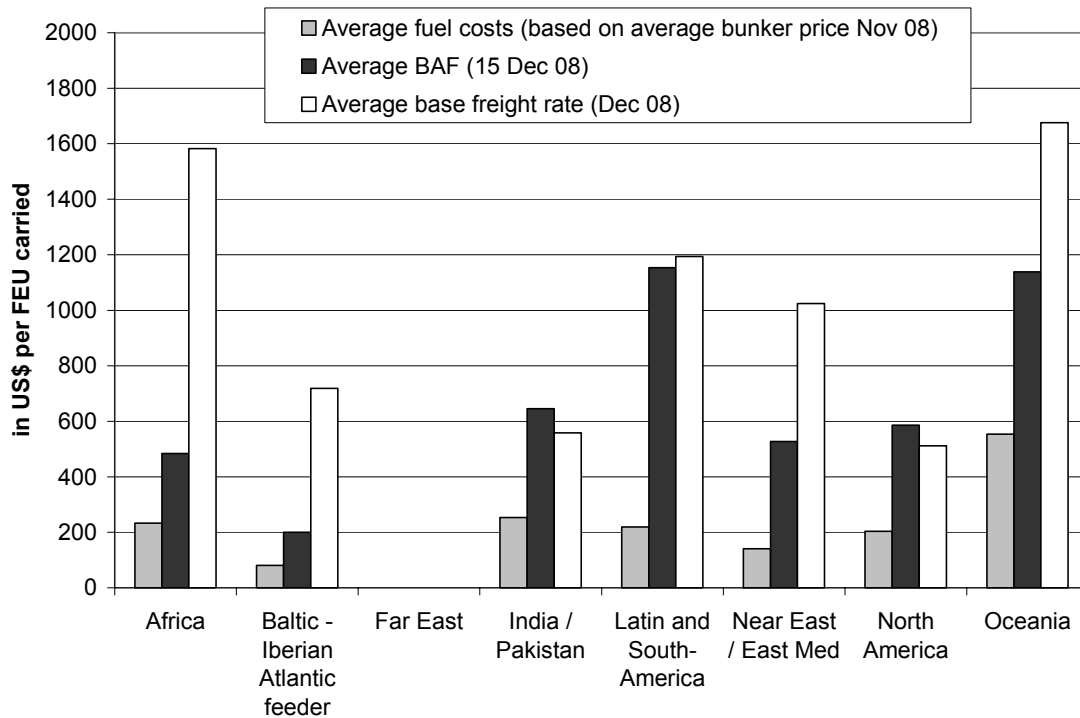


Figure 8: Base freight rate per day of transit time (port-to-port) and difference between BAF and actual fuel costs per day of transit time (n = 117), June/July 2008

