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Sea Voyage Costs
Document Status

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"It is a veritable [cost] revolution of the shipping industry" (Stopford 2013)

1 Introduction

The dominating mode of global transport is by sea. Accordingly, the efficiency and costs of transportation of goods has huge implications for global trade and general economic development. In the last 10 – 20 years, transportation of passengers by sea has taken a huge upswing with cruise ships, and this is now a USD 40 billion market (Statista 2015). However, we shall not deal with passenger traffic in this paper but concentrate on transportation of different types of goods.

The purpose of this short paper is to account for the cost categories involved in transportation using sea traffic for part of the transportation.

Anderson and Wincoop (2004) carried out one of the most authoritative analyses of the different trade cost items in shipping. They define trade costs in general to include all costs associated with bringing the product from the manufacturer to the end-customer, including land and sea transportation. For sea traffic, this includes among others the use of bunker, ship costs, policy barriers, information costs, and contract enforcement costs. Trade costs, i.e. transport costs, border related trade barriers, and retail & wholesale distribution costs, account for an add-on of 170% on top of the production costs. Figure 1 illustrates the average costs if one chooses between producing in the US and producing overseas. For example, if a product costs USD 1 in production in e.g. China, the consumer price in the United States will be 2.70. This price does not include any mark-up to cover R&D, stock keeping, marketing, profit margins, etc. which might put the final price to the consumer at USD 10. The total cost is comprised of the following cost items:

- Local production e.g. in China: USD 1.00
- Transport: USD 0.21
- Border related trade barriers: USD 0.53
- Retail & wholesale distribution costs: USD 0.96

Total production & trade costs USD 2.70

These total costs (of USD 2.70) may be further broken down as illustrated in Figure 1, where the lowest line indicates how much the different costs items are loaded on the total costs.
The relative modest costs of transportation in global trade, compared to total cost, illustrates the importance of global transport for outsourcing of production to low cost countries. Producing in China, for example, means lower production costs and the transport to the final destination is rather insignificant as it does not increase the cost significantly. Anderson and Wincoop (2004) have found an average mark-up for transportation costs of 21% on top of production costs. Border related trade barriers, on the other hand, are much more substantial. Accordingly, lowering all the border related trade costs, which are almost four - five times the freight costs, would mean a substantial reduction in price of global trade, and would increase GDP globally.

2 Changes in Sea Voyage Costs Distribution

Throughout the shipping industry’s history, the single most important expense in seaborne transportation has been the capital cost related to building a ship. For example, in 2005 it still made sense to sail faster by speeding up, because it was possible to save one USD per ton of cargo by arriving at the destination earlier. In 2005, the ship costs represented 3 times the fuel costs (Figure 2).

In 2008, the financial crisis meant a dramatic drop in the demand for transportation and sharply falling costs of capital. Accordingly, the ship costs went into a sharp decline, while oil prices kept skyrocketing. This shifted the discussion to revolve primarily around fuel costs and bunker consumption. In that year, fuel costs represented up to 60% of total ship operating costs depending on the type of ship and service (World Shipping Council 2008). This development continued, and by 2012, ship costs represented only half the fuel price (Figure 2). Accordingly, slow steaming to optimize bunker consumption became the standard.

In 2007, shipping companies were able to save three USD per ton of cargo by slow-steaming (ibid.). Simultaneously, sustainability and a reduced environmental impact strengthened the argument for less bunker consumption and a more optimized use of energy. The biggest challenge was thus to use energy as efficient as possible (Figure 2).
However, since 2011, the rapid decline in fuel prices has started to shift the focus once again towards putting a greater emphasis on the costs for fixed assets—the ship—and port expenses. Optimizing operational costs in order to reduce the turnaround time as much as possible has become the top priority of many shipping companies today. Accordingly, Stopford (2015) deems the current business models of the shipping industry as obsolete. The key argument is the lack of digital transformation and of the deployment of state-of-the-art technology. As energy efficiency has already improved significantly throughout the last decade, primarily due to new technology adoption in the building of the ships (more fuel efficient engines, more modern ships, or LNG\(^1\) technology), Stopford argues that the only thing that can substantially enhance efficiency is “smart” shipping. To his mind, the recipe for successfully overcoming the current challenges is a combination of an enhancement of the existing products, engines, and antifouling\(^2\) as well as the evolvement of new technologies and information technology. Therefore, the focus is less on finances but rather on how to make the shipping assets more productive (ibid.).

“[Today,] the ship only represents 27 percent of the total operating cost, so there are some problems with the [traditional] business model after 65 years. Today's business model is basically just a matter of smaller companies, large balances, incredibly volatile income, tight costs and few technical resources. The

\(^1\) LNG = liquefied natural gas

\(^2\) Antifouling is a specialized coating applied to the hull of a ship or boat to slow the growth of subaquatic organisms that attach to the hull and can affect a ship's performance and durability
environmental pressure keeps rising, and I believe it’s picked up steam this year. It’s always been there in the background, but that’s no longer the case” (Stopford 2015).

