RBB Economics

Consortia, pass-on and service quality

Prepared at the request of the WSC

RBB Economics, 14 March 2019

1 Introduction

This note is prepared at the request of the World Shipping Council (WSC) in the context of a consultation on the Consortia Block Exemption Regulation (BER), and as a follow up to the earlier RBB report which has been submitted to the European Commission as part of the WSC's input to the consultation.

It is generally acknowledged, and as far as we know not contested, that shipping rates with and without bunker surcharges[1] have dropped over time, showing the pass-on of efficiencies. Efficiencies are achieved through, in particular, the use of larger vessels, which use is enabled by an increase in scale through cooperation in consortia (as well as mergers and acquisitions). This is a clear indication that notwithstanding consolidation and the formation of consortia, competition in the industry has been and remains intense. We have substantiated this point in more detail in our previous report.

In this note we address some of the apparently remaining concerns as regards consortia, and therefore concerns as regards the extension of the BER, which focus on pass on of efficiencies and service quality.

In this note we set out why concerns with respect to both pass on of efficiencies and service quality are not warranted. In particular we explain why, if liner shipping companies were to operate independently rather than in consortia, this would result in a decrease in service quality. In our view, this addresses the Commission's request for further substantiation of the

[1] See Figures 2 and 3 of RBB's paper of 19 December 2018.

(quality) benefits of consortia: if the absence of consortia would result in a decrease in service quality then obviously consortia contribute to attaining a higher service quality level. This type of comparison is the most direct way of showing the contribution of consortia to service quality as it is not possible to provide a meaningful before-during-after type of counterfactual assessment as consortia have been an integral part of the industry structure for a very long time.

Moreover, the concerns raised that service levels on Europe trades have deteriorated in recent years are based only by anecdotal evidence and isolated metrics that do not provide a comprehensive assessment. For example, the number of distinct port pairs has far less relevance than the scope of ports served and the markets that have become more accessible because of carriers' choice of ports. These choices are made in response to fluctuations in market demand and requests from shippers to serve different markets. Similarly, an analysis of the number of services is not meaningful without assessing the capacity deployed and the scope of service provided.

For this reason, we have embarked on a more comprehensive review of the service development using two different methodologies and approaches.

The remainder of this note is structured as follows.

Section 2 provides some further evidence of efficiencies being passed on to customers through lower rates.

In Section 3 we show that, on the basis of the UNCTAD connectivity index, there has not been a decrease in service quality between 2013 and 2018. In fact, as measured by this index, quality has increased rather than decreased.

Section 4 discusses a stylized example to illustrate the negative impact on service quality in the absence of consortia. Essentially, that if carriers did not cooperate within consortia and offered the relevant services independently, this would be at the expense of service quality.

In Section 5 we apply the insights from the stylized example to the Asia – North Europe trade, showing that the absence of consortia would reduce service quality from their current level (unless of course the carriers would resort to mergers and acquisitions to build scale similar to those of the consortia today).

2 Efficiencies and pass on

For some time, Drewry Maritime Research has been estimating the global average revenue and operating cost per TEU using data from carriers that publicly disclose financial information each quarter.

Drewry divides the total industry revenue by the loaded container moves, which are separately tracked, to arrive at an estimated revenue per TEU, which is an approximation of the global freight rate (inclusive of all surcharges). The industry's operating cost per TEU is calculated

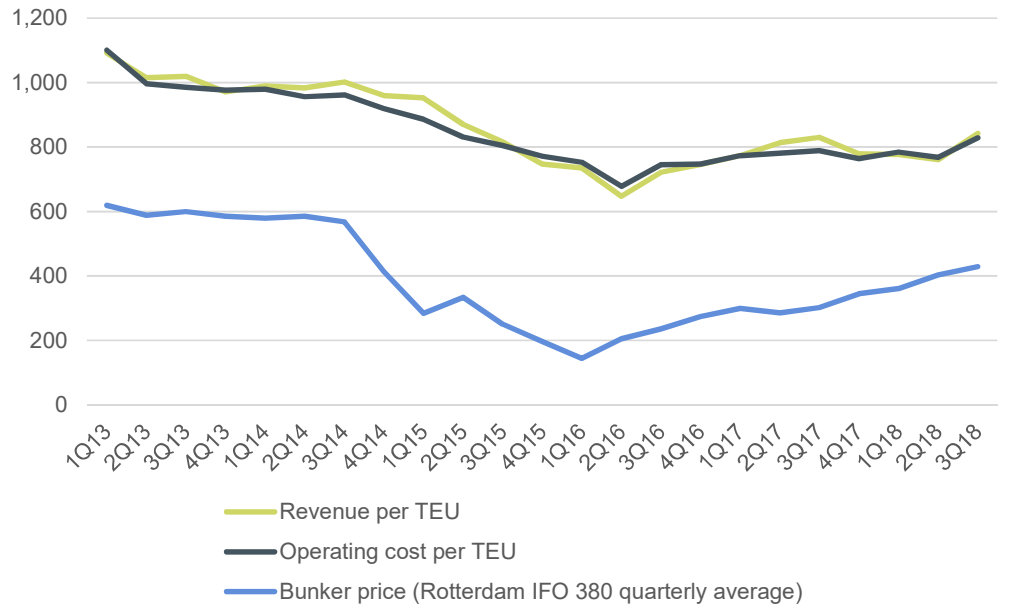
by subtracting EBIT (earnings before interest and taxes) from the industry revenue and dividing that result by the loaded container moves.