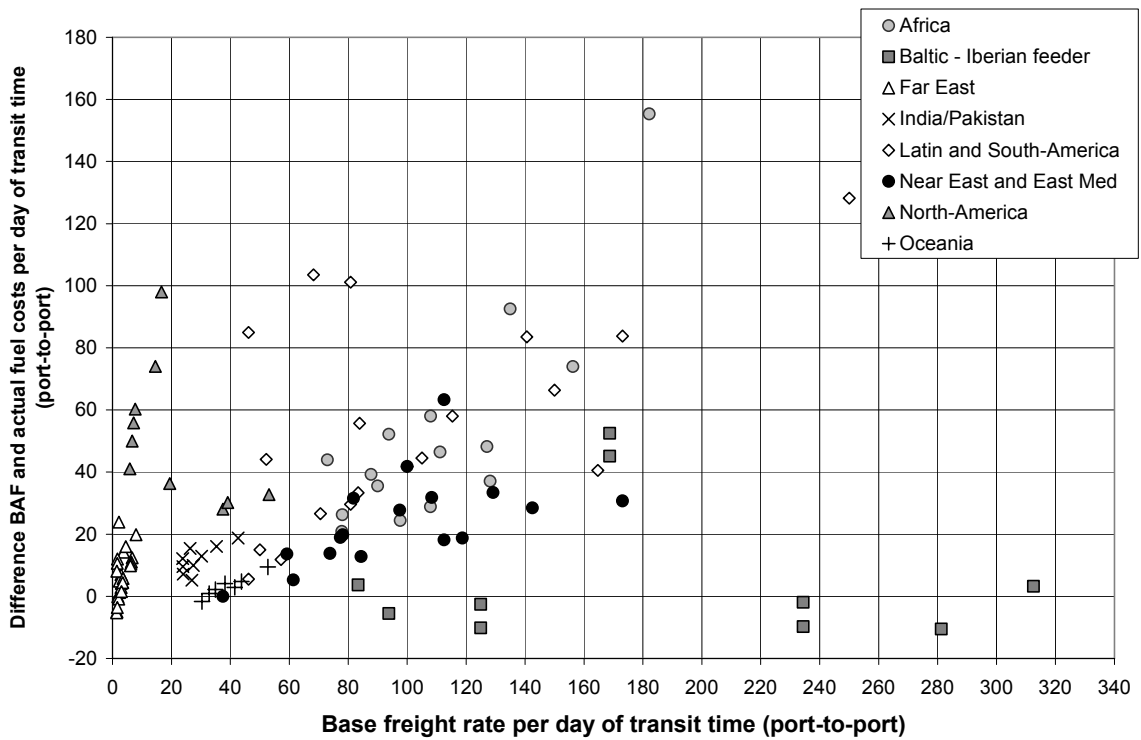
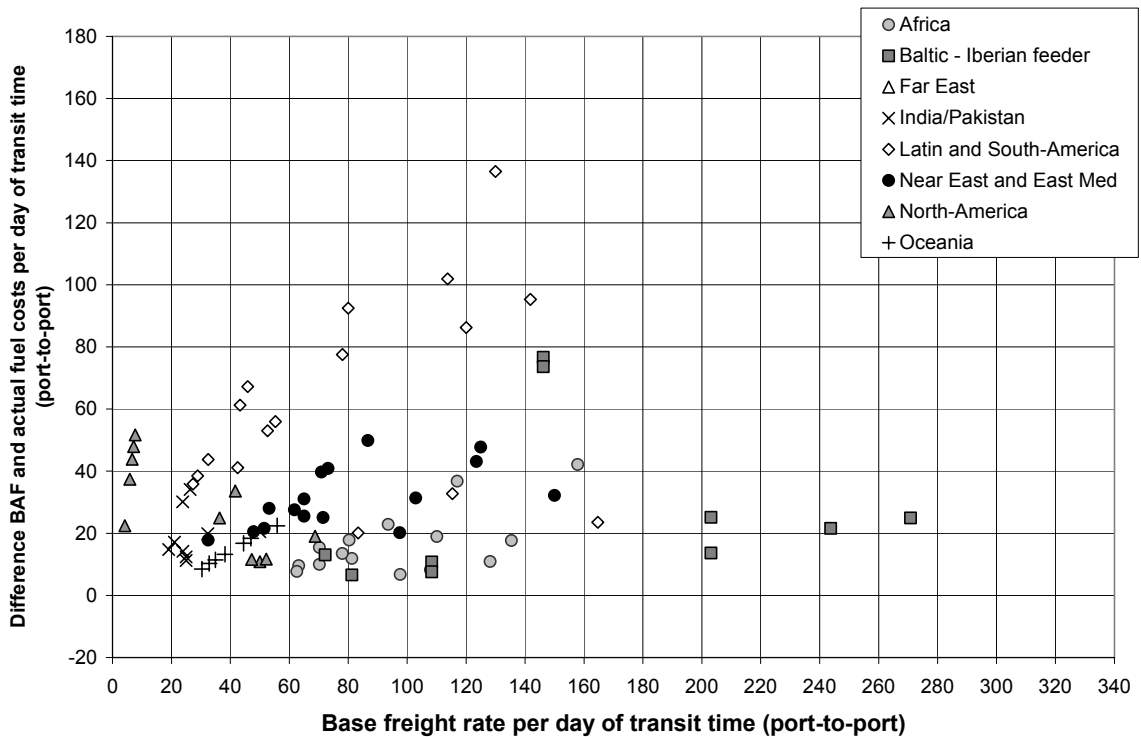


Figure 9: Base freight rate per day of transit time (port-to-port) and difference between BAF and actual fuel costs per day of transit time (n = 117, however no figures for Far East), December 2008



Based on tables 7 and 8 and figures 6 to 9 the following conclusions on the liner service relations with loading port Antwerp can be draw.