Fuel costs used to be the single most important voyage cost item representing around 47% of total operational costs (Stopford 2009, pp. 232ff.) However, Stopford (ibid.) points out that the actual sea voyage by 2009 only represent 40% of total transportation costs, which again might be divided into 70% for bunker and 24% for port costs. Furthermore, he argues that slowing down from 14 to 11 knots on average decreases the average amount of fuel uses in a year by more than half, i.e. from 33.9t/day to 16.5t/day. However, there is a great disparity in fuel consumption even between ships of the same size due to hull conditions, machinery, and age of the ship.

Another very important development has been the increased efficiency in bunker consumption. This can be illustrated with the costs of bunker for transport of a FFE³ container. If one studies the annual report from Mærsk Line in Figure 3, we can see the significant reduction in bunker consumption during the last seven years due to a decline in bunker prices (-12.7% in 2014) and lower bunker consumption per FFE unit (-7.9% in 2014). It is a reduction of 49% per FFE since 2007 (Mærsk 2015). Moreover, the annual report also indicates the increasing importance of port and ship costs. They increased by 7.8% and 8.7% in 2014 (ibid.).

Consequently, declining relative costs of bunker per FFE, increases the relative importance of capital investment costs for the ship and the costs of port operations.

*Figure 3: Bunker Consumption per FFE (ton/FFE) Mærsk Line (Mærsk 2015, p. 8)*

### 3 Operational Costs of Different Types of Sea Transport

Although container shipping is by far the dominating type of transport, there are many other types. In a very comprehensive study, Karvonen and Makkonen (2009) divide sea traffic into six categories, one of which is containerized traffic (Figure 4).

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³ FFE = Forty-Foot-Equivalent Unit, i.e. standard 40 ft. container
This cost does not include port costs but only considers the costs for the actual sea voyage.

Figure 4: Running Costs of Ship (Kalli, Karvonen & Makkonen 2009)

The overall picture for all types of ship transport is that they all have more or less the same types of costs. The dominating cost items are still fuel (bunker) and capital expenditures. But the size of other cost items, e.g. crew vary a lot.

In order to investigate the different cost items in more detail, we analyzed the costs in 2015 of a small shipping company operating in the dry bulk area, of what they define as typical voyages. The costs below illustrate two—what the company defines as ‘typical’—voyages. These costs cover all running costs of the shipping company for conducting the voyage including port costs.

Figure 5: Profit & Loss Calculation (TKBosen)
Revenue and cost is divided into three main categories for two specific voyages with the same ship. Revenue is mainly the fee paid by the charterer, where it is interesting to note the demurrage income.

The three major costs areas are bunker, port expenses, and the ship; and it is characteristic that for this type of ship, they are almost equal in size. Bunker costs are directly related to the sailed distance, ship costs are directly related to total time consumption, while port costs are largely the same irrespective of distance.

Although bunker costs are at an all-time low (Stopford 2015), and shipping companies have done a lot to reduce the use of bunker, they are still a significant part of operational costs. Accordingly, there are substantial benefits to be obtained from energy-efficiency improvements and smart shipping that would allow for slow-steaming and thus less bunker consumption.

Figure 4 illustrates the running costs distribution according to different type of ships. In our example, bunker represents around 30% of the total sea voyage costs, however, we must not forget that it depends heavily of the length of the journey and also on the type of ship. The TKB example uses the same ship on two different journeys with a slightly different length of the sea voyage (Journey A: 6 days at sea, 16 days in the port; Journey B: 9 days at sea, 13 days in the port), and the variance in bunker costs is almost 10%. This comparison exemplifies the difficulties in providing concrete percentage figures for bunker consumption. Moreover, the longer a ship needs to stay in a port, the more significant port expenses become. A short turnaround time is therefore the best indicator for an effective and optimized sea voyage.

4 Conclusion

The shipping industry has undergone substantial changes throughout the last decade. From a several thousand-years-old traditional focus on effectiveness in reducing the time needed for a particular voyage to a strong focus on bunker and energy saving as key optimization areas in the 2005 – 2012, and back again to a sharper focus on short turnaround time in order to optimize port and fixed asset expenses. The weight of the different cost areas—the most important ones being bunker, port expenditures, and fixed asset expenses, are highly dependent on the price of fuel and the price of capital. In times of low fuel prices, bunker plays a relatively minor role. However, we should not neglect the importance of lower bunker consumption for the environment and sustainability aspects. However, the investment of shipping companies in new technology in order to make their ships both more energy efficient and more environmental friendly depends not only on the market demand but also available incentives from government side. For example, subsidies in form of lower port fees when ships are using alternative and more environment friendly energy sources, are likely to have a large effect (Tärntank 2015). Key enablers for this shift is the digital transformation of the shipping industry employing more modern technology and IT. This is echoed in the final quote from Stopford:
"I think tomorrow's globalization is about smart ships, smart operations, smart technicians [...] How this would be achieved linking together elements such as onboard sensors, cloud computing and 4G communications is the difficult part though—You really need the Steve Jobs of the industry to interpret it" (Stopford in Hand 2013).
5 References


Statista, 2015 http://www.statista.com/topics/1004/cruise-industry/


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