The difference between revenues per TEU and the operating cost per TEU is essentially the margin earned per container. As the graph shows, the difference between revenues and operating costs is typically very small. This implies that profit margins are close to zero, and at times negative for the industry as a whole.

The graph also includes the fluctuation of bunker prices, an important variable cost of container shipping. It is clear from the graph that changes in bunker costs help to explain the movement of costs over time.

During the period from Q1 2013 to Q2 2016, operating cost per TEU dropped 38%. Rates dropped even more by over 40%. Both rate and cost have increased since the low of Q2 2016. However, at Q3 2018 both revenues and costs per TEU remain well below Q1 2013, with revenues per TEU being 23% lower compared to Q1 2013 and operating costs per TEU being 25% lower.

Figure 1: Development of revenues and costs (USD per TEU) and bunker prices (USD per tonne)



Source: Drewry Maritime Research (www.drewry.co.uk)

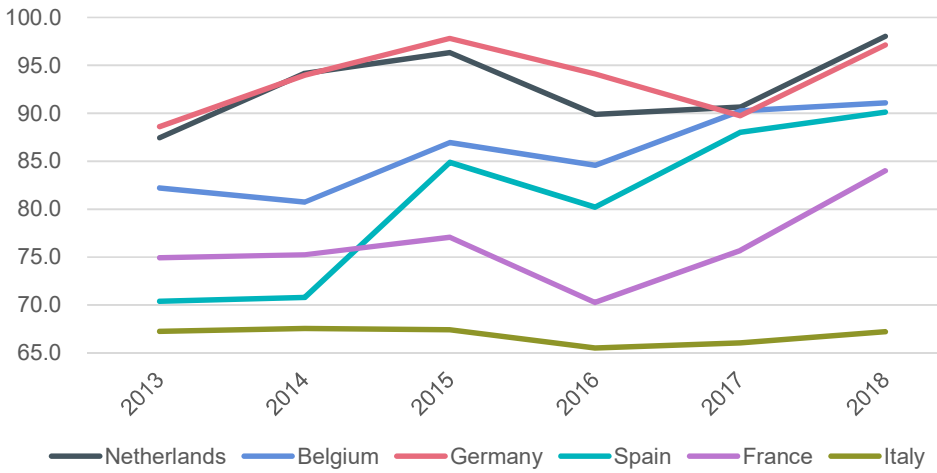
The close correlation and small difference between rates and costs demonstrates that shippers benefit from reductions in operating costs in the form of lower freight rates including surcharges. This hence demonstrates a high degree of pass-on of cost efficiencies. As the revenues include surcharges, it also demonstrates that surcharges have not been used as an instrument to inflate freight rates.

3 The UNCTAD connectivity index

UNCTAD's Liner Shipping Connectivity Index (LSCI) shows the integration level of countries to global liner shipping networks.[2] The LSCI is composed of five components: (1) the number of ships, (2) the total container-carrying capacity of the ships, (3) the maximum vessel size, (4) the number of services and (5) the number of companies that deploy container ships on services from and to a country's ports.[3] The higher the score on UNCTAD's index, the higher is the integration of a given country to liner shipping networks.

To better illustrate the LSCI development over time, we have divided the 21 EU countries included in the LSCI into 3 groups based on the value of their scores on the index. Countries with similar scores are grouped together.[4] The graphs below show the development of these countries' scores on the index between 2013 and 2018.

Figure 2: LSCI for the years 2013 to 2018 for countries in Group 1



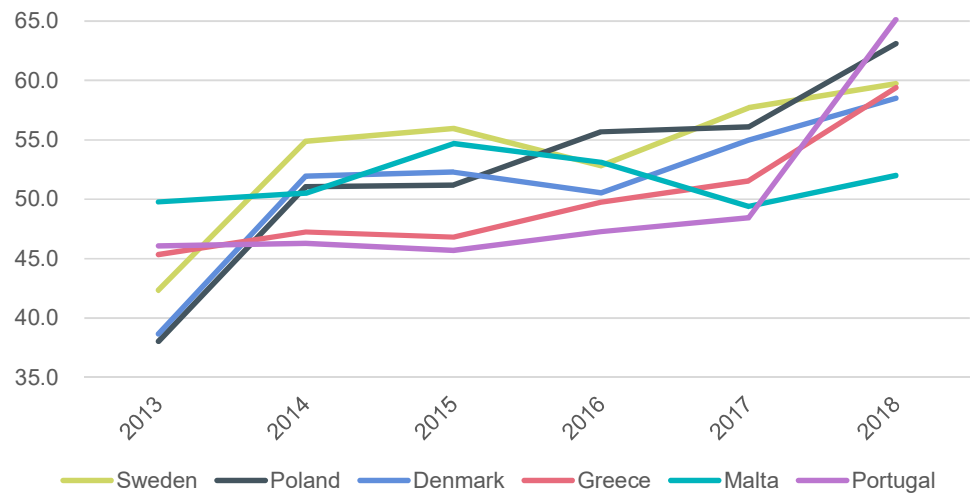
Source: Derived from UNCTAD LSCI

[2] LSCI data is available for 21 EU countries

[3] The index is calculated with respect to the country that has the highest value for each component. A country's value is divided by the maximum value of that component in 2004. When all five components are calculated, the average of these is calculated and divided by the maximum average for 2004 and multiplied by 100. Accordingly, the index level is 100 for the country with the highest averages in 2004. The data are derived from Containerisation International Online.