First of all, the BAF per FEU carried is typically (much) higher than the average fuel costs per FEU that we estimated. For June/July 2008, the BAF turned out to be slightly lower than the fuel costs in only ten of the 117 cases. The difference between BAF and the actual fuel costs ranges from 9% for Oceania to an elevated 147% for Latin and South America. These results confirm the earlier findings of Meyrick et al (2008) who concluded that the BAF would involve an element of revenue-making. The case-study for June/July 2008 demonstrates that the revenue-making characteristic of the BAF is significant on the shipping routes from Antwerp to Latin and South-America, Africa and North America. The revenue-making characteristic of the BAF is far less significant on intra-European feeder routes and on traffic relations with the Far East, India/Pakistan and Oceania.

Second, variations exist in the difference between BAF and the estimated fuel costs per FEU. The spread in observations is particularly high for Latin and South America, the Far East and Africa. A further investigation of the data stresses that the observed spread is mainly the result of differences in shipping lines' BAF policy for specific ports of discharge. The BAF strategy of shipping lines with respect to destinations in India/Pakistan, North-America and Oceania is revealed to be more aligned.

Third, the results for December 2008 stress that the revenue-making character of BAF has not disappeared after the abolition of liner conferences. On the contrary, most trade routes see an even larger gap between BAF and actual fuel costs. The difference between BAF and the actual fuel costs ranges from 106% for Oceania to an elevated 426% for Latin and South America. A closer investigation of the figures reveals that shipping lines held on to high BAFs while the actual fuel costs plummeted due to a sharp decrease in the bunker price. This coincided with falling base freight rates. In other words, the results demonstrate that a combination of decreasing freight rates and decreasing fuel costs seems to give an incentive to shipping lines to stall the downward correction of the BAFs. Such a pricing strategy allows shipping lines to (partly) compensate a decline in freight revenues by keeping the BAF disproportionately high.

Fourth, the relationship between the base freight rate and the BAF is weak. Figures 6 and 7 demonstrate that a high base freight rate not always coincides with a high BAF. In June/July 2008, particularly on the Far East trade (eastbound) and the North-American trade (westbound), a low base freight rate goes hand in hand with a high BAF, while for intra-European feeders the BAF remains low compared to the base freight rates.

Fifth, the relationship between the base freight rate and the difference between BAF and the actual fuel costs deserves special attention. One could expect that shipping lines impose a disproportionately high BAF when the base freight rate is low, in order to generate extra revenues. To investigate this specific issue and compare various routes, figures 8 and 9 compute the base freight rates and BAFs expressed per day of transit time. It stresses that a low base freight rate per day of transit time does not necessarily result in a comparatively high difference between the BAF and estimated fuel costs per day. Alternatively, a high base freight rate per day of transit time does not seem to always lead to a low difference between BAF and actual fuel costs per FEU carried. Tables 9 and 10 provide results from various regressions for each of the regions considered.

Table 9. Best fit and R-square for different trade routes (port of loading Antwerp)- June/July 2008

	Equation of best fit	R ²
Africa	$y = 0.9179x - 48.987$	0.6801
Baltic - Iberian Atlantic feeder	$y = -0.002x^2 + 0.7308x - 50.712$	0.1887
Far East	$y = 7.47\text{Ln}(x) - 1.0876$	0.2872
India / Pakistan	$y = 0.5118x - 2.9179$	0.5403
Latin and South-America	$y = 0.3563x + 19.71$	0.315
Near East / East Med	$y = 25.457\text{Ln}(x) - 90.797$	0.401
North America	$y = 70.093e^{-0.0146x}$	0.39
Oceania	$y = 17.654\text{Ln}(x) - 61.258$	0.9163

Note: x = Base freight rate per day of transit time, y = difference between BAF and actual fuel costs per day of transit time

Table 10. Best fit and R-square for different trade routes (port of loading Antwerp) – December 2008

	Equation of best fit	R ²
Africa	$y = 0.226x - 5.2324$	0.3888
Baltic - Iberian Atlantic feeder	$y = -0.0036x^2 + 1.2721x - 67.557$	0.2848
Far East	n.a.	n.a.
India / Pakistan	$-0.0222x^2 + 1.6776x - 8.2587$	0.0652
Latin and South-America	$y = -0.0075x^2 + 1.6076x - 4.4148$	0.2676
Near East / East Med	$y = -0.0033x^2 + 0.7652x - 5.7936$	0.4194
North America	$y = -0.4799x + 42.931$	0.5746
Oceania	$y = 0.5467x - 7.7107$	0.996