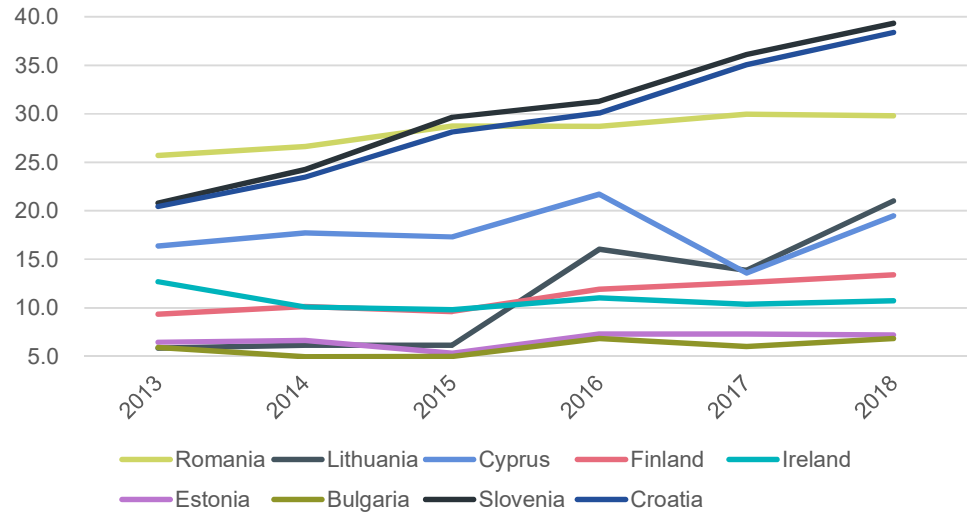
[4] The countries are sorted from highest index for 2013 to lowest; the first six countries compose Group 1; the following six countries compose Group 2; and the last nine countries compose Group 3.

Figure 3: LSCI for the years 2013 to 2018 for countries in Group 2



Source: Derived from UNCTAD LSCI

Figure 4: LSCI for the years 2013 to 2018 for countries in Group 3



Source: Derived from UNCTAD LSCI

The graphs clearly show that the LSCI scores have increased in the past 5 years for 19 of 21 EU countries included in the LSCI, with very small decreases for the remaining two countries.[5]

The average increase in the LSCI index score for the EU countries between 2013 and 2018 is 10.33. Hence, the formation of larger consortia and mergers and acquisitions in the industry have not reduced, connectivity: on the contrary, it has increased overall.

[5] Italy's LSCI score has decreased by 0.04 and Irelands score decreased by 1.96 between the years 2013 and 2018.

Whilst there may be some evidence of decreases in certain service quality metrics that could be of concern to customers, there is no evidence that any such concerns are causally related to consortia or the BER, and whilst it may be argued that the LSCI does not capture all relevant quality indicators, these results provide a clear indication that the overall connectivity provided by the industry has increased in the past 5 years. We are not aware of other indices or other structural, facts based, analyses contradicting these findings.

4 Impact of consortia on service quality: stylised example

4.1 Introduction

This section presents a stylised approach that is used to analyse the potential impact on the quality of service in the absence of consortia. This shows that moving from the current market structure with consortia to a market structure without consortia would result in a severe reduction in the quality of service offered. The converse conclusion is that the current market organisation using consortia provides enhanced service offerings compared to the available counterfactual. A more detailed description of this example is included in Annex A to this note.

4.2 Assumptions

We assume that there are four carriers (A, B, C & D) that each have a 25% market share which is evenly distributed across all four ports that serve the industry. The carriers are paired up in two consortia (AB & CD), each with a combined market share of 50%.[6] Furthermore, the shipping companies' activities are limited to the services provided in their respective consortia.

This model economy has two countries, X and Y, that trade with one another via their respective ports - X_1; X_2 and Y_1; Y_2. Each port has a weekly demand of 8,000 TEU which implies that 16,000 TEUs need to be shipped from country X to country Y and vice versa. Port demand is evenly served by the four carriers so that 25% of demand in X_1 is served by carrier A, another 25% is served by carrier B and so on.

An international voyage takes 28 days in either direction and for each possible port pair. Put differently, the travel times from X_1 to Y_1 and from X_1 to Y_2 are the same. Sailing between the ports in each country takes 7 days. Therefore, a round trip calling at all four ports takes 70 days.

Carriers can choose between three types of vessels that vary in their capacity and the associated costs per TEU: Small (2,000 TEUs), Medium (4,000 TEUs) and Large (8,000 TEUs) vessels.

Vessels with a higher capacity operate with increased efficiency with respect to bunker consumption which also allows for reduced CO_2 emissions per TEU.

[6] For the purposes of the current example we disregard the 30% threshold in the Consortia BER.

However, ships need to be filled to full capacity in order to achieve optimum cost efficiencies. Furthermore, reductions in variable costs are assumed to be passed on to clients (and as a result - end consumers) in the form of lower shipping rates.

4.3 Consortia are in place

AB and CD serve the demand in the most cost-efficient manner by deploying 10 large vessels that make a "round trip" calling at all four ports. This allows for clients to be charged lower rates than otherwise possible. Each carrier contributes 5 large vessels to the consortium of which it is a member.

The "round trip" service is assumed to be launched for the very first time at port X_1 where an 8,000 TEU vessel is situated and filled half-way with 4,000 TEU worth of cargo – 2,000 TEUs from each VSA member. A week later, the same vessel reaches port X_2 where another 4,000 TEUs of cargo are loaded onto it in the same manner so that it reaches full capacity.

Thereafter, the ship is deployed to port Y_2 where half of its cargo is unloaded and replaced with 4,000 TEUs of new cargo that needs to reach country X. This makes up for half of the total transit time – 35 days. In the next string of the service, the vessel heads to port Y_1 where the other half of cargo shipped from country X is replaced with another 4,000 TEUs that are to be shipped to country X. This adds another 7 days to the aggregate transit time. Finally, all 8,000 TEUs of new cargo is shipped to port X_1 where half of it is replaced with new containers. In total 70 days have passed.

4.4 Consortia are not in place

This section discusses possible scenarios and developments in the case that the simplified shipping industry described above faces a dismantling of consortia.

In the absence of consortia, each carrier would be left with 5 large vessels which it is unable to fill up to full capacity at the same rate as under its respective consortium. It would be very costly to replace them with smaller vessels.

4.4.1 Possible scenarios

Arguably the most important decision that would have to be made by carriers is whether to continue operations with the vessels they already have at their disposal or go through the lengthy and costly process of changing the composition of their fleet. This segment examines only the first case. However, a more detailed description of both choices and the possible developments of events is provided in the Annex of this note.

One option is for carriers to reduce service frequency so that their vessels are filled to full capacity instead of operating at significant overcapacity. In our example, this implies an additional week at every port and amounts to a 28 day increase in the total transit time of the "round trip" service. For service frequencies to be sustained, consolidation would need to take place in order to arrive at a similar market structure as in the example.

Both scenarios are likely to produce outcomes in which customers are worse off. In a consolidation scenario, the market structure moves from 4 to 2 firms, reducing competition (as A and B and C and D compete with each other despite being part of the same consortium). In a scenario in which the four firms continue to compete with each other independently, transit times would go up dramatically in order to avoid running a highly inefficient service.

In the next section we apply the insights from this stylised example to the Asia – North Europe trade lane and explore how services may change in the absence of consortia.

5 Asia – North Europe application

5.1 Introduction

This section provides a structural overview of the Asia – North Europe trade lane, as well as an application of the stylised model presented above.

5.2 Review of Asia-North Europe Services over Time

The table below compares services provided in the Asia North-Europe trade in 2013 to 2018,[7] providing a valuable insight into the way these services have changed to adjust to market conditions.

Table 1: Development of services on the Asia – North Europe Trade – 2013-2018

		2013	2018
No. of carriers		17	10
Weekly services	Total	23	21
	Offered through major global alliance[8]	9	17
	Offered through another VSA	5	1
	Offered as independent operator	9	3
Europe	No. of unique ports (direct calls)	20	24
	No. of EU countries	12	14
Asia	No. of unique ports (direct calls)[9]	25	23
	No. of countries	7	8

Source: Drewry Maritime Research's Container Forecaster Report

[7] Service profile information taken from the service and capacity tables included in the Q3 2013 and Q3 2018 editions of Drewry Maritime Research's Container Forecaster Report.

[8] In 2013, these services were offered through one of the 2 major global alliances; in 2018, these services were offered through one of the 3 major global alliances.

[9] One port call in Vostochny, Russia was added to one service's rotation in 2013 for the purpose of acquiring bunker fuel at a reduced rate. The Vostochny, Russia call, therefore has been excluded from this analysis.

Because there are 2 fewer services in 2018 than in 2013, one would expect a reduced number of direct port calls. However, the number of unique ports in Asia declined by just 2, and one additional country (Thailand) received a new direct call. China, including Hong Kong, lost a direct call at one port, Chiwan, but retained direct calls at 10 other ports. Japan lost a direct call at Kochi but retained direct calls at 5 other ports. The largest ports of Ningbo, Shanghai, Yantian, Hong Kong and Singapore, which are capable of handling the largest vessels and therefore have emerged as hub ports, saw reductions in the number of services with direct calls but still each retained 13-14 direct calls per week.

Similarly, some of the larger ports that have dominated liner shipping in Europe receive fewer services, including ports like Felixstowe, Hamburg, Le Havre and Rotterdam. However, in three of the four countries that these ports are located, another smaller port in the same country gained service(s). That is simply evidence of carriers adjusting to market demand changes as well as healthy competition among ports and terminal operators.