Note: x = Base freight rate per day of transit time, y = difference between BAF and actual fuel costs per day of transit time

In most cases, the R-square is rather low and when estimations are significant, the freight rate and the difference between BAF and the actual fuel costs are positively correlated. This particularly is the case for Oceania in both periods (R-square of 0.92 and 0.99 respectively) and to a lesser extent for Africa in June/July 2008 (R-square of 0.68), India/Pakistan in June/July 2008 (R-square of 0.54) and North-America in December 2008 (R-square of 0.57). Consequently, when freight rates are low, the room left to shipping lines to impose a BAF well above the actual fuel costs seems to be smaller.

The last observation combined with the third issue we discussed based on the above tables and figures leads to an interesting conclusion. A comparison between the results for June/July 2008 and December 2008 revealed that a combination of decreasing freight rates and decreasing fuel costs seems to give an incentive to shipping lines to stall the downward correction of the BAFs. Such a pricing strategy allows shipping lines to (partly) compensate a decline in freight revenues by keeping the BAF disproportionately high. The regression analysis suggests that on the routes with the lowest freight rates per day of transit time, the

possibility for shipping lines to increase the revenue-making characteristic of the BAF is not necessarily higher as on these markets the demand might be more price elastic to BAF.

6. CONCLUSIONS

This paper dealt with fuel surcharge practices in container liner shipping. The BAF is, at least in principle, one of the traditional methods used by shipping lines to hedge against the risks for sharp and temporary fluctuations in bunker costs and to mitigate their impact on the overall freight rate. The BAF has become a considerable element in the price paid by the customers of shipping lines. This paper particularly focuses on the relationship between fuel costs and fuel surcharging practices as part of carriers' pricing strategies, a relevant element to investigate when shipping lines have recently changed their practices regarding BAF. Considering the end of the liner conference era in Europe, each carrier came with its own independent decisions whether or not to charge a BAF and if so, how the calculation method and resulting quantum would be.

Shipping lines argue that the new formula explicitly takes into account the lines' underlying costs and is a response to the demand for more transparency in the calculation of fuel surcharges. During the liner conference era, shippers often complained that the BAFs were nothing more than revenue-makers for shipping lines. By means of this case-study, we test the real nature of the BAF practices used by shipping lines during the liner conference era and in the early days after the abolition of liner conferences. The case-study focuses on 117 port-to-port relations each with the port of Antwerp as the base loading port. All port-to-port relations involved direct calls via line-bundling services. Extensive market data on fuel consumption, transit times, port time, vessel sizes, etc. served as inputs for the development of the case-study.

The results of the case-study have led to the following conclusions. First of all, the BAF appears to involve a moderate to elevated element of revenue-making. On some trade routes, the BAF outstrips the actual fuel costs by a factor of two or more. Secondly, the observed variation in the difference between BAF and the actual fuel costs per FEU is mainly the result of differences in the shipping lines' BAF policies for specific ports of discharge. Thirdly, the relationship between the base freight rate and the BAF is weak. And finally, the correlation between the base freight rate and the difference between BAF and the actual fuel costs is typically low and, in cases where some correlation exists, positive. The hypothesis that low freight rates would give an incentive to shipping lines to increase the revenue-making character of the BAF is not confirmed. However, a combination of decreasing freight rates and decreasing fuel costs seems to give an incentive to shipping lines to stall the downward correction of the BAFs.

This paper should be considered as a further step towards a better understanding of shipping lines' strategies with respect to the incorporation of fuel costs in their pricing strategies. It does not pretend to provide a full answer to all pending issues in this area. While we could present a set of clear conclusions, there is room for further in-depth and comparative research on the relationship between BAF and the actual fuel costs. One obvious extension lies in broadening the scope of the case-study to other regions and other base ports. Such comparative research would reveal whether BAF policies are to some extent port-specific or route-specific. Another field of further research lies in the analysis of the relationship between BAF and fuel costs on port pairs that are not linked to each other via direct services, but for

which transshipment in another port is needed before reaching the port of discharge (i.e. interlining, relay or hub-feeder systems). In our case-study, we have only considered direct liner services.

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