While we can see that in 2018 there are fewer carriers operating in the trade and almost all are doing so through a major alliance, the industry as a whole – with fewer carriers and greater use of alliances – provided expanded services to the EU and to Asia by:

<u>In Europe:</u>

- continuing to provide direct weekly service (s) in 2018 to all but one port (Tilbury, England), that received a direct service in 2013
- providing direct weekly service to 5 more ports in 2018 than 2013: Marseilles-Fos, France; Klaipeda, Lithuania; London, England; Naples, Italy; Sines, Portugal.
- providing new direct weekly service to 2 additional countries: Lithuania and Portugal
- providing additional weekly services to other ports: Antwerp, Belgium; Gdansk, Poland; Piraeus, Greece; Wilhelmshaven, Germany

<u>In Asia:</u>

- providing a new direct weekly service from Laem Chabang, Thailand
- continuing to provide direct weekly service (s) in 2018 to all Asia countries that received service (s) in 2013 and adding another country (Thailand) in 2018
- continuing to provide directly weekly service (s) in 2018 to all but 3 Asia ports that received direct service(s) in 2013 (Note: While Ho Chi Minh City lost the 2 direct call services it had it 2013, Vung Tau gained 2 direct call services in 2018.)

Between 2013 and 2018, the Westbound or head-haul market also grew by 9.5%, and these fewer carriers had to invest in and provide enough capacity to absorb that growth while providing continued service. Capacity grew by about 14.5% during the same period. This investment occurred as freight rates continuously declined and reached an all-time low in 2016.

"The first half of 2016 was arguably the lowest point in container shipping history on the Asia-Europe trade with spot rates falling to less than $200 per TEU." [10]

During the same time period, multiple carriers' businesses changed significantly and rapidly as has been well documented, from the bankruptcy of Hanjin in 2016 to numerous mergers or acquisitions that included:

- The merger of COSCO and China Shipping (2016)
- The acquisition of APL-NOL by CMA CGM (2016);
- The acquisition of United Arab Shipping Company (UASC) by Hapag Lloyd in (2016);
- The market exit of Hanjin Shipping (2016);
- The acquisition of Hamburg Süd by Maersk Line (2017);
- The formation of the ONE joint venture combining the activities of NYK, MOL and K Line (2017);
- The acquisition of OOCL by COSCO (2017).

These events, combined with Zim's decision to exit the trade after redefining its overall corporate strategy, are the only reasons that the number of carriers (17) active in the Asia North Europe trade in 2013 was reduced by 7 in 2018.

This service review concludes that from 2013 to 2018, carriers increased capacity to cover an increased volume in trade despite low freight rates and retained or expanded service coverage between the countries in Asia and the countries in the EU.

5.3 Consortia currently active on the Asia – North Europe trade

Table 1 provides some basic facts in relation to the three consortia active on the trade lane. There are 17 services in total that are provided through the deployment of 179 vessels that have total capacity of 3,037,113 TEUs. Furthermore, all services provided by the consortia operate at a weekly frequency which is provided for by ships with an average size of 16,818 TEU (Table 2).

As can be seen in Table 2, the 2M consortium, which includes Maersk Line and MSC, accounts for 37% of the total capacity on the Asia – North Europe trade lane and offers 6 services. Maersk contributes about 65% of the consortium's capacity with 39 vessels, with the remainder being contributed by MSC with its 22 ships.[11]

The Ocean Alliance consists of three companies – COSCO/OOCL (27 vessels), CMA CGM (23 vessels) and Evergreen (16 vessels). The carriers have respective capacity shares of around 44%, 33% and 22% in the consortium and they make up about 38% of the available capacity on the Asia-NE trade lane.

[10] https://www.joc.com/maritime-news/asia-europe-spot-rate-edges-upwards-ahead-feb-1-increases_20180126.html
[11] Consortia-specific structure tables are available in the Annex section of this note.

Table 2: Shares of trade lane total capacity

Consortium	Carrier	Consortia Capacity Share	Carrier Capacity Share
2M		37.00%	
	Maersk		23.87%
	MSC		13.13%
Ocean Alliance		38.45%	
	COSCO/OOCL		17.10%
	CMA CGM		12.72%
	Evergreen		8.63%
THE Alliance		24.55%	
	Hapag-Lloyd		11.26%
	ONE		10.03%
	Yang Ming		3.25%

Source: RBB calculations based on Alphaliner data

The third consortium active on the market – THE Alliance, offers 5 services that are provided by three operators – ONE, Hapag-Lloyd and Yang Ming. In the same order, they deploy 23 vessels that make up for roughly 41% of the capacity, 22 vessels that account for 46% of the capacity and 7 ships that supply the other 13%. The consortium's vessels represent about 25% of the total capacity on the trade route.

Table 3: Consortia structure

	2M	Ocean Alliance	THE Alliance	Total
Capacity	1,123,733	1,167,816	745,564	3,037,113
Capacity Share	37.00%	38.45%	24.55%	100
Vessel Employed	61	66	52	179
Average Vessel Size	18,422	17,694	14,338	16,818
Number of Services	6	6	5	17
Vessels per Service	10	11	10	11

Source: RBB calculations based on Alphaliner data

5.4 Consortia services provided individually at full capacity

This section provides two examples of how the structure of services on the trade lane would look like if participating carriers were to operate independently at the highest possible efficiency. The first follows the stylised model - frequencies of services are reduced (waiting periods increased) so that vessels are filled up to an extent resembling the current situation.

In the second example current frequencies are maintained but the number of services is reduced.[12]

5.4.1 Reducing service frequency

Given the structure of 2M, if MSC were to individually offer the consortium's services provided today at the highest possible capacity it can achieve, vessels would need to call at ports roughly every three weeks instead of on a weekly basis in order to be filled up. This follows from the fact that MSC provides roughly one third of the TEU capacity and vessel fleet. Holding demand faced by carriers and capacity levels at which sailings are made constant, implies that it would now take three times longer for ships to be filled up to the same extent as in the ex-ante consortia setting.

Following the same logic, Maersk has a 65% TEU and vessel share in 2M so it would need to reduce frequency to about every 2 weeks if it were to offer the service on its own while facing unchanged demand.

Based on the stylised example and capacity shares, operating services individually in an efficient way would translate into roughly five-fold decrease in service frequency for Evergreen. CMA CGM and COSCO/OOCL would need to reduce their average service frequency to a lesser extent - with roughly 2 weeks and an additional week respectively if they operated independently.

Operating all 5 THE Alliance services on a stand-alone basis while aiming to maintain high efficiencies would imply that ONE and Hapag-Lloyd would need to decrease frequency by more than a week on average.

Furthermore, providing 5 different services only with the 7 ships at its disposal, Yang Ming would certainly be unable to offer a frequency that would come close to the weekly service currently provided by the consortium, which would make it very difficult for Yang Ming to compete as its service would be much less attractive when compared to the other carriers, including current consortium partners ONE and Hapag-Lloyd.

5.4.2 Reducing number of services

Rather than reducing frequencies, carriers operating independently may decide to lower the amount of services offered to avoid having to run highly inefficient sailings. This would therefore be detrimental to consumers as it limits the choices available to them.

For instance, if operating independently, Maersk would be able to offer 4 out of the 6 existing 2M services with its 39 vessels at best and MSC would manage no more than 2 services with its fleet of 22 ships. Thus, overall there would be 6 fewer services available as a choice for customers.

[12] In the stylised model each consortium provides only one service to begin with, so this scenario is not part of it.

If it were to sustain weekly frequencies with its current fleet, COSCO/OOCL would manage to cover only 2 out of 6 Ocean Alliance services with its 27 ships, given that on average 11 vessels are deployed to its current VSA services. Similarly, CMA CGM would also manage to provide no more than 2 services, while the 16-ship fleet would limit Evergreen to only a single service. This implies that there would be 14 services less for a customer to choose from if these consortia members operated independently.

In the case of THE Alliance - Hapag-Lloyd and ONE would manage to offer 2 of the existing 5 services each. Moreover, Yang Ming would not be able to offer even one of the consortia services at the current weekly frequency. Therefore, maintaining frequencies via a reduction in the number of services would eliminate 11 out of the 15 shipping options that are currently brought to the trade lane by THE Alliance.

5.4.3 Maintaining service frequency

If individual carriers would want to maintain the current frequency of services offered by the consortia, this essentially implies that they do not have the assets in place and would need to acquire those: i.e. this would likely result in consolidation in one form or the other: the capital requirements for acquiring new vessels are very high and may well be insurmountable.

This clearly shows the advantages of cooperation through consortia: by combining their services in a consortium, a customer may choose between the 6 weekly services offered by Maersk Line and the same 6 weekly services offered by MSC – services that have shorter transit times and higher frequency than the non-consortium alternative. Maintaining service frequency hence necessitates consolidation as the only alternative to cooperation in consortia.

5.5 Conclusions

In our example of the Asia – North Europe trade, it is clear that individual members of the consortia may be able to offer services independently if they would not be allowed to cooperate. However, if the asset mix (the vessels fleet) remains the same it is difficult to understand how this could result in an increase in the service quality. In fact, the service quality is likely to decrease:

- To offer, as an individual carrier, the same frequency of services as the consortium did appears impossible for all carriers.
- This implies that either the frequency of the service would need to decrease, or that consolidation is required to allow sufficient scale to operate services independently with the same frequency as today (but with a loss of price competition).
- If the vessel fleet make-up were changed to smaller vessels in order to increase port call frequency, that would result in a loss of efficiencies, i.e. increased capital costs, manning costs and fuel costs, all of which would require rates increases in order to make such services economically viable.

Annexes

A Stylised model of carrier cooperation under consortia

A.1 Assumptions

A.1.1 Carriers and consortia

- 4 identical carriers (A; B; C; D) each with a market share of 25% that is evenly distributed across 4 ports.
- 2 identical consortia (AB; CD) each with a combined market share of 50%.
- The carriers' activities in the liner shipping industry are limited to the services provided in their respective consortia.

A.1.2 Countries and ports

- 2 countries (X; Y) with 2 ports each (X_1; X_2 and Y_1; Y_2).
- Each of 4 ports has a weekly demand of 8,000 TEU which is evenly served by the 4 carriers (eg. 25% of the demand in X_1 is served by carrier A, another 25% is served by carrier B and so on).
- On aggregate 16,000 TEUs need to be shipped from country X to country Y and vice versa.

A.1.3 Vessels and variable costs

- Three types of vessels: Small – 2,000 TEUs; Medium – 4,000 TEUs; Large – 8, 000 TEUs.
- Vessels vary by costs per TEU based on their type (size). Namely the larger the vessel, the lower the associated costs per TEU. Such decreases in costs are mainly driven by higher efficiencies in bunker fuel consumption which also allows for lower levels of CO_2 emissions per TEU.
- All vessel types travel at a constant and equal speed.
- Vessels need to be filled to full capacity in order to achieve maximum cost efficiencies.
- Lower variable costs are assumed to be passed on to consumers in the form of lower shipping rates.

A.1.4 Travel times

- An international voyage takes **28** days in either direction for each possible port combination (eg. from X_1 to Y_1; from X_1 to Y_2 etc.).
- Intra-national voyages take **7** days in either direction.

- A round trip calling at all four ports would take **70** days.

A.2 Consortia setup

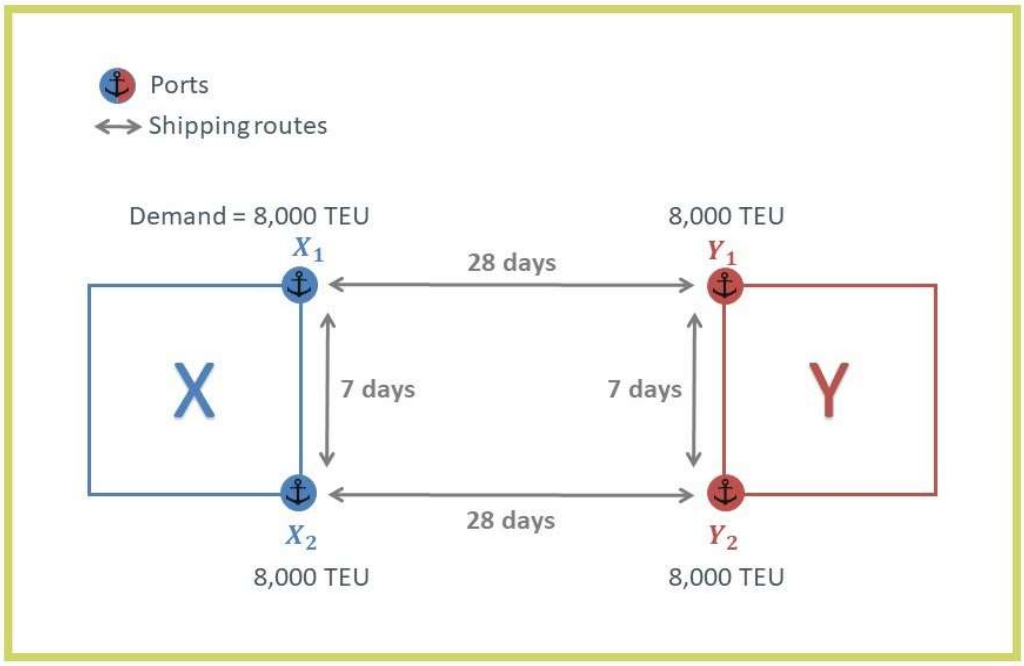
A.2.1 Consortia are in place

- Consortia AB and CD are assumed to deploy 10 large vessels that make a "round trip" calling at each of four ports as this is the most cost-efficient solution. Each of the carriers contributes 5 large vessels to its respective consortium.
- Detailed sketch of "round trip" service (See Figure 1):
  - We assume the service is launched for the very first time at port X_1 where an 8,000 TEU vessel is situated and 4,000 TEUs of cargo is loaded onto it (2,000 TEUs from each of the consortia members - A and B).
  - Thereafter, the vessel heads to port X_2 where another 4,000 TEU worth of cargo is loaded onto the ship in the same manner. So far 7 days have passed in total.
  - From port X_2 the vessel is deployed to port Y_2 at full capacity. Once the destination is reached, 4,000 TEUs worth of cargo are unloaded and 4,000 TEUs of new cargo that is to be shipped to country X is loaded onto the vessel. So far 35 days have passed.
  - The next string of the service sees the vessel travel from Y_2 to Y_1 where it exchanges the other 4,000 TEUs of cargo with new containers that need to be shipped from Y_1 to country X. So far 42 days have passed.
  - In the final section of the service all 8,000 TEU of new cargo is shipped to port X_1 where half of it is unloaded and replaced by another 4,000 TEU and so on. In total 70 days have passed.

A.2.2 Consortia are not in place

- In the absence of the consortia, each of the carriers A; B; C; D would be left with 5 large vessels that they cannot fill up to full capacity with the same port call duration as under consortia.
- The stylised model presented assumes that each deployed vessel by a consortium contains cargo to its full capacity that is spread evenly between each of two consortia members. In other words, each vessel is transporting cargo belonging to customers of both carriers making up the consortium.

Figure 5: Stylized example of a "round trip" service



Source: RBB analysis

A.2.2.1 Carriers keep large vessels

- In the case that a carrier decides to keep its five large vessels it would still prefer to deploy them at full capacity and call at every port since doing otherwise would be inefficient and would go against the purpose of owning a large vessel. In order to do so, each carrier would need to wait an additional week at every port to be able to utilize its fleet to the same extent as before (given that each carrier faces a weekly demand of 2,000 TEUs). This would lead to a prolonging of the "round trip" service by 28 days (an additional week at each of four ports), extending the transit time to a total of 98 days. As a result, customers would now be paying the same price for a service with a lower frequency and, thus, of lower quality.

- Another possible scenario is one in which all carriers keep their large vessels and maintain service frequencies while engaging in a price war so that there is a "survival of the financially fittest" in the market. The outcome would be such that half of the market participants go bankrupt so that the remaining 2 carriers capture their market share which would allow them to resume operations to previous efficiency levels.

- An additional option for carriers is to merge in order to maintain the efficiencies exercised under the two consortia. Given that all four carriers are identical, the rational consolidation would be between the respective consortia partners - A&B and C&D. Having worked together previously would facilitate the process and minimize any kind of related costs. In effect, such consolidation would lead to an outcome same as the initial consortia setting, but without the price competition which exists within the consortia between A&B and C&D respectively. Thus, the market would be operating in the same manner as ex-ante but

without the competition which previously existed between the individual consortia members. Such a development is likely to incentivise the two newly merged parties to increase shipping rates while maintaining service frequencies so that they serve the same demand at higher margins.

A.2.2.2 Carriers switch to smaller vessels

- In the case that a carrier somehow manages to revert to either small or medium size vessels (or a combination of both types) and in the process incur significant costs, it would now be operating at a lower efficiency in the form of higher costs per TEU, regardless of how it organizes its services. The latter would put upward pressure on shipping rates which here are assumed to be of the greatest importance to consumers, thus leaving them worse off.

- In addition, serving the same demand with smaller vessels instead of large ones would increase CO_2 emissions produced by containerised maritime transport by an estimated amount of 12.6%.[13]

- Hypothetical rearrangements *assuming carrier capacity and service frequency are not reduced ex-post by switching to smaller vessels[14]:*

  - **Carriers exchange 5 large vessels for 20 small vessels.** This could enable carriers to provide services connecting $X_1 – Y_1$ and $X_2 – Y_2$ at a higher frequency than before (8 small vessels on each service would be needed to maintain the previous weekly frequency). However, they would be operating the small vessels at suboptimal capacities. This would further increase costs per TEU and thus increase shipping rates relative to the case under consortia. In addition, the number of unique port pairs would now be reduced as there is no direct connection between ports $X_1 – Y_2$ and $X_2 – Y_1$. Therefore, this is unlikely to be the preferred option by carriers' clients.

  - **Carriers exchange 5 large vessels for 9 medium and 2 small vessels.** Such a hypothesized costless exchange would allow a carrier to maintain the weekly frequency as before by creating a service with a 63-day transit time that connects $X_1 – X_2 – Y_1$ by deploying its medium sized vessels. The 4,000 TEU vessels would stop at both X ports in order to reach full capacity before calling at Y_1. On the other hand, the 2 small vessels would be used in a 14-day feeder type service that connects ports Y_1 and Y_2. The latter would allow for the medium vessels to be utilized at full capacity on the $Y_1 – X_1$ string as well. While such a scenario maintains the ex-ante service frequency, it would also lead to higher costs per TEU and, thus, higher prices and CO_2 emissions. In addition, it would leave port Y_2 without direct sailings to/from country X, reducing the amount of unique port connections.

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[13] The calculation assumes a normal speed of 22 knots regarding the fuel consumption which is derived from Notteboom T. E. and Vernimmen B. (2009), The Effect of High Fuel Costs on Liner Service Configuration in Container Shipping, and is calculated using a conversion factor of 3.17 as suggested by literature on Psarsftis H. N. and Kontovas C. A. (2009), CO2 Emission Statistics for the World Commercial Fleet.
"https://www.sciencedirect.com/science/article/abs/pii/S0966692308000410"
"http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.615.7105&rep=rep1&type=pdf"

[14] This is aimed at providing a conservative approach regarding the negative impact of carriers having to dispose of larger efficient vessels in order to switch to smaller vessels, allowing them to preserve their aggregate capacity.

B Consortia structure on the Asia – North Europe trade

Table 4: 2M

Carrier	Maersk	MSC
Capacity	724,916	398,817
Capacity Share	64.51%	35.49%
Vessel Employed	39	22
Average Vessel Size	18,588	18,128
Number of Services	6	6
Vessels per Service	7	4

Source: RBB calculations based on Alphaliner data

Table 5: Ocean Alliance

Carrier	COSCO/OOCL	CMA CGM	Evergreen
Capacity	519,408	386,192	262,216
Capacity Share	44.48%	33.07%	22.45%
Vessel Employed	27	23	16
Average Vessel Size	19,237	16,791	16,389
Number of Services	6	6	6
Vessels per Service	5	4	3

Source: RBB calculations based on Alphaliner data

Table 6: THE Alliance

Carrier	Hapag-Lloyd	ONE	Yang Ming
Capacity	341,992	304,754	98,818
Capacity Share	45.87%	40.88%	13.25%
Vessel Employed	22	23	7
Average Vessel Size	15,545	13,250	14,117
Number of Services	5	5	5
Vessels per Service	4	5	1

Source: RBB calculations based on Alphaliner data